OKLAHOMA REGIONAL HAZE STATE IMPLEMENTATION PLAN REVISION

PLANNING PERIOD 2

June 1, 2022

OKLAHOMA Environmental Quality

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Acronyms and Abbreviations

AOI	Area-of-influence
CenSARA	Central States Air Resources Agencies
CSAPR	Cross-States Air Pollution Rule
DEQ	Oklahoma Department of Environmental Quality
EPA	Environmental Protection Agency
FLM	Federal Land Manager
IMPROVE	Interagency Monitoring of Protected Visual Environments
MIDs	Most impaired days
Mm^{-1}	Inverse megameter (measurement unit for visibility impairment/light scattering data)
NO_x	Nitrogen oxide(s)
NSPS	New Source Performance Standards
RH	Regional Haze
RPG	Reasonable progress goal
SIP	State implementation plan
SO_2	Sulfur dioxide
URP	Uniform rate of progress
WMWA	Wichita Mountains Wilderness Area
WRAP	Western Regional Air Partnership

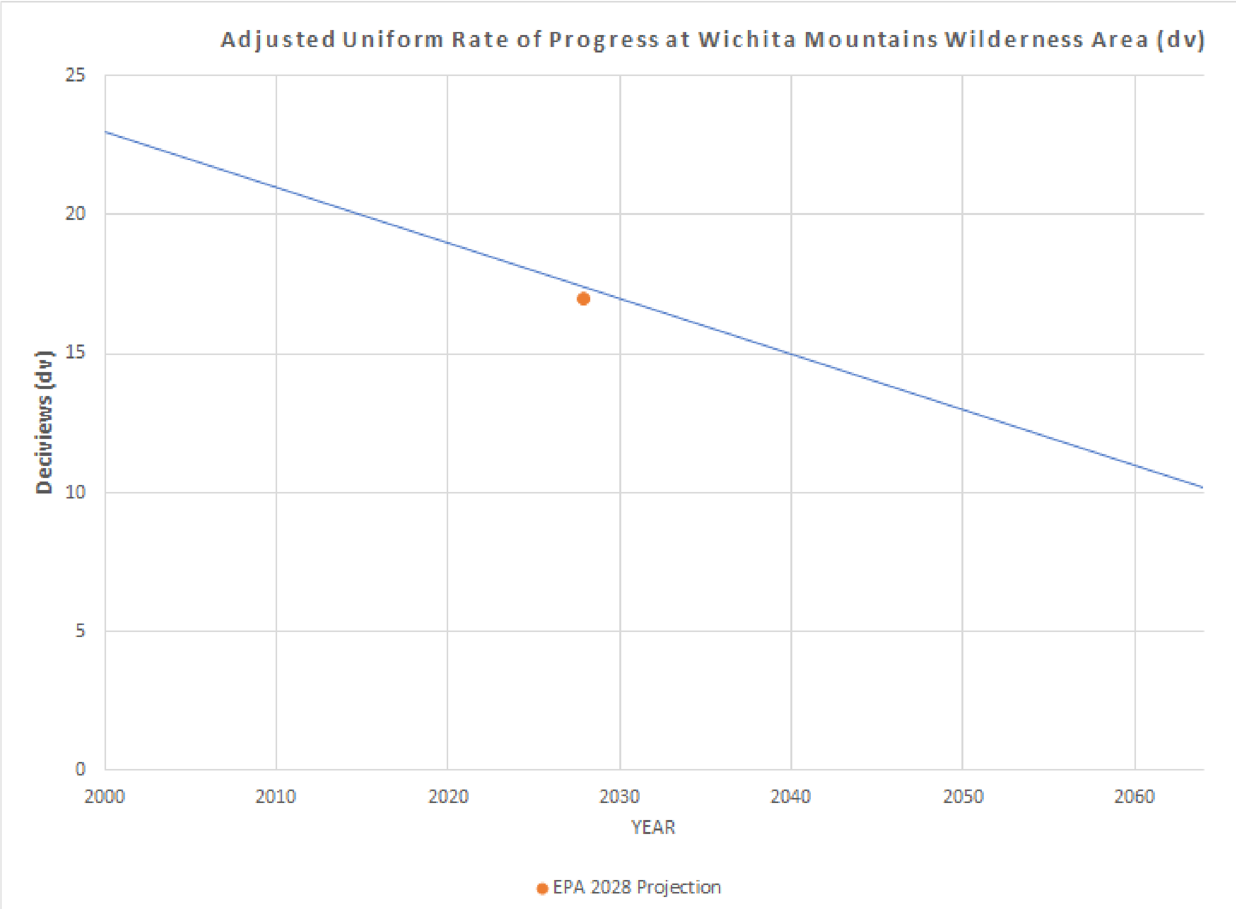
Executive Summary

The Regional Haze (RH) Program was established by Congress under Sections 169A and 169B of the Clean Air Act with the goal of restoring visibility to natural conditions at all mandatory Class I federal areas. This program relies on collaboration between the U.S. Environmental Protection Agency (EPA), states, and Federal Land Managers (FLMs) to meet periodic goals toward reaching natural conditions by 2064. States are required to submit implementation plans that address visibility impairment at all Class I areas – both those within the state and those outside the state that may be affected by emission sources within the state. This document serves as the comprehensive periodic revision and progress report to Oklahoma's Regional Haze (RH) state implementation plan (SIP) for the Second Planning Period (hereinafter, this document is referred to as the Planning Period 2 RH SIP), as required by 40 C.F.R. § 51.308(f).

Oklahoma's only Class I area is the Wichita Mountains Wilderness Area (WMWA), located in Comanche County. Visibility conditions are measured by air sample analysis from an Interagency Monitoring of Protected Visual Environments (IMPROVE) monitor located at the Wichita Mountains Wildlife Refuge. The Oklahoma Department of Environmental Quality (DEQ) also analyzes potential effects on visibility by Oklahoma sources at nearby Class I areas in Texas, Arkansas, and Missouri. Detailed analysis of the monitoring data reveals a majority contribution from particulates of sulfate and nitrate. Anthropogenic emissions that correlate to sulfate and nitrate particulates are SO_2 and NO_x, respectively.

Oklahoma submitted a comprehensive SIP revision covering Planning Period 1 (2010-2018) on February 18, 2010 (hereinafter referred to as the Planning Period 1 RH SIP) requiring control measures that resulted in substantial visibility improvement, far outpacing the uniform rate of progress for the WMWA. Recent monitoring data for visibility conditions at the WMWA exhibits the significant progress toward natural conditions that has already occurred. The most current data through the year 2019 shows visibility conditions at the WMWA are closer to a reasonable progress goal for 2028 than the 2018 reasonable progress goal, as established by DEQ. Emissions of SO_2 and NO_x have decreased substantially in the last decade. Air quality programs, including the Cross-State Air Pollution Rule (CSAPR) and New Source Performance Standards (NSPS), continue to reduce emissions nationwide to the benefit of visibility conditions at Class I areas. More favorable economics for and significant investments in cleaner energy and transportation have also played a role in emission reductions across the country. DEQ expects these trends to continue throughout this planning period, resulting in much-improved visibility conditions at Class I areas, including the WMWA. The graph below further demonstrates these conclusions, particularly that Oklahoma's projected progress is below the adjusted glidepath at the end of Planning Period 2.

Figure ES-1: EPA's Projected 2028 Impairment (20% Most Impaired Days)



As stated above, this graph demonstrates the reductions made during Planning Period 1 and the reductions expected in Planning Period 2 place Oklahoma's projected progress below the adjusted glidepath at the end of Planning Period 2 in 2028.

The Regional Haze Rule (RH Rule) sets forth requirements for implementation of the Regional Haze Program under the Clean Air Act (specifically, the most recent iteration of the rule, published in 82 Fed. Reg. 3078 (Jan. 10, 2017), and found in 40 C.F.R. Part 51, Subpart P). Among the updates in the most recent amendments to the RH Rule was the inclusion of a progress report element in the Planning Period 2 RH SIP due July 31, 2021. Under the RH Rule, the periodic RH SIP revisions also serve as progress reports. This Planning Period 2 RH SIP and progress report covers the time since the last progress report was submitted (September 28, 2016) through the year of the most recently available data (i.e., 2019). All emission control requirements established during Planning Period 1 have been implemented as prescribed. Monitoring data reveal that Planning Period 1 emission control requirements were sufficient to make reasonable progress in visibility improvement at affected Class I areas.

Preparation for Planning Period 2 (2018-2028) began as a regionally collaborative process among the Central States Air Resources Agencies (CenSARA). Emissions that can contribute to visibility impairment can originate thousands of miles away. The RH Rule changes made in 2017 acknowledge and allow for the fact that states have little or no influence over international contributions, and therefore should not be required to compensate for such international contributions. 82 Fed. Reg. 3107, footnote 116. However, the

2017 RH Rule requires coordination among states in proximity to Class I areas as a necessity for making reasonable progress. CenSARA contracted with Ramboll-Environ to produce an "area-of-influence" (AOI) study on point source contributions to visibility impairment. This study considered facility emissions, distance from Class I areas, and air-flow patterns to produce a measure of a source's likelihood to affect visibility conditions.

Based on results of the AOI study, DEQ selected 12 facilities to conduct further analysis on potential for emission controls. This analysis considers four factors, as required under 40 C.F.R. § 51.308(f)(2)(i) (i.e., the "four-factor analysis"). The four-factor analysis consists of the following factors: 1) cost of compliance; 2) time necessary to implement compliance; 3) energy and non-air quality impacts of compliance; 4) remaining useful life of the source. This analysis guides decisions through the development of a long-term strategy for reducing visibility impairment at the WMWA and other Class I areas.

Considering the advanced progress toward natural conditions thus far, the time remaining in planning period 2 (2018 – 2028), the results of the four-factor analyses, and financial uncertainty associated with Oklahoma's sources, DEQ selected a long-term strategy that recognizes and relies in large part upon the existing pollution control programs and clean energy technology advances that have resulted in and will continue to result in advanced progress. As older emission units continue to be replaced or retire, emission reductions will likely continue along the recent trends, and meeting a reasonable progress goal will be achievable with this long-term strategy.

As allowed by the RH Rule, DEQ will request an adjustment to the natural condition's visibility index at the WMWA to account for emissions from wildland prescribed fires and international sources. The resulting uniform rate of progress (URP) trendline places the visibility index data point for 2028 at 17.36 deciviews. EPA conducted photochemical modeling that projected visibility conditions at Class I areas for 2028. The projections, based on existing controls and enforceable shutdowns, produced a visibility index for the WMWA of 16.93 deciviews on the 20% most impaired days in 2028. DEQ concurs with this as a justified, reasonable assessment and projection of visibility conditions at the WMWA, and therefore adopts 16.93 deciviews on the 20% most impaired days as a reasonable progress goal for visibility at the WMWA in 2028.

1. Visibility – Clean Air Act Goals and Regional Haze Rule

Section 169A of the Clean Air Act (CAA) Amendments of 1977 sets the following national visibility goal:

> *Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution.*

EPA promulgated 40 CFR Part 51, Subpart P – Protection of Visibility, effective August 30, 1999, to set the path to meet the CAA's national visibility goals. Subpart P, also known as the RH Rule, established a goal of reaching natural visibility conditions at all Federal Class I areas by 2064 and sets forth the requirements for states to address visibility impairment, defined as any humanly perceptible difference between actual visibility and natural visibility due to air pollution from anthropogenic sources. States must address regional haze in each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State which may be affected by emissions from within the State. 40 C.F.R. § 51.308.

The RH Rule required states to develop and submit to EPA for approval a comprehensive Regional Haze State Implementation Plan (SIP), covering the initial planning period (2008 – 2018), with a comprehensive review and revision every ten years thereafter. The most recent amendment to the RH Rule, effective January 10, 2017, pushed the Planning Period 2 RH SIP due date from July 31, 2018 to July 31, 2021 (82 Fed. Reg. 3078, January 10, 2017). A detailed history of Oklahoma's RH SIPs can be found in Section 5 herein.

In its October 1, 2020 letter, EPA approved Oklahoma's request under the Safe, Accountable, Flexible, Efficient Transportation Equity Act of 2005 (SAFETEA) to administer the State's environmental regulatory programs in certain areas of Indian Country. Therefore, the scope of this request includes the portions of Indian Country covered by EPA's approval of Governor Kevin Stitt's SAFETEA request letter dated July 22, 2020. Through the SAFETEA request, the State sought approval to administer environmental programs throughout the State consistent with the extent to which the programs were administered by the State prior to the U.S. Supreme Court's recent decision in McGirt v. Oklahoma, 140 S.Ct. 2452 (2020). In its SAFETEA request, the State of Oklahoma did not seek to expand its historic regulatory jurisdiction and specifically excluded tribal trust land from its request. For the purposes of this Planning Period 2 RH SIP, DEQ intends to request information and seek reductions as necessary to meet the goals of the RH Rule in all areas of the state.

2. Class I Areas

Federally designated Class I areas include national parks and wilderness areas (portions of national forests and national wildlife refuges) that attract outdoor enthusiasts and visitors year-round. One of the many appeals of these areas is the incredible views of the beautiful landscapes. To ensure that these special places retain their beauty, the RH Rule requires air pollution control agencies work to reduce man-made pollution that causes visibility impairment. The RH Rule requires states to analyze visibility degradation at their Class I areas from haze-causing emissions. States are also required to consider the effects of emission sources in their territorial jurisdiction at Class I areas in other states.

2.1. Oklahoma's Class I Area

The Wichita Mountains Wilderness Area (WMWA), located in Comanche County, Oklahoma, in the Wichita Mountains National Wildlife Refuge, is the state's only Class I area. The US Fish and Wildlife Service (FWS), a Federal Land Manager (FLM), manages the WMWA.

2.2. Class I Areas potentially impacted by Oklahoma sources

The Regional Haze Rule requires states to address visibility impairment for each Class I area within the state and for each Class I area located outside the state that may be affected by emissions from the state. 40 C.F.R. § 51.308. Through consultation with states and DEQ's own analysis, five nearby Class I areas were identified for potential visibility impacts from the transport of pollutants from Oklahoma emission sources.

Table 2-1: Class I Areas considered for potential affects by Oklahoma sources

Class I Area	State
Caney Creek Wilderness Area	Arkansas
Upper Buffalo Wilderness Area	Arkansas
Hercules-Glades Wilderness Area	Missouri
Guadalupe Mountains National Park	Texas
Big Bend National Park	Texas

Section 6 herein describes the method DEQ used during the Planning Period 2 RH SIP development to identify Oklahoma emission sources with the potential for impairing visibility at the WMWA and/or Class I areas in surrounding states. Using the same method, DEQ identified emission sources located outside Oklahoma with the potential for impairing visibility at the WMWA. During the consultation process with surrounding states for Planning Period 2 RH SIP development, DEQ requested that the sources be considered for further analysis in the corresponding state's RH SIP development.

3. Visibility Monitoring

An Interagency Monitoring of Protected Visual Environments (IMPROVE) monitor, established at the Wichita Mountains in 2001, fulfills the monitoring requirements for Oklahoma established by the RH Rule. Visibility conditions are calculated from sample observations taken at the monitor every three days. The observation period of 2000-2004 provides baseline visibility conditions at every Class I area, and therefore the average of the value for these years (2000-2004) is listed in Tables 3-1 through 3-8 as "Baseline." The most recently available 5-year period of IMPROVE data for measuring progress toward natural conditions for this planning period is 2015-2019. These tables show the arithmetic mean of the annual statistics for the five-year period of 2015 to 2019. As prescribed by the RH Rule, the 20% most impaired days (MIDs) and the 20% clearest days must be evaluated from a baseline period to current conditions to track progress toward achieving the goal of natural visibility conditions by 2064 (listed as "Natural" in Tables 3-1 through 3-8).

3.1. Visibility Monitoring and Changes in Visibility at the Wichita Mountains

The RH Rule requires each state to evaluate its progress toward achieving natural visibility conditions at its Class I area(s). This evaluation requires the State to establish natural visibility conditions and to implement a method to collect and to analyze data to form the basis of the evaluation. The Oklahoma Planning Period 1 RH SIP contained an extensive discussion of natural visibility conditions at the Wichita Mountains Wilderness Area. As required by the RH Rule, the Planning Period 1 RH SIP also included a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. The IMPROVE monitor established at the Wichita Mountains in 2001 fulfills the monitoring requirements for Oklahoma established by the RH Rule. Visibility conditions are calculated from sample observations taken at the monitor every three days. Baseline visibility conditions for the WMWA are represented by the observation period of 2000-2004. As prescribed by the RH Rule, the 20% most impaired days and the 20% clearest days must be evaluated from a baseline period to current conditions to track progress toward achieving the goal of natural visibility conditions by 2064. The uniform rate of progress (URP) line, drawn from baseline conditions to natural conditions, provides a good illustration for how well the state is making progress. In this Planning Period 2 RH SIP, Oklahoma is adding an estimate of visibility impairment from international emissions and prescribed fires to the estimate of natural conditions to calculate a new 2064 visibility target. Oklahoma recognizes that prescribed fire is an important ecological management tool and plans to continue to support accommodating the use of prescribed fire in future RH planning.

3.1.1. Monitoring Strategy Review

The IMPROVE program began as a cooperative effort between EPA, federal land management agencies, and state air-pollution control agencies. This program uniquely provides observational data essential to the development of any implementation plan for regional haze. Measurements at the Wichita Mountains began in March 2001. The Oklahoma Planning Period 1 RH SIP thoroughly summarizes the IMPROVE protocol.

The IMPROVE program has made minor adjustments to its protocol through the years but has maintained protocols that result in comparable data for many key elements, ions, and other constituents of particulate matter. Oklahoma's monitoring strategy continues to rely upon participation in the IMPROVE network. For the current Planning Period 2 RH SIP, DEQ considers the IMPROVE site at the Wichita Mountains essential and critical to visibility assessment.

U.S. Fish and Wildlife Service personnel send the filter samples from the Wichita Mountains to the Crocker Nuclear Laboratory at the University of California in Davis for analysis. The IMPROVE website and the Visibility Information Exchange Web System (VIEWS) at Colorado State University make the data publicly available. Further, EPA's Air Quality System (AQS) database includes these data. DEQ relies on these data to fulfill its monitoring obligations under the RH Rule and currently lacks any alternative suitable for assessing visibility conditions at the Wichita Mountains.

DEQ formerly operated a monitor in Ellis County until 2015. Cherokee Nation operates an IMPROVE monitoring program in eastern Oklahoma. The Department of Energy also began operating an IMPROVE monitor at its Southern Great Plains climate observation site in 2019. Because of the location of these monitors, they provide no data directly relevant to the Wichita Mountains or any other mandatory Class I federal area.

3.1.2. Monitoring Results

The determination of reasonable progress at the Wichita Mountains requires an assessment of baseline conditions, natural conditions, and current conditions. The Oklahoma Planning Period 1 RH SIP includes an extensive critical discussion of natural conditions at the Wichita Mountains. That implementation plan uses the strictest natural conditions estimate, intended to represent clean conditions in the American West without fires. The January 2017 revisions to the RH Rule included a less conservative, but quite complex, method to assess natural conditions. This new method classifies a greater proportion of carbonaceous, coarse, and fine-soil particulate as natural. A considerable proportion of such particulate matter at the Wichita Mountains arises from natural events, fires, dust storms, and emissions outside the United States of America. For Planning Period 2, DEQ elects to use the method specified in the January 2017 RH Rule revision (82 Fed. Reg. 3078, January 10, 2017). DEQ may continue to develop better estimates of natural conditions in future implementation plans.

For comparison purposes, the former 20% worst days now bears the moniker 20% haziest days, and the former 20% best days now bears the moniker 20% clearest days. A new category, the 20% most impaired days, now encompasses the days with the most culpable anthropogenic visibility impairment, ignoring any visibility degradation from fine soils, organic carbon, or coarse matter above a certain threshold. Thus, the 20% most impaired days replaces otherwise relatively clean days among the 20% haziest days with thick smoke or blowing dust and replaces them with other days. The 20% most impaired days, however, may include days with unusually high sulfur or nitrate particulate haze even if those same days also featured dense smoke or dust.

Significant improvement during the 20% most impaired days without degradation during the 20% clearest days during each year generally indicates some degree of compliance with the RH Rule. Tables 3-1 through 3-8 show the 20% clearest, most impaired, and haziest days as well as annual averages for comparison. The RH Rule generally requires some improvement in the 20% most impaired days, and no degradation in visibility for the 20% clearest days. Below is a discussion of Rayleigh scatter and each particulate species that limit visibility at the Wichita Mountains. Note that data from 2009 is not included below because data from the PM_{10} module was invalidated and is not reported in the IMPROVE database.

3.1.3. Rayleigh Scatter

The IMPROVE protocol represents Rayleigh scattering as a constant, contributing 11 Mm^{-1} to visibility degradation at the Wichita Mountains on account of elevation. Rayleigh scattering results from the interaction of light and the molecules of the atmosphere and is therefore a natural occurrence. Rayleigh scattering varies slightly with atmospheric pressure, humidity, cloud cover, and temperature structure, but this protocol currently ignores such variation.

3.1.4. Saline Particulate

The IMPROVE protocol approximates saline particulate with chloride and chlorine measurements. The protocol assumes that saline particulate arises exclusively from natural sources, generally from breaking ocean waves. Because the Wichita Mountains lie a significant distance from the nearest ocean, saline particulate rarely contributes noticeably to visibility degradation. The apparent decline in saline particulate in Table 3-1 may reflect refinements and changes in analytical methods rather than an actual phenomenon.

Table 3-1: Saline Particulate at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2001			.12	.6				
2002	.1	.3	.06	.32	.1	.4	.1	.4
2003	.1	.6	.10	.5	.1	.6	.1	.6
2004	.05	.25	.073	.39	.13	.7	.08	.43
2005	.02	.12	.047	.25	.04	.21	.04	.20
2006	.02	.09	.045	.23	.05	.26	.08	.42
2007	.037	.20	.067	.35	.07	.37	.10	.56
2008	.05	.3	.066	.35	.08	.45	.09	.5
2009			.040	.21				
2010	.03	.18	.040	.21	.04	.24	.04	.22
2011	.04	.20	.067	.35	.09	.48	.09	.50
2012	.015	.08	.0602	.313	.062	.33	.065	.35
2013	.01	.07	.051	.274	.09	.50	.09	.47
2014	.017	.090	.055	.294	.082	.43	.10	.55
2015	.02	.11	.049	.260	.058	.30	.09	.46
2016	.012	.06	.040	.21	.041	.22	.049	.26
2017	.005	.03	.036	.19	.048	.27	.042	.23
2018	.018	.10	.050	.26	.06	.32	.07	.37
2019	.04	.20	.074	.39	.11	.60	.25	1.3
Baseline	**.07**	**.4**	**.088**	**.47**	**.10**	**.5**	**.08**	**.5**
2015-2019	**.02**	**.10**	**.050**	**.263**	**.06**	**.34**	**.10**	**.52**
Natural	**.07**	**.4**	**.088**	**.47**	**.08**	**.5**	**.08**	**.5**

3.1.5. Coarse Particulate

IMPROVE monitors include a coarse particulate (PM_{10}) module, which samples PM with aerodynamic diameter less than 10 µm, and a fine particulate ($PM_{2.5}$) module, which samples PM with aerodynamic diameter less than 2.5 µm. The protocol includes gravimetric analysis of both samples; coarse particulate describes the difference between the masses of these two samples. The increase in coarse PM during 2011, 2012, and 2014, shown in Table 3-2, resulted from an increased prevalence of dust storms, associated with drought. Dendroclimatic analyses and other long-term climate records from the Oklahoma area suggest that a relatively drier climate prevailed in previous centuries.

Table 3-2: Coarse Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2001			8.2	4.9				

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2002	4.25	2.5	7.3	4.4	5.7	3.4	9.2	5.5
2003	5.57	3.3	7.4	4.5	4.7	2.8	7.0	4.2
2004	3.8	2.3	6.3	3.8	4.9	2.9	7.1	4.3
2005	5.9	3.6	7.4	4.5	6.3	3.8	9.1	5.4
2006	5.85	3.5	8.5	5.1	6.6	3.9	12.1	7.3
2007	3.83	2.3	6.6	4.0	5.6	3.4	7.3	4.4
2008	3.92	2.4	7.0	4.2	5.6	3.3	7.8	4.7
2009			7.1	4.3				
2010	4.60	2.8	7.5	4.5	5.8	3.5	6.5	3.9
2011	5.25	3.2	10.9	6.6	9.2	5.5	14.9	8.9
2012	6.29	3.8	10.02	6.0	7.7	4.6	13.3	8.0
2013	3.90	2.3	7.0	4.2	7.4	4.5	10.1	6.0
2014	6.23	3.7	10.2	6.1	6.9	4.1	15.7	9.5
2015	3.99	2.4	7.8	4.7	7.8	4.7	12.0	7.2
2016	5.55	3.3	7.5	4.5	6.0	3.6	10.1	6.1
2017	5.1	3.1	7.2	4.3	7.4	4.4	8.4	5.0
2018	4.3	2.6	7.9	4.8	6.8	4.1	9.3	5.6
2019	5.00	3.0	7.8	4.7	5.3	3.2	11.7	7.0
Baseline	4.6	2.73	7.3	4.39	5.10	3.06	7.7	4.6
2015-2019	4.79	2.87	7.7	4.60	6.67	4.00	10.3	6.2
Natural	1.9	1.1	3.0	1.8	3.0	2.0	3.0	2.0

3.1.6. Fine Soil Particulate

The IMPROVE protocol estimates fine-soil particulate from Aluminum, Silicon, Calcium, Iron, and Titanium measurements from the $PM_{2.5}$ module. Considerable fine soil arrives at the Wichita Mountains via intercontinental transport from the Sahara, especially during the late spring and early summer months. Saharan dust exhibits considerable interannual variability but reaches Oklahoma in noticeable quantities almost every year. This transport phenomenon deposits considerable important minerals onto the soils, offsetting leaching and runoff from heavy rains. These minerals contribute to the flourishing of natural and agricultural vegetation throughout the Caribbean, Central America, and the American South and even at and near the Wichita Mountains. The new protocols classify the more extreme dust storms as primarily natural but still classify some probably natural dust as anthropogenic. Dust storms of North American origin consist principally of coarse matter and unmeasured large sand particles but still result in slightly elevated fine soils. Table 3-3 shows statistics about fine-soil particulate matter.

Table 3-3: Fine Soil Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m-3	µg m^{-3}	Mm^{-1}	µg m^{-3}
2001			.98	.98				
2002	.261	.261	.79	.79	.595	.60	.787	.79
2003	.375	.38	.849	.85	.50	.50	.86	.86
2004	.299	.299	.82	.82	.519	.52	.717	.72
2005	.438	.44	.65	.65	.555	.55	.718	.72

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m-3	µg m^{-3}	Mm^{-1}	µg m^{-3}
2006	.516	.52	.98	.98	.698	.70	1.51	1.51
2007	.330	.330	.87	.87	.553	.55	1.09	1.09
2008	.389	.39	.996	1.00	.613	.61	1.30	1.30
2009			.879	.88				
2010	.632	.63	1.00	1.00	.833	.83	.870	.87
2011	.346	.346	.94	.94	.68	.68	1.04	1.04
2012	.531	.53	1.33	1.33	.548	.54	1.13	1.13
2013	.258	.258	.91	.91	.449	.45	1.47	1.47
2014	.504	.50	1.33	1.33	.64	.64	1.94	1.94
2015	.256	.256	1.03	1.03	.79	.79	2.69	2.7
2016	.343	.34	.92	.92	.51	.51	1.50	1.50
2017	.364	.36	.65	.65	.400	.40	.469	.47
2018	.330	.33	.92	.92	.370	.37	1.40	1.40
2019	.40	.40	.89	.89	.40	.40	1.90	1.90
Baseline	**.312**	**.312**	**.860**	**.86**	**.539**	**.539**	**.789**	**.79**
2015-2019	**.339**	**.34**	**.88**	**.88**	**.493**	**.49**	**1.59**	**1.59**
Natural	**.19**	**.19**	**.50**	**.50**	**.5**	**.5**	**.5**	**.5**

3.1.7. Elemental Carbonaceous Particulate

The IMPROVE protocol uses a thermal-optical reflectance method to differentiate between elemental carbon and organic carbon. Elemental carbon enters the atmosphere almost exclusively because of combustion. Table 3-4 illustrates the considerable decline in elemental carbonaceous particulate from the baseline period of 2002-2004.

Table 3-4: Elemental Carbonaceous Fine Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2001			.26	2.6				
2002	.12	1.2	.23	2.3	.35	3.5	.40	4.0
2003	.13	1.3	.289	2.9	.35	3.5	.44	4.4
2004	.13	1.3	.25	2.5	.27	2.7	.43	4.3
2005	.16	1.6	.33	3.3	.50	5.0	.61	6.1
2006	.120	1.20	.27	2.7	.40	4.0	.52	5.2
2007	.130	1.30	.25	2.5	.42	4.2	.42	4.2
2008	.110	1.10	.217	2.17	.31	3.1	.31	3.1
2009			.21	2.1				
2010	.086	.86	.21	2.1	.29	2.9	.36	3.6
2011	.114	1.14	.23	2.3	.33	3.3	.41	4.1
2012	.084	.84	.195	1.95	.33	3.3	.33	3.3
2013	.078	.78	.168	1.68	.25	2.5	.26	2.6
2014	.086	.86	.164	1.64	.27	2.7	.27	2.7
2015	.078	.78	.161	1.61	.23	2.3	.23	2.3
2016	.077	.77	.16	1.6	.21	2.1	.25	2.5

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2017	.072	.72	.19	1.9	.28	2.8	.30	3.0
2018	.14	1.4	.20	2.0	.27	2.7	.30	3.0
2019	.110	1.1	.22	2.2	.270	2.7	.350	3.5
Baseline	**.128**	**1.28**	**.260**	**2.60**	**.32**	**3.2**	**.42**	**4.2**
2015-2019	**.095**	**.95**	**.186**	**1.86**	**.250**	**2.50**	**.287**	**2.87**
Natural	**.010**	**.10**	**.02**	**.20**	**.034**	**.34**	**.034**	**.34**

3.1.8. Organic Carbonaceous Particulate

Organic carbonaceous particulate arises from a variety of sources, including natural biological processes, fires, and petrochemical industries. Table 3-5 shows a slow and unsteady decrease in this component of visibility impairment.

Table 3-5: Organic Carbonaceous Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}	µg m^{-3}	Mm^{-1}
2001			1.34	8.2				
2002	.61	3.3	1.22	7.3	1.60	9.7	2.30	14.7
2003	.69	3.8	1.50	9.2	1.41	8.4	2.26	15.0
2004	.71	3.9	1.55	9.9	1.54	9.2	3.13	22.8
2005	.66	3.6	1.42	8.6	1.93	12.2	2.64	17.7
2006	.54	2.91	1.18	7.0	1.56	9.3	2.09	13.6
2007	.69	3.8	1.19	6.97	1.63	9.9	1.84	11.4
2008	.58	3.13	1.18	6.92	1.30	7.6	1.57	9.6
2009			1.07	6.4				
2010	.49	2.64	1.18	7.3	1.30	7.6	2.05	14.8
2011	.58	3.15	1.38	8.6	1.61	9.7	2.64	18.8
2012	.43	2.31	1.026	5.87	1.22	7.0	1.43	8.4
2013	.44	2.37	.92	5.27	1.09	6.2	1.43	8.5
2014	.50	2.69	.87	4.95	1.04	5.9	1.33	8.0
2015	.58	3.15	1.12	6.61	1.28	7.5	1.60	9.9
2016	.47	2.48	1.02	5.9	1.16	6.8	1.63	9.9
2017	.47	2.51	1.13	6.5	1.36	7.9	1.67	10.1
2018	.60	3.23	1.09	6.5	.99	5.6	1.73	12.0
2019	.68	3.7	1.15	7.3	1.04	5.9	2.38	16.5
Baseline	**.67**	**3.67**	**1.40**	**8.63**	**1.52**	**9.1**	**2.56**	**17.5**
2015-2019	**.559**	**3.02**	**1.104**	**6.56**	**1.168**	**6.74**	**1.80**	**11.7**
Natural	**.16**	**.8**	**.33**	**1.8**			**.6**	**3.3**

3.1.9. Nitrate Particulate

The IMPROVE protocol uses a special module to capture ions, particularly nitrate. Nitrate constitutes a considerable proportion of fine particulate matter at the Wichita Mountains, primarily on cold, dark, humid winter days. The highest nitrate occurs especially in Arctic air masses with temperatures near or below the freezing point of water and a snow-covered origin region on the northern Plains near or east of Lincoln, Nebraska, although some such days feature southerly wind as the barely modified Arctic air mass retreats from Texas. The incidence of these days varies considerably among winter seasons, and the number of freezing days at the Wichita Mountains, in a given year, correlates strongly with most metrics of nitrate particulate matter in Table 3-6. Some improvement in recent years may reflect several mild winters in addition to emissions reductions. The years with the most freezing days (in descending order) include 2014, 2015, 2007, and 2010; those with the fewest freezing days include 2012, 2006, and 2016. Moreover, an increase in the number of days in recent years with missing samples decreases confidence in the apparent trend.

Table 3-6: Nitrate Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	$\mu g\ m^{-3}$	Mm^{-1}	$\mu g\ m^{-3}$	Mm^{-1}	$\mu g\ m^{-3}$	Mm^{-1}	$\mu g\ m^{-3}$	Mm^{-1}
2001			1.2	9.3				
2002	.432	3.16	1.168	8.89	2.00	16.1	1.32	10.3
2003	.379	2.70	1.36	10.9	3.70	31.5	3.33	28.5
2004	.346	2.52	1.42	11.8	4.16	37.9	3.51	32.4
2005	.336	2.36	1.06	8.2	1.41	11.5	1.29	10.3
2006	.269	1.97	.92	7.0	1.72	13.7	1.42	11.3
2007	.254	1.80	1.29	10.7	3.38	31.1	3.01	27.9
2008	.378	2.71	1.00	7.8	2.10	17.4	2.25	18.7
2009			.82	6.3				
2010	.25	1.72	1.02	8.0	2.75	22.8	2.72	22.6
2011	.493	3.61	1.13	8.9	3.04	25.6	2.95	24.8
2012	.270	1.97	.89	6.9	2.05	17.0	2.26	18.7
2013	.325	2.44	.99	7.6	2.68	22.1	2.40	20.0
2014	.264	1.86	1.14	9.1	3.08	26.2	2.78	23.6
2015	.237	1.76	.74	5.5	1.71	13.0	1.33	9.9
2016	.224	1.57	.63	4.8	1.46	11.8	1.18	9.4
2017	.167	1.22	.69	5.2	1.16	8.9	1.03	7.8
2018	.29	2.1	.97	7.5	2.80	22.8	2.86	23.0
2019	.33	2.4	.87	6.5	2.063	16.8	1.624	13.1
Baseline	**.385**	**2.80**	**1.29**	**10.2**	**3.28**	**28.5**	**2.72**	**23.7**
2015-2019	**.249**	**1.81**	**.78**	**5.9**	**1.84**	**14.7**	**1.60**	**12.7**
Natural	**.023**	**.21**	**.08**	**.7**	**.16**	**1.5**	**.16**	**1.5**

3.1.10. Sulfureous Particulate

The IMPROVE protocol measures the sulfur content of fine particulate matter. Sulfur particulate generally enters the atmosphere from the sulfur content of combusted fuels. Coal contains varying proportions of sulfur, so the ongoing shift away from coal likely continues to contribute to the considerable reduction in monitored sulfureous fine particulate at the Wichita Mountains. Moreover, EPA mandated lower sulfur content in diesel fuel and gasoline throughout the United States of America at various times during the observational period. Table 3-7 shows that the 20% clearest days show no reduction in sulfureous particulate. Even after the dramatic reductions in sulfur emissions during the past couple of decades, sulfureous particulate still leads all other contributors to visibility impairment at the Wichita Mountains on an average day.

Table 3-7: Sulfureous Particulate Matter at the Wichita Mountains

Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	μg m-3	Mm-1	μg m-3	Mm-1	μg m-3	Mm-1	μg m-3	Mm-1
2001			3.05	22.3				
2002	.798	5.35	3.25	24.4	6.38	52.5	7.52	62.2
2003	.763	4.98	3.04	22.3	4.48	35.2	5.44	43.4
2004	.756	4.97	2.93	21.3	4.46	34.2	5.29	41.6
2005	1.15	7.4	4.08	32.0	9.0	78.	9.6	84.
2006	.88	5.91	2.88	20.7	5.24	40.5	5.54	42.5
2007	.91	5.82	2.81	20.4	5.37	42.4	5.77	45.4
2008	1.02	6.74	2.73	19.7	5.31	41.7	5.13	40.0
2009			2.37	16.9				
2010	.91	5.96	2.43	17.3	4.49	34.3	4.26	32.0
2011	.908	6.13	2.40	16.8	4.26	31.5	4.33	32.3
2012	.664	4.38	2.180	15.16	3.87	28.0	3.61	26.1
2013	.653	4.38	2.09	14.5	3.45	25.5	3.74	27.5
2014	.767	4.97	2.16	15.1	4.06	29.6	3.97	28.5
2015	.644	4.37	1.89	12.9	3.17	22.2	3.26	22.3
2016	.496	3.24	1.53	10.4	2.45	17.2	2.38	16.4
2017	.459	3.08	1.69	11.5	3.12	22.4	3.00	21.3
2018	.568	3.78	1.55	10.4	2.41	16.9	2.17	14.8
2019	.781	5.2	1.65	11.2	2.537	17.8	2.869	19.5
Baseline	**.772**	**5.10**	**.744**	**22.6**	**5.10**	**40.6**	**6.09**	**49.1**
2015-2019	**.590**	**3.94**	**.552**	**11.3**	**2.736**	**19.28**	**2.735**	**18.84**
Natural	**.007**	**.19**	**.029**	**.76**	**.06**	**1.5**	**.06**	**1.5**

3.2. *Deciview Visibility Index*

The RH Rule in 40 C.F.R. Part 51, Subpart P calls for analysis of reasonable progress in terms of a regulatory unit called the deciview (dv), a logarithmic function of the additive extinction factors in inverse Megameters (Mm^{-1}). Table 3-8 applies this regulatory unit to assess total visibility degradation at the Wichita Mountains. The reasonable progress goals (RPGs) at the Wichita Mountains for 2018, listed in this table, reflect the revised RPGs calculated by EPA and included in the Federal Register notice preamble (and associated Technical Support Document) for actions taken on Texas' and Oklahoma's RH implementation plans on January 5, 2016 (81 Fed. Reg. 296, January 5, 2016). Although EPA's final action was remanded, and therefore this RPG value is not an accurate reflection of the control measures that were actually in place for Texas sources at the end of 2018 because the controls required under the federal implementation plan (FIP) were never implemented, it should be noted that both values are higher than the corresponding average values for 2015-2019.

Table 3-8: Deciview visibility index at the Wichita Mountains

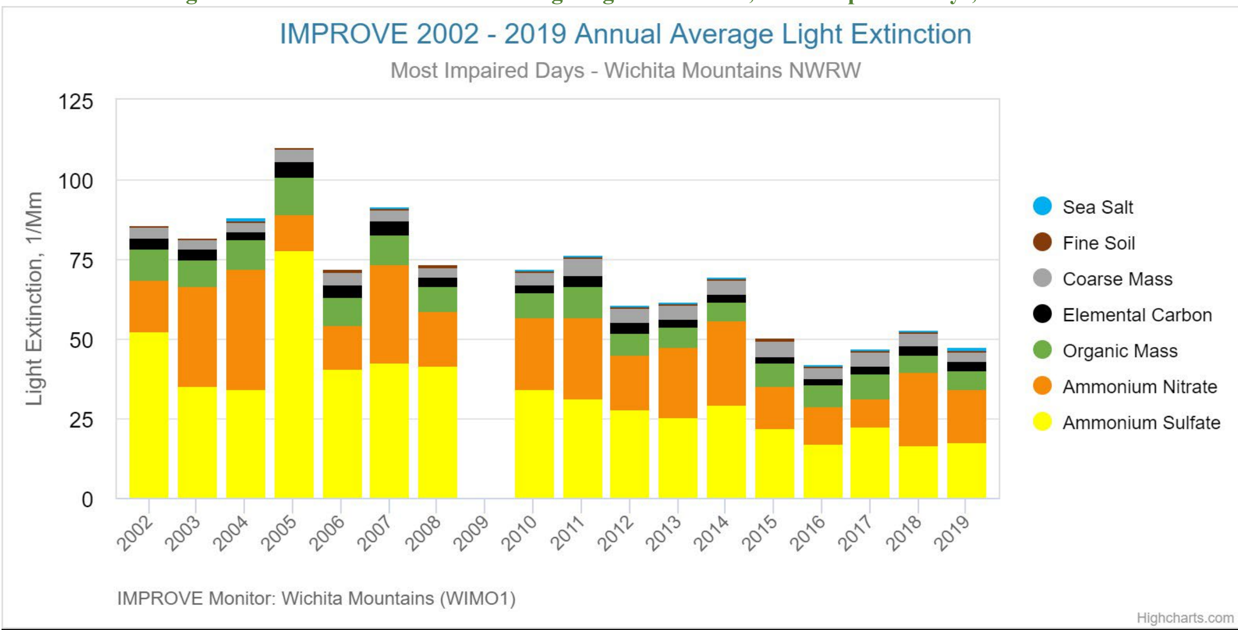
Year	20% Clearest Days		Annual Average		20% Most Impaired Days		20% Haziest Days	
	dv	Mm^{-1}	dv	Mm^{-1}	dv	Mm^{-1}	dv	Mm^{-1}
2001			16.9	60.				
2002	9.9	27.1	16.60	59.4	22.29	97.	23.62	109.
2003	10.2	28.1	17.20	62.0	22.09	93.5	23.65	108.
2004	9.6	26.6	16.83	61.6	22.16	99.1	24.2	118.
2005	10.8	30.1	17.9	68.5	24.4	122.	25.7	135.
2006	9.8	27.1	16.1	54.7	20.86	83.4	21.86	92.8
2007	9.6	26.5	16.21	56.8	22.43	103.	22.85	106.
2008	10.0	27.7	15.83	53.2	21.11	85.2	21.61	89.1
2009			14.75	48.0				
2010	9.3	25.8	15.41	51.4	20.94	83.0	21.67	89.3
2011	10.4	28.7	16.18	55.5	21.25	87.7	22.91	101.4
2012	9.0	24.9	15.02	48.5	19.45	71.7	20.19	77.1
2013	8.5	23.7	14.30	45.5	19.55	72.7	20.33	77.6
2014	9.3	25.7	15.06	49.5	20.43	80.6	21.16	85.8
2015	8.6	23.8	14.05	43.5	18.09	61.7	18.77	65.8
2016	8.2	22.8	13.2	39.2	16.47	53.1	17.25	57.0
2017	7.8	22.0	13.7	41.3	17.52	58.1	17.70	59.0
2018	8.8	24.5	14.1	43.4	18.16	63.8	19.3	71.1
2019	9.9	27.	14.1	44.1	17.6	58.	20.0	74.
Baseline (2000-2004)	**9.92**	**27.3**	**16.90**	**60.7**	**22.18**	**96.6**	**23.83**	**111.4**
2015-2019	**8.65**	**24.0**	**13.83**	**42.3**	**17.58**	**59.02**	**18.60**	**65.3**
EPA-calculated RPG for 2028	**9.22**				**21.33**			

3.3. Baseline and Current visibility conditions at WMWA

The 5-year average impairment for 2015-2019 on the MIDs is 17.58 deciviews, a 21% improvement from the 2000-2004 baseline of 22.18 deciviews.

Figure 3-1 details the components of light extinction on the MIDs from 2002-2019. Particulates of ammonium sulfate and ammonium nitrate dominate the components of light extinction at the WMWA. Reductions in SO_2 emissions (and corresponding lower ammonium sulfate formation shown in yellow) during this period commensurately reduced light extinction at the WMWA. NO_x reductions (and lower corresponding ammonium nitrate formation shown in orange) occurred from 2002-2019 as well, but at a lesser rate than SO_2 reductions. Thus, the light extinction attributable to NO_x has increased as a percentage of the total, although the total light extinction at the WMWA has decreased considerably.

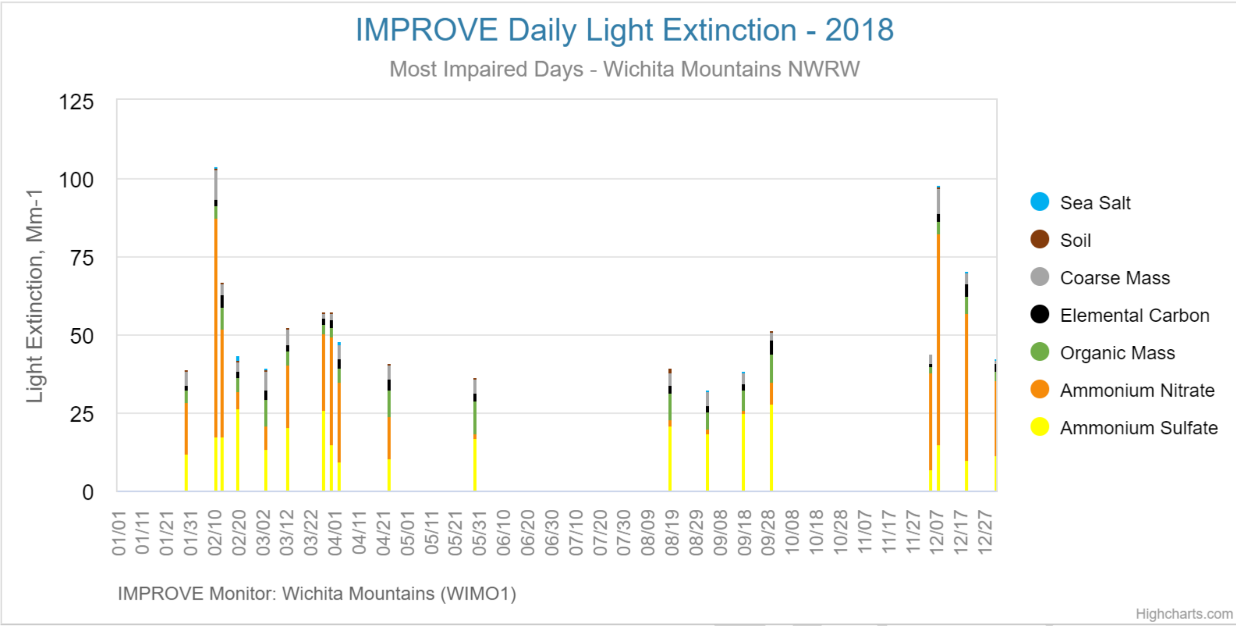
Figure 3-1: IMPROVE Annual Average Light Extinction, Most Impaired Days, 2002-2019



Courtesy: Western Regional Air Partnership

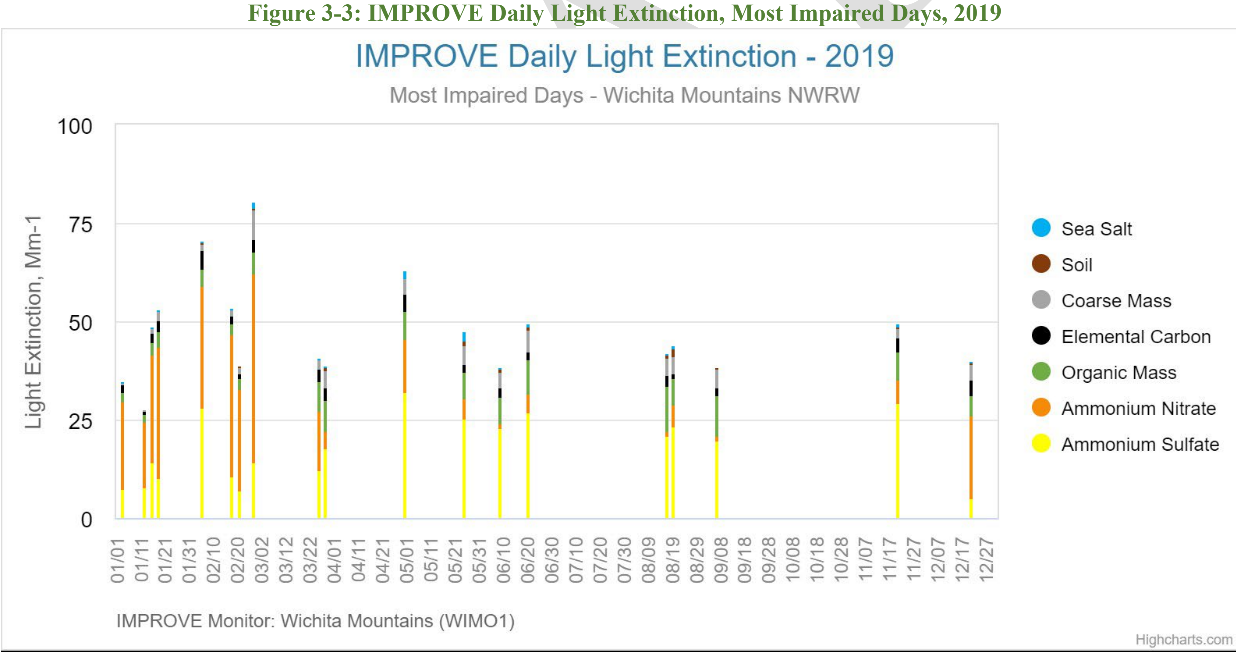
Figures 3-2 and 3-3 break down individual components of light extinction for the individual MIDs in 2018 and 2019, respectively. These graphs illustrate the seasonality of components to light extinction at the WMWA. Whereas the effect to visibility due to sulfate particulate stays fairly uniform throughout the year, nitrate particulate clearly dominates visibility impairment in the colder, winter months. Wind patterns in these months typically flow from north to south, bringing air masses across the plains before arriving at the WMWA. On the days leading up to the most impaired visibility at the WMWA air masses trapped by meteorological inversions travel the eastern agricultural plains, which also include larger metropolitan areas, such as Kansas City and Omaha. Higher NO_x emissions from on-road mobile sources are likely a key contributor to the winter-time nitrate particulate that impairs visibility at the WMWA. Section 3.1.9 further describes the nitrate particulate contribution at the WMWA.

Figure 3-2: IMPROVE Daily Light Extinction, Most Impaired Days, 2018



Courtesy: Western Regional Air Partnership

Figure 3-3: IMPROVE Daily Light Extinction, Most Impaired Days, 2019



Courtesy: Western Regional Air Partnership

4. Emission Trends

Analyzing emission trends helps to better understand the effect of anthropogenic emissions on visibility impairment at Class I areas. At the WMWA, the primary pollutants contributing to visibility impairment were ammonium nitrate and ammonium sulfate during Planning Period 1. The focus of DEQ's analysis is on emissions of NO_x and SO_2. Tables 4-1, 4-2, and 4-3 summarize the national emission inventory for the years 2002, 2011 (as provided in Table 5-2 of Oklahoma's RH Five Year Progress Report, September

2016), and 2017 respectively for Oklahoma. Please note that at the time this report was generated, 2017 was still the most recent complete National Emissions Inventory (NEI) data year available as the 2020 NEI data had not been released by EPA yet.

Table 4-1: Oklahoma emission inventory summary for 2002 (Tons)

	VOC	NO_x	$PM_{2.5}$	PM_{10} - $PM_{2.5}$	NH_3	SO_2
Point	37,794	158,818	8,636	8,026	24,102	148,761
Non-Point	201,758	115,407	109,279	304,560	114,363	11,779
Non-Road	47,863	49,396	4,580	433	4,434	4,708
On-Road	99,924	142,592	2,459	879	280	4,773
Biogenic	988,314	35,909	0	0	0	0
Total	1,375,653	502,122	124,954	313,898	143,179	170,021

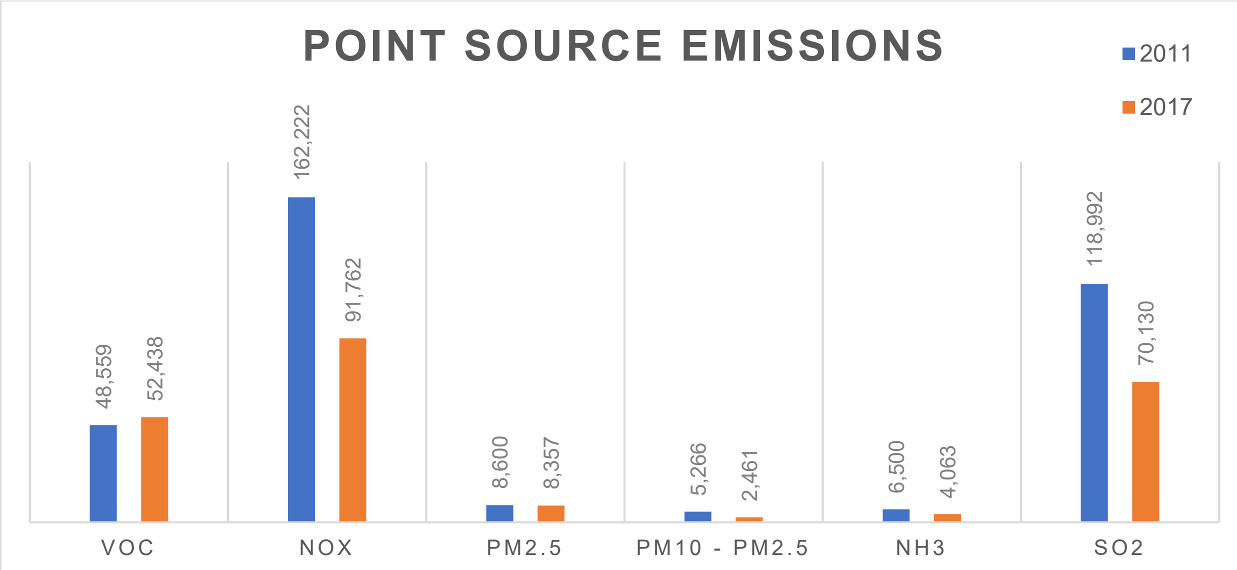
Table 4-2: Oklahoma emission inventory summary for 2011 (Tons)

	VOC	NO_x	$PM_{2.5}$	PM_{10} - $PM_{2.5}$	NH_3	SO_2
Point	48,559	162,222	8,600	5,266	6,500	118,992
Nonpoint (Area)	284,354	103,506	89,167	554,650	103,782	4,078
On-road mobile	54,975	115,105	3,555	3,011	1,918	516
Non-road mobile	27,815	24,650	2,316	107	30	63
Biogenic	1,185,031	42,428				
Event	243,573	20,193	93,067	109,819	16,944	9,601
Total	1,844,307	468,104	196,705	672,853	129,174	133,250
2011-2002 Change	225,081	-54,211	-21,316	249,136	-30,949	-46,372

Table 4-3: Oklahoma emission inventory summary for 2017 (Tons)

	VOC	NO_x	$PM_{2.5}$	PM_{10} - $PM_{2.5}$	NH_3	SO_2
Point	52,438	91,762	8,357	2,461	4,063	70,130
Nonpoint (Area)	676,468	133,587	88,782	456,501	110,878	1,350
On-road mobile	36,947	72,377	2,185	1,892	1,580	409
Non-road mobile	15,052	12,910	1,274	68	24	27
Biogenic	452,714	50,091				
Event	235,599	20,684	90,787	16,342	16,389	9,634
Total	1,016,504	381,411	191,385	477,264	132,934	81,550
2017-2011 Change	-584,320	-116,670	87,747	-85,770	20,704	-42,098
2017-2002 Change	-359,239	-170,801	66,431	163,366	-10,245	-88,470

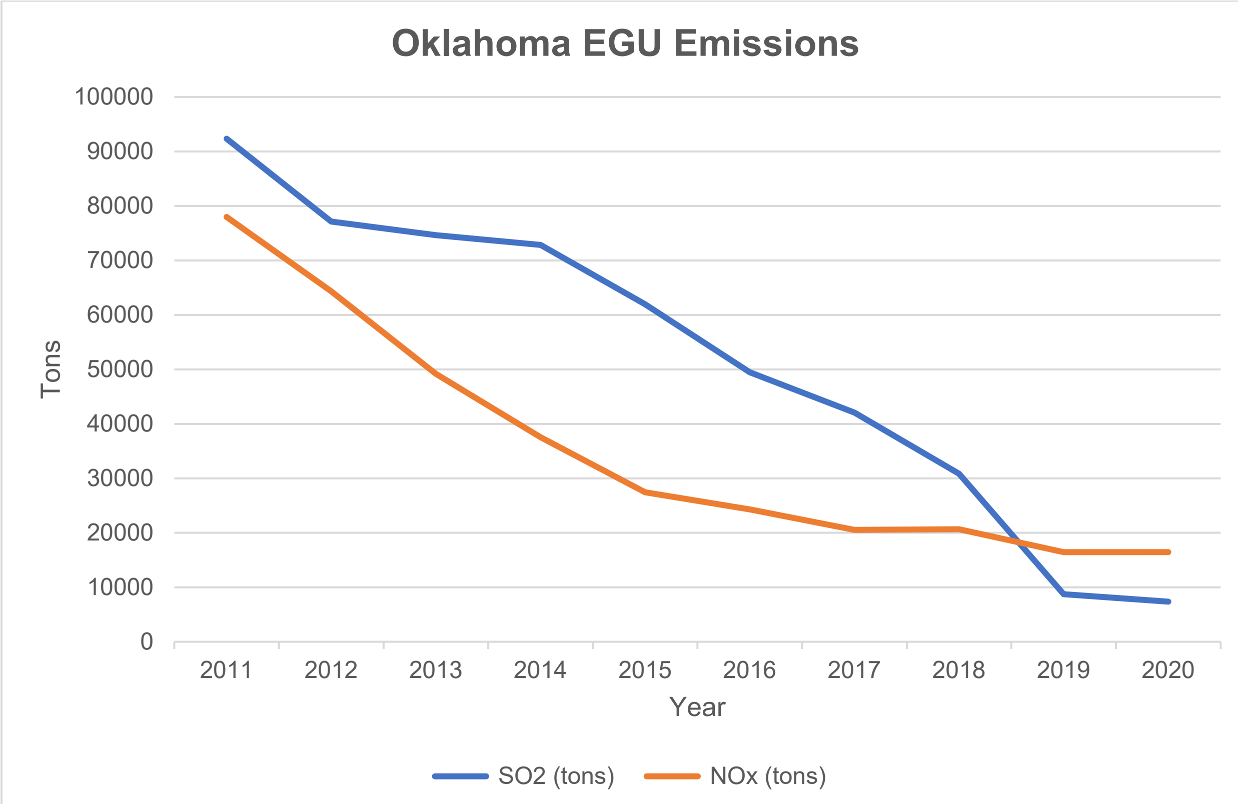
Figure 4-1: Oklahoma Point Sources in National Emissions Inventory, total emissions (tons per year, 2011 and 2017)



NO_x and SO_2 emissions have considerably decreased from 2011 to 2017, especially from the point source sector. Note, the NEI reporting structure changed in 2008, adding an "event" sector for wildfires and prescribed burning sources and moving biogenic emissions into the nonpoint category. DEQ has removed the biogenic emissions totals from the nonpoint source category in Tables 4-1 and 4-2 and reported them separately for easier comparison to previous reports. Also note that the 2017 emissions totals listed in Table 4-3 were significantly lower than the predicted emissions totals for 2018 given in the 2016 RH Five Year Progress Report (Table 5-3) for all parameters except $PM_{2.5}$ and PM_{10} - $PM_{2.5}$. PM data were particularly affected by the addition of the event sector ($PM_{2.5}$) and changes to methodologies for estimating nonpoint emissions (PM_{10} - $PM_{2.5}$).

Both DEQ and EPA recognize that Electric Generating Utilities (EGUs) in general are significant sources of NO_x and SO_2 emissions. For certain EGU units, emissions are required to be reported to EPA's Clean Air Markets Division (CAMD) on a more frequent basis than the NEI. Figure 4-2 lists more recent data from CAMD for this subset of point source inventory of emissions, to show the considerable reduction in emissions that have occurred since 2011 for the EGU sector; that trend continues.

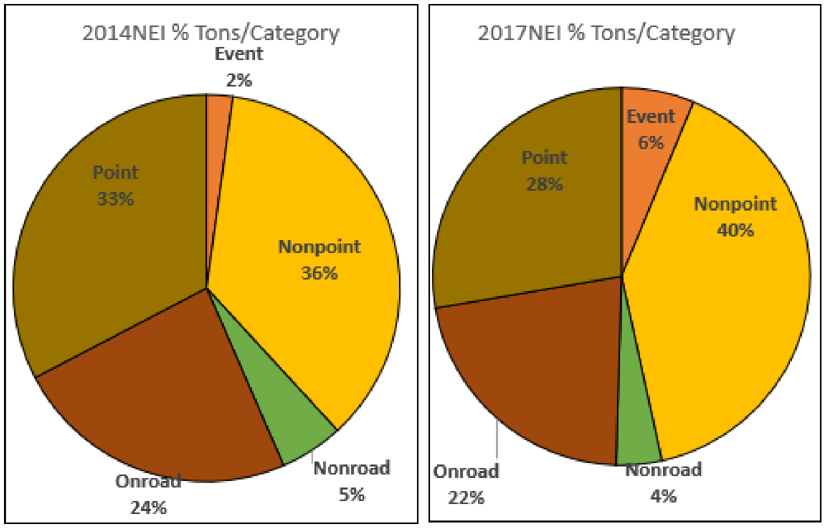
Figure 4-2: 2011 – 2020 Emissions from EPA Clean Air Markets Division, Acid Rain Program (ARP)



The majority of SO_2 emissions continue to be attributed to the point source category of the inventory. During Planning Period 2, Oklahoma's focus will be on evaluating controls for point sources. Inventoried emissions of SO_2 decreased by approximately 35% from 2011 to 2017, a trend likely to continue as evidenced by the major reductions achieved after 2017; as Planning Period 1 controls were fully implemented (see Section 5.2).

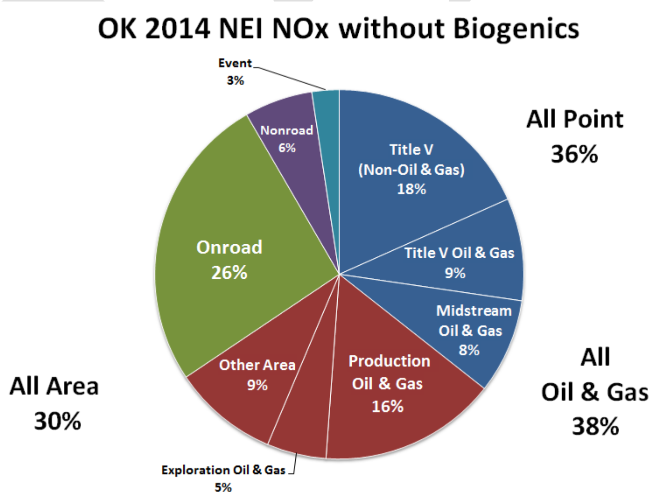
NO_x emissions are not dominated by one source category, but instead are heavily contributed to by the point, nonpoint, and on-road sectors. Figure 4-3 displays the percentage of NO_x emissions from the 5 major categories for 2014 and 2017. Total NO_x emissions decreased almost 15% from 2014 to 2017 with point source reductions of 27%. While NO_x emissions from nonpoint sources decreased from 2014 to 2017, it was not as drastic as point sources. Therefore, the proportion of NO_x emissions attributable to nonpoint sources increased slightly for this time period. Although on-road emissions decreased slightly from 2014 to 2017, DEQ lacks the authority to require controls for the on-road sector and will continue to rely on EPA and other federal entities to effect meaningful emissions reductions for this source category.

Figure 4-3: Relative Contribution of Each National Emission Inventory Category to Total NO_x Emissions in Oklahoma



NO_x emissions in the 2014 NEI for Oklahoma were further split into separate categories to analyze contribution from the oil and gas sector. Figure 4-4 shows that oil and gas operations, whether as a point or area source, accounted for 38% of the NO_x emissions in Oklahoma (with biogenics removed from consideration) in 2014. It is reasonable to presume a similar split of the 2017 NEI would yield similar results.

Figure 4-4: NO_x emissions without Biogenics by NEI category



DEQ continues to have one of the most robust permitting programs in the country for oil and gas operations, and many oil and gas sources that would typically be considered area sources (i.e. midstream oil and gas sources) are accounted for under the point source category in Oklahoma as of 2011. In addition, DEQ has been on the forefront of developing accurate emission estimates for the sector through the National Oil and Gas Emissions Inventory Committee. Starting in 2014, DEQ began supplying actual, collected data to the NEI for the oil and gas production source category rather than data generated by assumptions in the Oil and

Gas Tool. This shift in the way data was reported resulted in an increase in the emissions considered from the area source category. DEQ will continue to evaluate oil and gas activity, operations, and air quality permitting standards to maintain appropriate control of emissions, including NO_x. Where appropriate, larger oil and gas point sources have been evaluated for potential NO_x controls during Planning Period 2. The sheer number of small oil and gas sources makes it extraordinarily inefficient and impracticable for ODEQ, a state agency with limited means, to evaluate each source individually for possible emission reductions. As of 2022, EPA has proposed regulations for oil and natural gas sources that, if finalized, would have the co-benefit of reducing NO_x emissions from this sector.

5. SIP Progress Report

The most recent progress report from DEQ was submitted on September 28, 2016, and then approved by EPA on June 28, 2019. That progress report analyzed both the emissions of visibility-impairing pollutants and the changes in visibility at the WMWA for the five-year period of 2009-2013 for consideration of control measure effectiveness. Section 4 of this SIP Revision includes an analysis of changes in emissions of visibility-impairing pollutants since the period covered by the last progress report. The current analysis of reasonable progress therefore includes the most recently available visibility monitoring data through 2019, and therefore will be included in this analysis of reasonable progress.

5.1. 2010 – 2018: Planning Period 1

Oklahoma submitted to EPA its Planning Period 1 RH SIP addressing regional haze on February 18, 2010. This submittal included BART determinations for 13 units at six facilities (all electric generating units) in Oklahoma. EPA approved the determinations for seven units. EPA approved DEQ's BART determinations for NO_x and PM and disapproved the determinations for SO_2 on six units, effective January 27, 2012 (76 Fed. Reg. 81728, December 28, 2011). In the same action, EPA issued a federal implementation plan (FIP) for the six units for which it disapproved BART SO_2 determinations. Following a settlement agreement, covering two of the units affected by the FIP, EPA approved the Planning Period 1 RH SIP Revision on March 7, 2014, to incorporate new control requirements (79 Fed. Reg. 12944, March 7, 2014).

Table 5-1: First Planning Period Sources

Facility Name	BART Emission Units	Pollutants Evaluated
OG&E Seminole Generating Station	Units 1, 2, 3	NO_x
PSO Comanche Power Station	Units 1 & 2	NO_x
PSO Southwestern Power Station	Unit 3	NO_x
OG&E Sooner Generating Station	Units 1 & 2	SO_2, NO_x, PM
OG&E Muskogee Generating Station	Units 4 & 5	SO_2, NO_x, PM
PSO Northeastern Power Station	Units 2, 3, & 4	Unit 2: NO_x Units 3 & 4: NO_x, SO_2, PM

5.2. Status of control measure implementation

All required control measures from the Planning Period 1 have been constructed and continue to operate. The requirements that EPA approved on January 27, 2012, had a deadline of five years after EPA approval, thus January 27, 2017. The deadline for meeting the FIP requirements at OG&E Muskogee and Sooner was later extended to January 4, 2019. AEP/PSO entered into a settlement agreement and First Amended Regional Haze Agreement (First Amended Regional Haze Agreement, DEQ Case No. 10–025 (March 2013) to address the FIP for Units 3 and 4 at the Northeastern Power Plant. The AEP/PSO Regional Haze Agreement was part of the 2013 Oklahoma Regional Haze SIP Revision, which was approved by EPA in the March 7, 2014 final rule. In accordance with that agreement, Unit 4 was retired in 2016, and Unit 3 is now achieving an interim emission rate for SO_2. The primary significant remaining requirement from the AEP/PSO Regional Haze Agreement is for Unit 3 at Northeastern to incrementally reduce the capacity factor until its mandatory retirement by December 31, 2026.

5.3. BART-subject Units

All the controls required by Planning Period 1 were on BART-subject units. Below is a discussion of each facility, the BART-applicable units, the emission controls added, and the federally enforceable permit in which the control and emission limits are required.

5.3.1. OG&E Seminole

Permit 2015-1986-TVR3, issued August 14, 2016, incorporates the following BART limits:

Table 5-2: BART control and emission limits for OG&E Seminole Units 1, 2, 3

Control	Unit 1	Unit 2	Unit 3
NO_x control	Combustion controls including: Low-NO_x Burners, Overfire Air, and Flue Gas Recirculation	Combustion controls including: Low-NO_x Burners, Overfire Air, and Flue Gas Recirculation	Combustion controls including: Low-NO_x Burners, Overfire Air, and Flue Gas Recirculation
NO_x emission rate	0.203 lb/MMBtu (30-day rolling avg)	0.212 lb/MMBtu (30-day rolling avg)	0.164 lb/MMBtu (30-day rolling avg)

Additionally, OG&E's Title V semi-annual report covering the time period of December 21, 2018 to June 21, 2019, indicates the facility has remained in compliance with these limits.

5.3.2. AEP/PSO Comanche

Permit 2016-0646-TVR3, issued August 10, 2017, incorporates the following BART limits:

Table 5-3: BART control and emission limits for PSO Comanche Units 1 and 2

Control	Unit 1	Unit 2
NO_x control	Dry Low-NO_x burners	Dry Low-NO_x burners
NO_x emission rate	0.15 lb/MMBtu (30-day rolling average)	0.15 lb/MMBtu (30-day rolling average)

Additionally, PSO's Title V semi-annual report covering the time period of April 1, 2019, to September 30, 2019, indicates the facility has remained in compliance with these limits.

5.3.3. AEP/PSO Southwestern

Permit 2016-0341-TVR3, issued December 3, 2018, incorporates the following BART limits:

Table 5-4: BART control and emission limits for PSO Southwestern Unit 3

Control	Unit 3
NO_x control	Low-NO_x burner with overfire air
NO_x emission rate	0.45 lb/MMBtu (30-day rolling average)

Additionally, PSO's Title V semi-annual report covering the time period of March 1, 2019, to August 31, 2019, indicates the facility has remained in compliance with these limits.

5.3.4. OG&E Sooner

Permit 2016-0552-TVR3 (M-4), issued May 29, 2019, incorporates the following BART limits:

Table 5-5: BART control and emission limits for OG&E Sooner Units 1 and 2

Control	Unit 1	Unit 2
NO_x control	Low-NO_x burner with overfire air	Low-NO_x burner with overfire air
NO_x emission rate	0.15 lb/MMBtu (30-day rolling average)	0.15 lb/MMBtu (30-day rolling average)
PM_{10} control	Existing electrostatic precipitator	Existing electrostatic precipitator
PM_{10} emission rate	0.10 lb/MMBtu (3-hour rolling average)	0.10 lb/MMBtu (3-hour rolling average)
SO_2 control	Dry-gas desulfurization*	Dry-gas desulfurization*
SO_2 emission rate	0.06 lb/MMBtu (30-day rolling average)	0.06 lb/MMBtu (30-day rolling average)

*The deadline to meet FIP limits was extended to January 4, 2019

Additionally, OG&E's Title V semi-annual report covering the time period of February 25, 2019, to August 25, 2019, indicates the facility has remained in compliance with these limits.

5.3.5. OG&E Muskogee

Permit 2005-271-C (M-13), issued August 13, 2018, incorporates the following BART limits:

Table 5-6: BART control and emission limits for OG&E Muskogee Units 4 and 5

Control	Unit 4	Unit 5
NO_x control	Low-NO_x burner with overfire air	Low-NO_x burner with overfire air
NO_x emission rate	0.15 lb/MMBtu (30-day rolling average)	0.15 lb/MMBtu (30-day rolling average)
NO_x emission rate	822 lb/hr (30-day rolling average)	822 lb/hr (30-day rolling average)
NO_x emission rate	3,600 TPY (12-month rolling)	3,600 TPY (12-month rolling)
PM_{10} control	Existing electrostatic precipitator	Existing electrostatic precipitator
PM_{10} emission rate	0.10 lb/MMBtu (3-hour rolling average)	0.10 lb/MMBtu (3-hour rolling average)
PM_{10} emission rate	548 lb/hr (3-hour rolling average)	548 lb/hr (3-hour rolling average)
PM_{10} emission rate	2,400 TPY (12-month rolling average)	2,400 TPY (12-month rolling average)
SO_2 control	Dry gas desulfurization*	Dry gas desulfurization*
SO_2 emission rate	0.06 lb/MMBtu (30-day rolling average)	0.06 lb/MMBtu (30-day rolling average)

*The deadline to meet FIP limits was extended to January 4, 2019.

OG&E opted to convert units 4 and 5 from coal-fired to natural gas-fired, which was completed February 18-21, 2019. This conversion and the associated limits will be incorporated into its next issued permit.

5.3.6. AEP/PSO Northeastern

In accordance with the AEP/PSO Regional Haze Agreement and the 2013 Oklahoma RH SIP Revision, Unit 4 was retired in 2016, and required controls were installed on Units 2 & 3.

Permit 2012-918-TVR2 (M-2) includes the following BART limits:

Table 5-7: BART control and emission limits for PSO Northeastern Units 2 and 3

Control	Unit 2	Unit 3*
NO_x control	Low-NO_x burner with overfire air	Low-NO_x burner with overfire air
NO_x emission rate	0.28 lb/MMBtu (30-day rolling average)	0.15 lb/MMBtu (30-day rolling average)
SO_2 control	N/A	Dry-sorbent/carbon injection
SO_2 emission rate		0.40 lb/MMBtu (30-day rolling average)

*for Unit 3 – per the RHA – the SO_2 emission rate is under review to determine if a lower rate is appropriate.

The AEP/PSO Regional Haze Agreement, under revised paragraph 26, subparagraph E, required AEP/PSO to develop and propose a monitoring program for Unit 3 to test various operating profiles and other measures in order to determine whether increased SO_2 removal efficiencies – more stringent than the permitted 0.40 lb/MMBtu SO_2 emission limit shown in Table 5-7 above – can be achieved at Unit 3 during normal operations using existing DSI. The AEP/PSO Agreement also contained additional requirements for Unit 3 dependent on the results of the required monitoring program.

PSO developed and implemented the monitoring program, and submitted the "BART SO_2 Monitoring Program for Northeastern Power Station Unit 3," dated June 25, 2019, to DEQ. Based on the results of the SO_2 Monitoring Program, PSO concluded that the lowest target emission rate sustainably achieved consistent with the conditions in the AEP/PSO Regional Haze Agreement is 0.35 lb/MMBTU on a 30day rolling average basis, and that the resulting federally enforceable emission rate should be 0.37 lb/MMBtu on a 30-day rolling average basis. DEQ concurs with PSO's determination that the BART emission limit for Unit 3 should be revised to 0.37 lb/MMBtu, and this revised limit will be incorporated into a future permit modification.

Additionally, the AEP/PSO Regional Haze Agreement requires that Unit 3 will decrease the annual capacity until retirement by December 31, 2026, as follows (quoted from subsection (1)(g) of Attachment A to the Settlement Agreement):

> *The [Regional Haze Agreement] RHA will require that beginning in calendar year 2021, the Annual Capacity Factor (calculated for each calendar year as a percentage of MWH based on a rated capacity of 470 MW times 8760 hours) for the operating coal-fired generating unit at Northeastern Station will be reduced as follows:*
>
> *i. to no more than 70 percent in calendar years 2021 and 2022;*
> *ii. to no more than 60 percent in calendar years 2023 and 2024; and*
> *iii. to no more than 50 percent in calendar years 2025 and 2026.*

5.3.7. Summary of Planning Period 1 Emission Reductions

Table 5-8 and Table 5-9 summarize emission reductions resulting from implementation of BART as of the end of the first RH Planning Period.

Table 5-8: SO_2 Emission reductions achieved from Planning Period 1 control measures

Source	Unit	BART baseline emissions (tons SO_2)	Emissions in 2019 (tons SO_2)	Net reduction (tons SO_2)
OG&E Sooner	1	9,394	307	**17,377**
	2	8,570	280	
OG&E Muskogee	4	9,113	2	**18,115**
	5	9,006	2	
PSO Northeastern		31,779	4,216	**27,563**
Total				**63,055**

Table 5-9: NO_x Emission reductions achieved from Planning Period 1 control measures

Source	Unit	BART baseline emissions (tons NO_x)	Emissions in 2019 (tons NO_x)	Net reduction (tons NO_x)
OG&E Seminole	1	4,068	409	**9,720**
	2	4,248	290	
	3	2,636	533	
PSO Comanche	1	1,393	23	**2,731**
	2	1,385	24	
PSO Southwestern	3	2,136	889	**1,247**
OG&E Sooner	1	7,266	1,273	**10,373**
	2	5,689	1,309	
OG&E Muskogee	4	5,258	274	**10,441**
	5	5,709	252	
PSO Northeastern	2	2,861	512	**14,839**
	3 and 4	13,971	1,481	
Total				**49,351**

5.4. Visibility conditions and progress

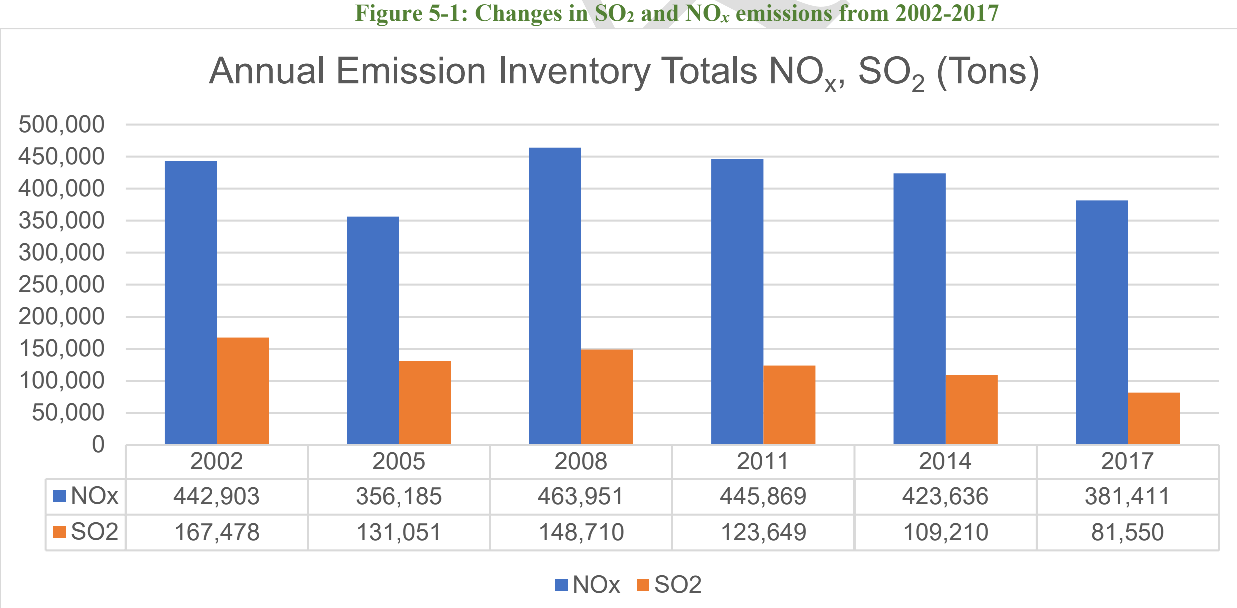
In conformity with a previous version of the federal regional haze rule, DEQ prepared and submitted an implementation plan revision for the first planning period, and EPA approved some parts of this plan, including some sections that analyzed the haziest 20% of days at the Wichita Mountains. Section 3.1.2 herein presents statistics for visibility at the Wichita Mountains since the establishment of the monitoring station in March 2001. After DEQ submitted its proposed implementation plan revision for the first planning period, EPA updated the regional haze regulations to require that implementation plans consider instead the most *impaired* 20% of days. The current version of the RH Rule requires that the progress report in the Planning Period 2 RH SIP include "the difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions."

The average visibility metric on the most impaired 20% of days for the five-year period of 2015-2019 at the Wichita Mountains was 17.58 deciviews, an improvement of 4.60 deciviews from 22.18 deciviews during the baseline period (2000-2004). Additionally, no degradation of visibility occurred on the 20% clearest days during Planning Period 1; the visibility metric on the cleanest 20% of days improved from 9.92 deciviews during the baseline period of 2000-2004 to 8.65 deciviews during the five-year period of 2015-2019 for a difference of 1.27 deciviews. The 2018 reasonable progress goal (RPG) for the WMWA, as submitted by DEQ in the Planning Period 1 RH SIP (February 18, 2010) is 21.33 deciviews on the haziest 20% of days. Visibility conditions at the WMWA improved such that the submitted RPG was met by the end of Planning Period 1 in 2018. A full analysis of visibility conditions at the WMWA can be found in Section 3.

5.5. Changes in impairment contribution

Sulfate and nitrate emissions are the major contributors to visibility impairment at the WMWA. As SO_2 emissions have decreased considerably (see Section 4. Emissions Inventory), the contribution of nitrate particulate has increased (see Section 3. Visibility Monitoring). Emissions of SO_2 and NO_x have decreased substantially in both the point and nonpoint sectors, highlighting the effects of ongoing air pollution control programs implemented by DEQ. The following graph illustrates changes in SO_2 and NO_x emissions from 2002 – 2017.

Figure 5-1: Changes in SO_2 and NO_x emissions from 2002-2017



5.6. Significant changes in anthropogenic emissions impeding progress

Emissions of all major contributors to visibility impairment at the WMWA have decreased since the analysis provided in the initial SIP revision for regional haze. Therefore, progress toward the reasonable progress goal established for the first planning period has not been impeded by any anthropogenic source or sector of emissions.

5.7. *Adequacy of implementation plan*

As evidenced by the visibility monitoring data, presented in Section 3, the approved Oklahoma Planning Period 1 RH SIP was more than sufficient to meet the reasonable progress goal established in Planning Period 1. The 2014-2018 visibility index on the haziest days is 2.50 deciviews better than the RPG that DEQ proposed and submitted from Planning Period 1. Additional progress toward natural conditions continues on track for meeting the target visibility conditions goal before the 2064 endpoint. EPA modeling projects the 2028 visibility index on the most impaired days to be 0.43 deciviews better than the URP glidepath.

6. 2018 – 2028: Planning Period 2

In amendments to the RH Rule, effective January 10, 2017, EPA delayed the due date of the Planning Period 2 RH SIPs until July 31, 2021, to better integrate with other federal air program requirements (82 Fed. Reg. 3078, January 10, 2017). The delayed deadline shortens the time remaining in the planning period for the RH SIP to be reviewed, approved, and implemented from the normal ten years to seven years, which means much of the progress possible during this planning period has already been realized as a result of completed or partially completed implementation of Planning Period 1 actions and other regulatory changes. Any requirements for implementation of additional controls during Planning Period 2 must be limited to only those control measures shown to be cost-effective at reducing visibility impairing pollution per the four-factor analyses. The work on Planning Period 3 (2028-2038) will begin shortly after the submittal of this SIP and possibly before EPA approval of this SIP. In addition to the advanced progress made during Planning Period 1, EPA modeling shows that visibility impairment will continue to decrease during Planning Period 2 at a pace better than the uniform rate of progress at the WMWA and at other Class I areas where Oklahoma sources may impact visibility, as demonstrated below.

6.1. *Visibility conditions at the WMWA*

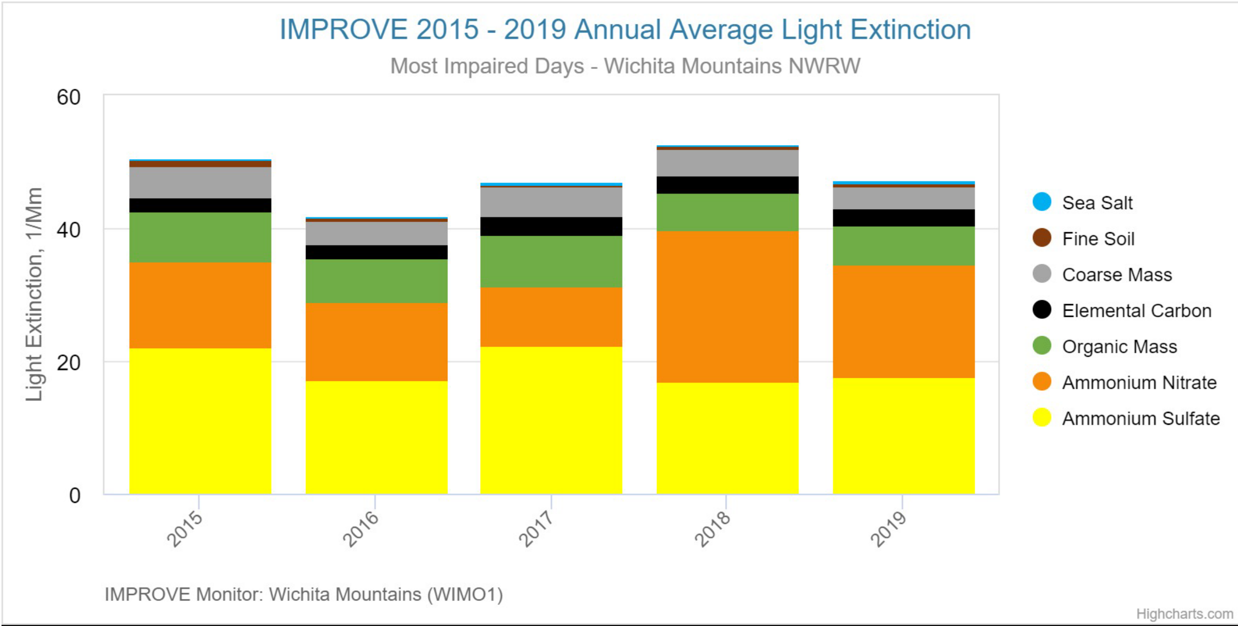
The most recently available 5-year period of IMPROVE monitoring data for the Planning Period 2 analysis is 2015-2019. Table 6-1 shows the 5-year average deciview index on the 20% most impaired days and 20% clearest days at the WMWA.

Table 6-1: Baseline, current, and natural visibility index at WMWA

	Average deciview index for 2000-2004 baseline	**Average deciview index for 2015-2019**	**Deciview index for natural conditions**
Most Impaired Days	22.18	17.56	10.19
Clearest Days	9.92	8.33	4.20

Figure 6-1 shows the breakdown of particulate species on the most impaired days at the WMWA for 2015-2019.

Figure 6-1: Average Annual Light Extinction, MIDs, 2015-2019



Courtesy: Western Regional Air Partnership

Nitrate and sulfur particulate constitute the greatest proportion of impairment contribution at the Wichita Mountains. IMPROVE data also provide statistics for saline, soil, elemental carbon, and organic carbon fine particulate and coarse particulate matter. The algorithm considers all chlorine and chloride particulate (labeled as sea salt) as entirely natural and therefore not subject to regulatory action. The fine soil particulate originates in large part from windblown dust, which originates principally in the Sahara region of Africa on the days with the greatest quantity of fine soils. Elemental carbon particulate derives from combustion of organic matter, especially in fires, although a small portion originates from industrial sources and automobile engines. Even federal land managers in comments on this implementation plan admit to use of fire as a land-management practice. The complexities of organic chemistry in the atmosphere complicated identification of the sources of organic carbonaceous particulate matter, but seasonal cycles and analysis of daily data suggest a dominant origin in the natural processes of plant life with a notable contribution from burning vegetation. Coarse mass episodes correspond to North American dust storms, but some of the coarse mass undoubtedly includes the largest particles from other sources, especially pollen grains, sulfur, and nitrates. In summary, sources of chlorine, fine-soil, coarse mass, elemental carbonaceous, and organic carbonaceous particulate matter at the Wichita Mountains and their precursors include a preponderance of natural sources and other sources not well characterized in existing emission inventories.

In contrast to the foregoing categories, sulfur and nitrate particulate originate primarily from unambiguously anthropogenic sources, well defined in Oklahoma inventories and national emissions inventory and subject to permitting and other regulation from EPA and air pollution control agencies. Moreover, sulfur and nitrate still contribute the majority of visibility impairment at the Wichita Mountains. Therefore, DEQ chose to focus on NO_x and SO_2 emissions for analysis in this implementation plan revision.

6.2. Long-term strategy development

A long-term strategy (LTS) for improving visibility conditions during the second planning period ending 2028 is required by 40 C.F.R. § 51.308(f)(2) of the RH Rule. In developing the LTS, a state must consider: 1) the cost of compliance; 2) the time necessary for compliance; 3) the energy and non-air quality environmental impacts of compliance; and 4) the remaining useful life of the source when determining what controls are appropriate. This consideration of control scenarios is often referred to as a "four-factor analysis." Cost of compliance is expressed in terms of cost per ton of emissions (NO_x or SO_2) reduced annually. Time necessary for compliance considers what a reasonable deadline for installing controls should be. The energy and non-air quality environmental impacts of compliance considers additional factors that could affect control selection. If the remaining useful life of a source is such that it is expected to close within the planning period, a state may consider that sufficient reason not to select the source for the addition of controls. Because applying a four-factor analysis is resource intensive, states typically first employ a method for identifying the sources reasonably anticipated to impair visibility at Class I areas (U.S. Environmental Protection Agency, *Guidance on Regional Haze State Implementation Plans for the Second Implementation Period, August 20, 2019*). As discussed in detail below, DEQ used an "area-of-influence" (AOI) analysis to identify such sources.

6.2.1. Source selection

The Central States Air Resource Agencies (CenSARA) is a partnership of member states that work collectively to achieve regional air quality goals. The member states include Louisiana, Arkansas, Missouri, Iowa, Nebraska, Kansas, Oklahoma, and Texas. To work collectively on regional haze SIP development, CenSARA contracted Ramboll-Environ to produce an AOI study for the region.

The Ramboll-Environ AOI study was developed to quantify impacts from stationary sources on visibility conditions at Class I areas of interest. By combining emissions profiles with atmospheric air trajectory patterns, the AOI represents an area that contains sources that most commonly impair visibility at a target Class I area. To assess or to estimate potential for impairment of visibility, extinction weighted residence times (EWRTs) were developed using Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) 72-hour back-trajectories at four elevations: 100 m, 200 m, 500 m, and 1,000 m. Emissions data were drawn from the 2016 EPA modeling platform, developed in collaborative effort with states. The full AOI outputs and corresponding report can be found in Appendices B and C.

While using EWRTs is useful for identifying large geographic areas likely to contain sources of visibility impairing emissions, photochemical modeling has suggested that EWRT tends to over-emphasize small sources of emissions located close to Class I areas. Because the analysis goes back only 72 hours, it does not analyze long-range transport or emissions in more distant areas. Visibility-degrading fine particulate matter commonly travels in the atmosphere for two weeks or longer after emission, most indisputably in the case of Saharan dust. To help alleviate this over-emphasis on small sources, DEQ opted to consider a simple "Q/d," or emissions mass divided by distance, threshold for eliminating small sources from further analysis.

When analyzing source contribution to visibility impairment, DEQ considered NO_x and SO_2 emissions separately instead of aggregating contributions from each pollutant for a total source contribution. Visibility impairment at the WMWA is clearly dominated by NO_x in winter conditions and SO_2 in most of the rest of the year (see Figures 3-2 and 3-3 in Section 3). If DEQ had considered the total contribution of a source from both NO_x and SO_2 together, the potential for visibility improvement by controlling aggregated emissions would not reasonably correspond with the MIDs identified through monitoring. Control options for NO_x and SO_2 vary widely, resulting in the possibility that controlling one, but not both, is cost effective. The visibility improvement from controlling one pollutant at a source identified through aggregate contribution would be far less than would be considered cost effective. Additionally, given the resource intensity of conducting a four-factor analysis, DEQ focused on greater emissions of one pollutant, not split between moderate emissions of two pollutants.

The results of Ramboll-Environ's AOI study quantify contribution by calculating individual source EWRTs and combining with the source's emissions. The total contribution (from the sources included in the AOI) to a single Class I area is therefore the aggregate of each individual source's contribution to visibility impairment at that Class I area. Different Class I areas have different contribution makeup; some may have a relatively small number of sources that contribute the bulk of the visibility impairment from point source anthropogenic emissions (e.g. theoretically ten sources might be responsible for more than 80% of the contributing emissions). For the WMWA, a large number of NO_x sources each contribute a small fraction toward nitrate-based impairment, but a small number of SO_2 sources each contribute a relatively larger percentage of the sulfate-based impairment.

It should be noted that implementation of BART determinations continued beyond 2016, which was used as the baseline emissions year for conducting the AOI study to correspond with EPA's 2016-based RH modeling. Additionally, the Big Brown Power Plant in Freestone County, Texas ranked as the single largest contributor of SO_2 emissions but after 2016, this plant and some other sources of visibility impairment for the Wichita Mountains ceased operations. These shutdowns resulted in major decreases in total emissions, compared to emissions in 2016, and therefore in changes in the respective proportional contributions from the facilities that continue their operations. In identifying sources for analysis, DEQ chose to use emissions for the same year for every source to avoid potential misrepresentation of potential effects of emission controls. However, based on suggestions from EPA, DEQ did remove some sources and their corresponding emissions, such as the Big Brown Power Plant, from the source selection calculations. These eliminations were done in an effort to not skew the source selection criteria towards sources that had already achieved significant, known reductions that were not reflected in the 2016 data. The sources whose emissions contributions were removed are documented in Appendix D. DEQ could have used absolute results rather than a proportion of the total product of the extinction-weighted residence time and the ratio of quantity of emissions to distance. However, this alternative statistic does not change the ranking of sources and therefore would not have affected the source selection in any way.

DEQ, in consultation with air pollution control agencies in nearby states, based its analysis primarily on data for 2016. EPA based the modeling platform, which it developed and supplied to the states and the public, on data for 2016. With this platform, EPA projected emissions from 2016 toward the conclusion of the second planning period. DEQ relied heavily on this critical tool in the development of the Planning Period 2 RH SIP. Due to the substantial variation in weather conditions among years, the use of an inventory for a different, more recent year than the year of the meteorological analysis in the area-of-influence study introduces uncertainty and indefensible inconsistencies. Equipped with the national model output and the area-of-influence study, DEQ analyzed emissions and meteorological conditions principally and comprehensively for 2016 in preparation of this Planning Period 2 RH SIP. Several known changes in emissions that occurred during or after 2016 will affect the long-term strategy to make reasonable progress toward the national visibility goal at the Wichita Mountains. Nevertheless, full confirmation and documentation of changes that occurred after the most recent fully quality-controlled national emissions inventory were not available to DEQ early enough to be utilized during development of this Planning Period 2 RH SIP.

During consultation, FLMs suggested that DEQ focus on sources within Oklahoma while analyzing data produced by the AOI study. By establishing a methodology that considered a "reasonable" number of sources within the state's purview, it limited the possibility for missing potential reductions because of the magnitude of contribution from Texas, other states, and foreign countries. This is especially true at the WMWA Class I area, where most visibility-impairing pollutants originate at emission sources in Texas and other states. For these reasons, DEQ's methodology, as discussed in this section, focuses exclusively on sources within Oklahoma. Sources outside Oklahoma that contribute to visibility impairment were identified using the same methodology, but only after DEQ analyzed solely Oklahoma sources.

After analyzing the resulting data from the AOI study and removing emissions from sources with known large reductions, DEQ began by selecting a Q/d threshold of 5 tons per year^{-1} km^{-1} for Oklahoma sources, where Q is the 2016 annual tons of emissions of NO_x or SO_2, and d is the distance from WMWA in km. Sources below that level generally had emissions much lower than would typically be considered to warrant controls. This resulted in the identification of twenty potential sources in Oklahoma for NO_x and ten potential sources for SO_2, as shown in Tables 6-2 and 6-3, respectively, below (seven sources for both NO_x and SO_2, thirteen for NO_x only, and three for SO_2 only). See also Appendix D.

Facilities that were subject to best available retrofit technology (BART) analyses in Planning Period 1 are included in the tables, although they were not ultimately required to perform a four-factor analysis for the Planning Period 2 long-term strategy development. See Section 6.3 for a more detailed explanation. Two airports located in Oklahoma were identified via the discussed source-selection methodology, but, as discussed in Section 6.3, no significant emission sources associated with airport operations are under state jurisdiction and they were therefore not analyzed any further.

DEQ next selected an individual source contribution threshold of 0.5% or greater for source selection to perform a four-factor analysis. Given the successful reduction in visibility impairment over the last decade, 0.5% is an appropriate threshold for identifying sources of the greatest importance for further analysis. Eight of the thirty originally identified sources were eliminated from further analysis, because they were too small to be considered after using the 0.5% contribution metric as shown in Tables 6-2 and 6-3 below. The 0.5% threshold identified twelve total sources, which is a reasonable number of sources that warranted further analysis in the form of a four-factor analysis and on which to focus limited available resources. These twelve sources are also shown in relation to the Class 1 areas in Figure 6-2.

DEQ performed some additional calculations to determine the relative contributions the selected point sources represented as compared to all Oklahoma point sources. These calculations are based on emissions from Oklahoma sources only and do not correspond directly to the percentages shown in Tables 6-2 and 6-3, which are based on all emissions that contribute to visibility impairment at the WMWA. With extinction-weighted residence time divided by distance from the WMWA as a weighting factor, the NO_x sources selected for four-factor analyses and shown in Table 6-2 represented 12% of NO_x emissions from all point sources in Oklahoma from the 2016 inventory. Sources subject to BART in Oklahoma accounted for a further 12% of such NO_x emissions. Similarly, with extinction-weighted residence time divided by distance from the WMWA as a weighting factor, the SO_2 sources selected for four-factor analyses and shown in Table 6-3 represented 55% of SO_2 emissions from all point sources in Oklahoma from the 2016 inventory. Sources subject to BART in Oklahoma accounted for a further 31% of such SO_2 emissions. As stated above, NO_x sources each contribute a small fraction toward nitrate-based impairment resulting in less collective contributions despite a higher number of selected sources than SO_2.

Table 6-2: NO_x Sources Evaluated for Possible Four-Factor Analysis

Facility	County	Q/d - NO_x (tons/km)	Emissions sector	% EWRT × Q/d	Disposition
OG&E Muskogee Generating Station	Muskogee	19.56164	electric generating utility	-	best available retrofit technology

Facility	**County**	**Q/d - NO_x (tons/km)**	**Emissions sector**	**% EWRT × Q/d**	**Disposition**
OG&E Sooner Generating Station	Noble	11.98438	electric generating utility	-	best available retrofit technology
AEP/Public Service Company of Oklahoma (PSO) Southwestern Power Station	Caddo	10.3934	electric generating utility	-	best available retrofit technology
DCP Chitwood Gas Plant	Kingfisher	10.20981	gas plant	1.49%	four-factor analysis requested
ONEOK Maysville Gas Plant	Garvin	9.420284	gas plant	1.00%	four-factor analysis requested
Mustang Gas Binger Plant	Caddo	8.838011	gas plant	2.67%	four-factor analysis requested
ONEOK Lindsay Booster Station	Garvin	8.798333	oil and gas gathering	0.93%	four-factor analysis requested
OG&E Seminole Generating Station	Seminole	8.694886	electric generating utility	-	best available retrofit technology
Altus Air Force Base	Jackson	7.46931	military	-	excluded as airport
Western Farmers Electric Cooperative Hugo Generating Station	Choctaw	7.181259	electric generating utility	0.13%	excluded for small contribution
City of Frederick Frederick Regional Airport	Tillman	6.858501	airport	-	excluded as airport
Public Service Company of Oklahoma Northeastern Power Station	Rogers	6.779603	electric generating utility	-	best available retrofit technology
Grand River Dam Authority Grand River Energy Center	Mayes	6.599336	electric generating utility	0.24%	excluded for small contribution
International Paper Valliant Paper Mill	McCurtain	6.411024	paper mill	0.12%	excluded for small contribution
Lone Star/Buzzi Unicem Pryor Cement Facility	Mayes	6.027821	cement plant	0.22%	excluded for small contribution

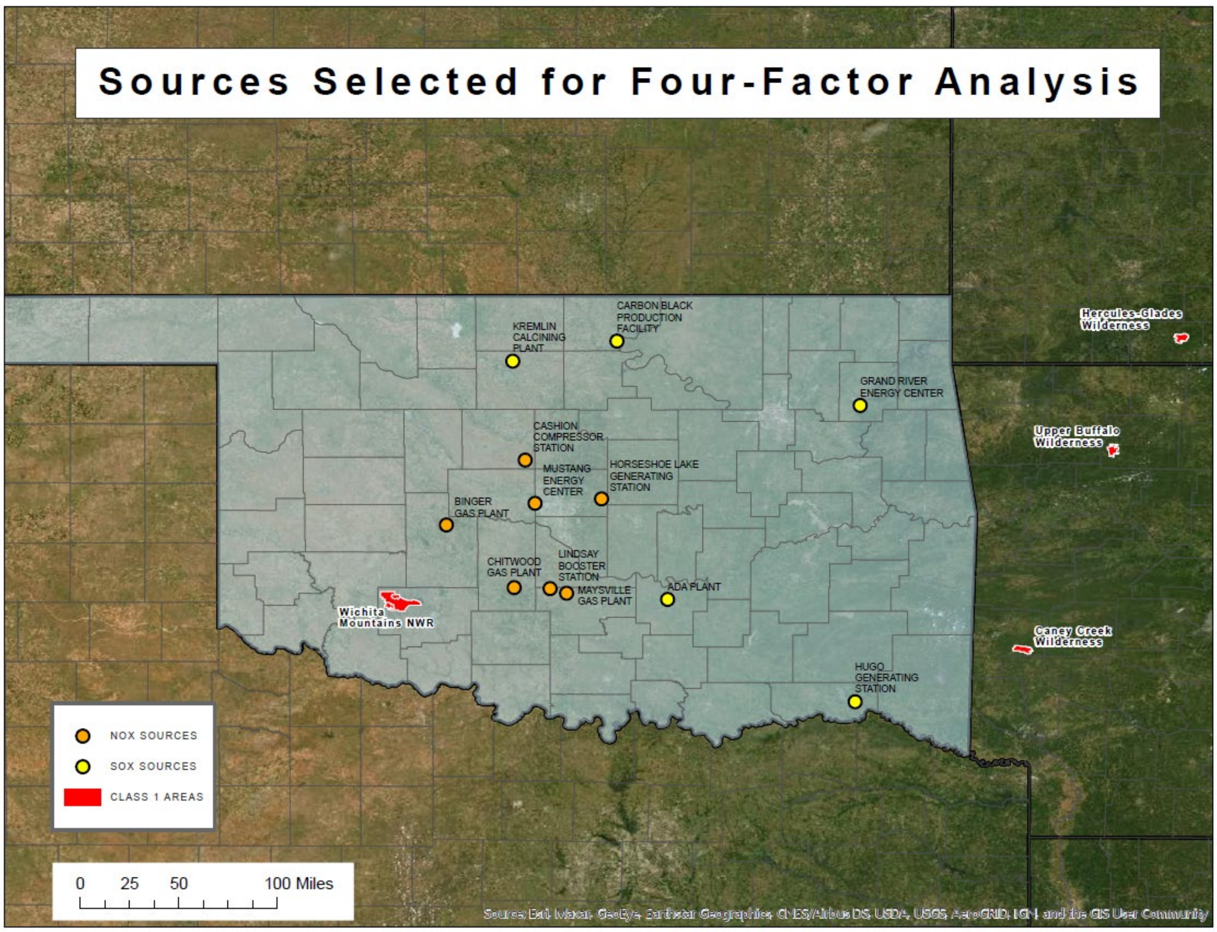
Facility	County	Q/d - NO_x (tons/km)	Emissions sector	% EWRT × Q/d	Disposition
OG&E Mustang Generating Station	Canadian	5.984149	electric generating utility	0.82%	four-factor analysis requested
Panhandle Eastern Cashion Station	Logan	5.602299	oil and gas gathering	0.69%	four-factor analysis requested
Holcim Ada Plant	Pontotoc	5.247147	portland cement plant	0.38%	excluded for small contribution
OG&E Horseshoe Lake Generating Station	Oklahoma	5.233127	electric generating utility	0.54%	four-factor analysis requested
Georgia Pacific Muskogee Mill	Muskogee	5.032026	paper mill	0.17%	excluded for small contribution

Table 6-3: SO_2 Sources Evaluated for Possible Four-Factor Analysis

Facility	County	Q/d - SO_2 (tons/km)	Emissions sector	% EWRT × Q/d	Disposition
Oxbow Kremlin	Garfield	59.45982	petroleum coke calcining	8.06	four-factor analysis requested
OG&E Muskogee Generating Station	Muskogee	53.90887	electric generating utility	-	best available retrofit technology
OG&E Sooner Generating Station	Noble	46.34065	electric generating utility	-	best available retrofit technology
Grand River Dam Authority Grand River Energy Center	Mayes	25.78439	electric generating utility	3.17	four-factor analysis requested
Western Farmers Electric Cooperative Hugo Generating Station	Choctaw	22.70217	electric generating utility	3.39	four-factor analysis requested
Public Service Company of Oklahoma Northeastern Power Station	Rogers	12.55256	electric generating utility	-	best available retrofit technology
Holcim Ada Plant	Pontotoc	12.00789	portland cement plant	1.43	four-factor analysis requested
Continental Carbon Carbon Black Production Facility	Kay	10.42704	carbon black manufacturing	1.18	four-factor analysis requested

Facility	County	Q/d - SO_2 (tons/km)	Emissions sector	% EWRT × Q/d	Disposition
Georgia Pacific Muskogee Mill	Muskogee	5.799093	wood products	0.410	excluded for small contribution
OG&E River Valley Generating Station (formerly AES Shady Point- Cogeneration Plant)	Le Flore	5.120371	electric generating utility	0.447	excluded for small contribution

Figure 6-2: Location of Sources Subject to Four-Factor Analysis and Closest Class I Areas



6.3. Sources not required to submit a four-factor analysis

Multiple sources identified as having a potential for affecting visibility at the WMWA were not required to perform a four-factor analysis. This is because 2016 emissions data used to calculate potential impacts in the AOI study did not include many of the control applications required in previous implementation plan revisions. As discussed in Section 5, thirteen emission units at six facilities were required, through either

Oklahoma's Planning Period 1 RH SIP or EPA's FIP, to implement BART controls in conjunction with Planning Period 1. All thirteen emissions units reduced NO_x emissions by installation of (or in some cases utilizing existing) low-NO_x burners. For the six coal-fired BART units, existing PM controls were considered to meet BART requirements. BART SO_2 requirements for these six units have been applied as follows: the four OG&E units have installed dry-gas desulfurization, one PSO unit was retired, and the other is applying dry-sorbent/carbon injection SO_2 controls until its retirement in 2026. It is unlikely that a new four-factor analysis would result in a finding that additional cost-effective controls are available and appropriate for these emission units.

Much like utilizing a two-tiered approach to identify sources of highest importance for analysis in the current implementation plan revision, eliminating sources identified in the AOI study that underwent BART reduced the potential for expending valuable resources on analyzing sources with little opportunity for further reductions. The cost of implementing BART on these sources, which in many cases was incurred less than 5 years ago, also factored into the decision to not push for greater reductions from these same sources at this time.

Unit 3 for PSO Northeastern has undergone BART and the unit is slated to shut down in 2026 per an existing and EPA-approved agreement (First Amended Regional Haze Agreement, DEQ Case No. 10–025 (March 2013)). Emissions from this unit will cease before the end of the current planning period. Therefore, there is no reason to request or conduct a four-factor analysis on the unit as any additional controls cannot prove cost-effective in such a brief period. PSO plans to submit a permit application to limit SO_2 emissions from Unit 3 to 0.37 lb/MMBTU. Similarly, there is no reason to require a source-specific SIP limit for Unit 3 in the brief interim before the unit shuts down.

Two airports also appear on the list of facilities: Frederick Municipal Airport and Altus Air Force Base. The emissions at these airports include those from airplane engines during takeoff and landing and fall under EPA's jurisdiction for transportation. DEQ did not further analyze any potential for reductions at these sources.

6.4. Sources subject to a four-factor analysis and results

As previously mentioned, the RH Rule requires that a state consider four factors when developing control options for its long-term strategy: 1) the cost of compliance; 2) the time necessary for compliance; 3) the energy and non-air quality environmental impacts of compliance; and 4) the remaining useful life of the source. As shown in Table 6-2 and 6-3, DEQ ultimately requested that the owners or operators of seven sources of NO_x emissions and five sources of SO_2 emissions provide additional information. A letter detailing DEQ's request was sent to each source identifying units of concern. Sources were instructed to provide additional information regarding the unit's status and to perform a four-factor analysis for NO_x or SO_2 emissions, as appropriate.

The following summarizes each analysis for the twelve sources. A copy of each four-factor analysis (FFA) request, the full analyses submitted by the sources (excluding confidential business information), additional DEQ request for clarification, and sources' corresponding responses, can be found in Appendix E.

6.4.1. SO_2 Sources

6.4.1.1. Oxbow Calcining – Kremlin

Oxbow Calcining LLC (Oxbow) owns and operates the Kremlin Calcined Coke Plant in Garfield County, Oklahoma. The petroleum coke calcining plant utilizes three kilns in the calcining process. The plant reported emissions of 12,663 tons of SO_2 in 2016. For each of the three kilns, Oxbow evaluated three emissions reduction options: wet flue gas desulfurization (WFGD), dry flue gas desulfurization (DFGD), and dry sorbent injection (DSI). As stated in its four-factor analyses responses, Oxbow was unable to verify whether these particular control systems have been used successfully on petroleum coke calcining kilns at other locations. Nonetheless, the four-factor analyses for this plant estimate that the lowest cost per ton of SO_2 removed would be $6,574 for Kiln 1 if WFGD were used and if the company were able to utilize water from the City of Enid. (Note that Table 6-4 below shows the estimated cost of compliance for each kiln and control option, with two scenarios, depending upon the source of additional water for SO_2 controls.) Oxbow concluded this was not an economically viable option. Due to the cost and the technical uncertainly of the control technologies, the company concluded that no additional controls are reasonable during Planning Period 2. DEQ concurs that this is a reasonable conclusion.

6.4.1.2. Western Farmers – Hugo Plant

Western Farmers Electric Cooperative (WFEC) owns and operates the Hugo Electric Generating Plant, located in Choctaw County, Oklahoma. In 2016, the Hugo plant reported emissions of 7,275 tons of SO_2 from a coal fired boiler ("Hugo Unit 1"), used to generate electricity. An analysis provided by WFEC evaluated wet flue gas desulfurization, dry flue gas desulfurization, and dry sorbent injection for potential to control SO_2 emissions. At $8,203 per ton of SO_2 removed, dry flue gas desulfurization is the lowest cost option, and therefore the analysis concluded there is no economically viable control option for the unit.

In response to a DEQ request for further clarification (*see* Appendix E), WFEC provided additional estimates of cost-effectiveness values utilizing a lower interest rate, as recommended in FLM/EPA comments. FLM/EPA comments also asserted that higher removal efficiencies than those used in the FFA are possible. Although WFEC reiterated that the emission rates (in lb SO_2/MMBTU) used for DFGD and WFGD were appropriate, DEQ staff attempted to address FLM/EPA comments by calculating the cost-effectiveness for a removal efficiency range of 87% to 99% (corresponding to a range of 0.06 to 0.005 lb/MMBtu) using the recommended interest rate. Although these calculations yielded lower cost-effectiveness values, they did not alter DEQ's judgment that WFEC's finding that no additional controls are required during the second planning period for the Hugo Generating Station is and remains a reasonable conclusion, because the controls would not be cost-effective.

6.4.1.3. Grand River Dam Authority – Energy Center

Grand River Dam Authority (GRDA) owns and operates the Grand River Energy Center (GREC), located in Mayes County, Oklahoma. In 2016, the facility reported emissions of 8,987 tons of SO_2 from two coal fired boilers used in generating electricity. Unit 1, which emitted 93% of the SO_2 emissions in 2016, has been converted to operate on natural gas, and was therefore not included in the FFA request. Unit 2, which accounted for 629 tons of SO_2 emissions in 2016, is the remaining coal fired boiler in operation, and was analyzed for potential controls. Coal washing, circulating dry scrubbing, dry sorbent injection, a new spray dryer absorber, and wet flue gas desulfurization were all considered technically feasible control options. Of the control options evaluated for cost-effectiveness, dry sorbent injection was the lowest cost per ton of SO_2 removed at $21,187, which was determined by GRDA to not be economically viable.

In response to a DEQ request for further clarification (*see* Appendix E) regarding questions raised in EPA comments, GRDA provided additional documentation in support of its analysis. The additional information provided in GRDA's response did not alter DEQ's judgment that GRDA's finding that no additional controls are required during the second planning period for the GREC Unit 2 is and remains a reasonable conclusion because the controls would not be cost-effective.

6.4.1.4. Holcim – Ada Plant

Holcim US Inc. owns and operates the Ada Portland Cement Production Plant, located in Pontotoc County, Oklahoma. In 2016, the plant emitted 2,203 tons of SO_2, primarily from two kilns utilized in its production process. Those two kilns have subsequently been removed and replaced with a new kiln in 2017 that operates more efficiently and emits far less SO_2, estimated at 154 tons per year. The operating changes and SO_2 emissions decreases are reflected in Construction Permit No. 2013-0193-C (M-1), issued 11/7/2019 (modification of Construction Permit No. 98-087-C (M-7), issued 10/16/2014), and Operating Permit No. 2013-0193-TVR (M-1), issued 11/10/2020. Therefore, the Ada Plant was not analyzed further for SO_2 emission reductions.

6.4.1.5. Continental Carbon – Carbon Black

Continental Carbon Co. owns and operates the Carbon Black Production Facility located in Kay County, Oklahoma. In 2016, the facility reported 2,712 tons of SO_2 emissions for the entire facility, primarily from the utilization of three thermal oxidizers that controlled four carbon black production units. Continental Carbon entered into a federally enforceable consent decree (5:15-cv-00290F) with EPA on May 7, 2015, requiring the removal of the three thermal oxidizer units and replacement with two clean gas and energy cogeneration units, each with a selective catalytic reduction (SCR) system for the control of NO_x emissions and a dry scrubber for the control of SO_2 emissions. The consent decree requirements were incorporated into Construction Permit No. 2004-302-C (M-2), issued 4/25/2016 (as modified by Construction Permit No. 2004-302-C (M-4), issued 11/30/2018), and Operating Permit No. 2017-0914-TVR2, issued 8/21/2018. Prior to the consent decree, Continental Carbon was permitted to emit approximately 16,555 TPY of SO_2 from the three thermal oxidizers. The two clean gas and energy cogeneration units were installed in the fall of 2018. The dry scrubbers have been installed but are still being modified to operate effectively. The completion of this project is expected to occur in the summer of 2022. Project completion will result in a new permitted limit of approximately 708 TPY of SO_2 for an estimated permitted reduction of 15,800 tons of SO_2 annually. Therefore, the company concluded that there are no further reductions in SO_2 that can be cost-effectively achieved at the facility. DEQ concurs that this is a reasonable conclusion.

6.4.2. NO_x Sources

6.4.2.1. OG&E – Horseshoe Lake Generating Station

Oklahoma Gas and Electric Company (OG&E) owns and operates the Horseshoe Lake Generating Station, located in Oklahoma County, Oklahoma. In 2016, the facility reported emissions of 852 tons of NO_x. The Horseshoe Lake Station consists of five electric generating units: three boilers (Units 6, 7, & 8) and two turbines (Units 9 & 10). An analysis provided by OG&E evaluated control technologies on each of these five units. The cost-effectiveness results range from $14,179 to $129,391 per ton of NO_x removed. The analysis concluded that the evaluated control technologies are not cost-effective.

In response to a DEQ request for further clarification (*see* Appendix E) regarding questions raised in EPA comments, OG&E provided additional documentation in support of its analysis. The additional information provided in OG&E's response did not alter DEQ's judgment that OG&E's finding that no additional controls are required during the second planning period for the Horseshoe Lake Station Units 6-10 is and remains a reasonable conclusion because the controls would not be cost-effective.

6.4.2.2. OG&E – Mustang Generating Station

OG&E owns and operates the Mustang Generating Station, located in Canadian County, Oklahoma. In 2016, the facility reported emissions of 747 tons of NO_x from two natural gas fueled electric generating units. Units 3 and 4 were retired on December 31, 2017 as required under AQD Construction Permit No. 2011-1008-C (M-1) issued December 11, 2015. Units 3 and 4 are thus not included in the (TV renewal) Operating Permit No. 2018-0555-TVR3, issued August 15, 2018 or subsequent operating permit modifications/renewals. Units 3 and 4 therefore did not undergo any further evaluation for control of NO_x emissions.

6.4.2.3. Mustang Gas – Binger Gas Plant

Mustang Gas Products owns and operates the Binger Gas Plant located in Caddo County, Oklahoma. In 2016, the facility emitted 658 tons of NO_x, primarily from three of the four natural gas fueled four-stroke rich-burn engines utilized at the site. A four-factor analysis and follow-up response, submitted by Mustang Gas, considered potential controls on these four engines. Three of the four engines (CM-2323, CM-2324, and CM-2325) already operate with air fuel ratio controllers (AFRC). In addition, two of the engines (CM-2324 and CM2325) already operate with non-selective catalytic reduction (NSCR) installed, and no additional controls are considered cost effective for those engines. As shown in Table 6-4. at $24.00 and $24.67 per ton of NO_x removed, the analysis concluded the most efficient control application for the remaining two engines (CM-2323 and CM-2322) to be NSCR with good combustion practices. DEQ concurs that this is a reasonable conclusion. Mustang Gas already completed installation of NSCR on CM-2323 as permitted by 2015-1174-C (M-2). Mustang Gas Products will adhere to the following requirement for the remaining engine:

Mustang Gas Products will apply for a construction permit from DEQ for the installation of non-selective catalytic reduction (NSCR) to emission unit CM-2322 at the Binger Gas Plant. The NSCR will be operational no later than one year following the approval this section of Oklahoma's State Implementation Plan by EPA.

6.4.2.4. ONEOK – Lindsay Booster Station

ONEOK Field Services owns and operates the Lindsay Booster Station, located in Garvin County, Oklahoma. In 2016, the facility emitted 928 tons of NO_x, primarily from eight grandfathered natural gas fueled compression engines. ONEOK has since removed the eight natural gas fueled engines and installed electric compression units as a replacement. This change was documented in the Notice of Intent (NOI) to construct (No. 2019-0758-NOI) under the General Permit for Oil and Gas General Facilities (GP-OGF), and the subsequent GP-OGF Authorization to Operate No. 2019-0758-O, issued on May 5, 2020. These emission reductions also resulted in the facility no longer being a Title V source (under previous Operating Permit No. 2015-1447-TVR3, issued on February 21, 2019). Therefore, a four-factor analysis was no longer necessary for the Lindsay Booster Station.

6.4.2.5. ONEOK – Maysville Gas Plant

ONEOK Field Services owns and operates the Maysville Gas Plant, located in Garvin County, Oklahoma. In 2016, the facility emitted 1,093 tons of NO_x, primarily from thirteen natural gas fueled compression engines. ONEOK has since removed seven of these engines and committed to removing the remaining six before the end of Planning Period 2. ONEOK agreed to a Regional Haze Agreement with DEQ (Oklahoma DEQ Air Quality Regional Haze Agreement, Case No. 22-085, effective 5/6/2022) as the enforceable mechanism for removing the remaining natural gas fueled engines by December 31, 2028. Per paragraph 13 in the Agreement:

> *ONEOK shall shut down and remove from service Engines C-4, C-5, C-6, C-8, C-11, and C-13 in lieu of conducting a four-factor analysis for the Maysville Gas Plant by December 31, 2028.*

The full Regional Haze Agreement No. 22-085 can be seen in Appendix F, which also includes information regarding the dates of the removal of the first seven engines.

6.4.2.6. Panhandle Eastern Pipeline – Cashion Compressor Station

Panhandle Eastern Pipeline Co. owns and operates the Cashion Compressor Station, located in Kingfisher County, Oklahoma. In 2016, the facility reported emissions of 759 tons of NO_x, primarily from four natural gas fueled two-stroke lean-burn engines operated at the site. An analysis submitted by Panhandle Eastern considered potential control scenarios for these four engines. Due to the potential for technical difficulties in applying and operating control devices and technology on these engines, the analysis concluded that adding controls was infeasible. But more importantly, the analysis also documented that historical emissions of NO_x were reported using conservative factors of allowable, permitted horsepower rates for the engines. The reported emissions were not based on the Federal Energy Regulatory Commission (FERC)-limited horsepower, the permitted maximum operating hours allowed, or on portable emission analyzer (PEA) engine test data. Recent test data submitted with the four-factor analysis by Panhandle Eastern, along with documentation of the tests themselves in a follow-up response, demonstrate emissions are lower than those previously reported and included in emission inventories. Based on the engine testing data provided, NO_x emissions from these two engines will be no more than 200 TPY. Had the actual emissions data been used when selecting sources for four-factor analysis, this facility would have been excluded for small contribution.

6.4.2.7. DCP Operating – Chitwood Gas Plant

DCP Operating Co. owns and operates the Chitwood Gas Plant, located in Grady County, Oklahoma. In 2016, the facility emitted 833 tons of NO_x from various natural gas fueled engines on site. An analysis submitted by DCP considered three potential control technologies on eight engines: selective catalytic reduction (SCR), clean burn technology (CBT), and good combustion practices. DCP's full analysis can be found in Appendix E. Except for engines C-6 and C-7, all of the engines are two-stroke lean burn engines. To retrofit the engines with CBT would require both the addition of air-to-fuel ratio controllers as well as a turbocharger. DCP provided two separate CBT options, one that reduced emissions to 6g/hp-hr. (CBT (6g)) and one that reduced emissions to 1 g/hp-hr (CBT (1g)). SCR was deemed to only be technically feasible in conjunction with the CBT, which would help stabilize the outlet emissions and combustion. It is anticipated that the addition of SCR to CBT(6g) would have a similar emissions reduction as CBT(1g). Spacing limitations for the addition of SCR controls on these existing units may still make this option not technically feasible. DCP stated that good combustion practices are already in place at the Chitwood Gas Plant. The resulting costs ranged from $3,250 to $20,186 per ton of NO_x removed as shown in Table 6-4 below. At the suggestion of EPA, DEQ calculated the cost options at a lower interest rate (3.25%) than the rate used by DCP (7%). The lowest cost option was reduced to approximately $2,400 per ton of NO_x removed. Although the lower end of these costs might be considered reasonable under certain circumstances, the four-factor analysis also addressed the amount of uncertainty associated with the control costs, the feasibility of the retrofits, and the potential emission reductions. Based on this information, the company concluded that no control option was determined to be cost-effective. DEQ concurs that this is a reasonable conclusion. Engine C-5 has been out of service since 2006 and its operation will no longer be authorized in the permit upon issuance of Permit No. 2021-0456-TVR4. The permit application, with Engine C-5 removed, is currently under technical review by DEQ and will be issued as soon as practicable.

Table 6-4: Summary of Four-Factor Analyses

Facility name	**Unit(s)**	**Technically feasible control(s) analyzed**	**Cost of Compliance ($/ton)**	
Oxbow/Kremlin	Additional water for SO_2 controls supplied by:		City of Enid	Other
	Kiln 1	WFGD	$ 6,574	$ 12,707
		DFGD	$ 6,691	$ 12,764
		DSI	$ 13,477	$ 24,889
	Kiln 2	WFGD	$ 7,390	$ 14,311
		DFGD	$ 7,460	$ 13,804
		DSI	$ 14,99	$ 27,847
	Kiln 3	WFGD	$ 12,778	$ 22,082

		DFGD	$ 12,688	$ 20,926
		DSI	$ 25,049	$ 42,258
WFEC/Hugo	Unit 1	DFGD	$ 8,203	
		WFGD	$ 8,462	
		DSI	$ 41,003	
GRDA/Energy Center	Unit 2	Coal wash	$ 126,796	
		DSI	$ 21,187	
		SDA	$ 143,321	
		CDS	$ 176,851	
		WFGD	$ 140,109	
OG&E/Horseshoe Lake	Unit 6	LNB+OFA+FGR	$ 14,179	
		SNCR	$ 24,528	
		SCR	$ 26,873	
	Unit 7	SNCR	$ 36,107	
		LNB+OFA+FGR	$ $129,391	
	Unit 8	SCR	$ 21,537	
		SNCR	$ 36,066	
		LNB+OFA+FGR	$ 41,088	
	Unit 9	SCR	$ 110,920	
	Unit 10	SCR	$ 110,920	
Mustang/Binger	CM-2322	NSCR	$ 24.67	
	CM-2323	NSCR	$ 24.00	
DCP/Chitwood	C-1	CBT(6g)	$ 4,366	
		CBT(1g)	$ 3,442	
		CBT+SCR(1g)	$ 3,657	
	C-2	CBT(6g)	$ 4,366	
		CBT(1g)	$ 3,442	
		CBT+SCR(1g)	$ 3,657	
	C-3	CBT(6g)	$ 20,186	
		CBT(1g)	$ 15,917	
		CBT+SCR(1g)	$16,909	
	C-4	CBT(6g)	$ 5,407	
		CBT(1g)	$ 4,263	
		CBT+SCR(1g)	$4,529	
	C-6	CBT(6g)	$ 4,823	
		CBT(1g)	$ 3,250	
		CBT+SCR(1g)	$ 3,293	
	C-7	CBT(6g)	$ 4,823	
		CBT(1g)	$ 3,250	
		CBT+SCR(1g)	$ 3,293	
	C-8	CBT(6g)	$ 7,306	
		CBT(1g)	$ 5,813	
		CBT+SCR(1g)	$ 6,339	
	C-9	CBT(6g)	$ 7,306	
		CBT(1g)	$ 5,813	
		CBT+SCR(1g)	$ 6,339	

6.5. State consultation for sources identified with potential contribution

In addition to the 12 facilities within Oklahoma, DEQ identified 19 sources outside Oklahoma that are reasonably anticipated to contribute to visibility impairment at the Wichita Mountains Wilderness Area. DEQ consulted with Texas, Arkansas, Louisiana, and Nebraska for inclusion of sources in their analyses, which are documented in Appendix A. Table 6-5 summarizes the sources that DEQ requested each state to consider for further analysis and the outcome of any analysis provided by the state in which they are located.

Table 6-5: Out-of-state sources identified for potential impacts

State	Source	Category	Result
Arkansas	Entergy White Bluff	EGU	Will cease burning coal by December 31, 2028
	Entergy Independence	EGU	Will cease burning coal by 2030
Louisiana	Cleco Dolet Hills	EGU	Projected retirement by 2022
Nebraska	OPPD Nebraska City	EGU	Not known at this time**
Texas	Martin Lake EGU	EGU	Included in modeling*
	WA Parish EGU	EGU	Outside of AOI for Class I Area
	Limestone EGU	EGU	>$5,000/ton
	Welsh EGU	EGU	Included in modeling*
	Oklaunion EGU	EGU	Included in modeling*
	Oxbow Calcining	Coke calcining	No control identified
	Oak Grove EGU	EGU	>$5,000/ton
	Calaveras Plant	EGU	$Q/d < 5$
	Coleto Creek EGU	EGU	Included in modeling*
	San Miguel EGU	EGU	Included in modeling*
	AEP Pirkey EGU	EGU	Included in modeling*
	Streetman Plant	EGU	No control identified
	Twin Oaks	Mineral & Earth Manufacturing	$Q/d < 5$
	Works No. 4	Glass plant	Included in modeling*
	Dallas-Fort Worth International Airport	Airport	Outside state authority

*TCEQ conducted photochemical modeling to analyze potential visibility benefits from controls on sources selected for a four-factor analysis. Only controls at or below a $5,000/ton threshold were included in the modeling.

**Updates will be added when information becomes available.

As stated herein, member states of CenSARA, which includes Oklahoma and Texas, worked collectively on Planning Period 2 RH SIP development. DEQ consulted with TCEQ on April 2, 2020 and May 12, 2020 to discuss Texas's modeled impacts on the WMWA and TCEQ's source selection methodology. On July 17, 2020, DEQ sent a letter to TCEQ requesting Texas consider the fifteen sources listed in Table 6-5 for further analysis and to continue to consult with DEQ regarding any resulting analyses or measures at the above-listed sources. On August 11, 2020, DEQ and TCEQ held a web conference during which TCEQ communicated its planned recommendations for Texas's SIP. TCEQ's photochemical modeling projected minimal visibility benefits from potential controls on sources of interest. TCEQ concluded that further controls were not necessary to meet reasonable progress at affected Class I areas. Reasonable progress will be achieved during Planning Period 2, regardless of control implementation decisions made outside Oklahoma. Still, sources in Texas undeniably contribute greatly to visibility impairment at WMWA. DEQ will continue to monitor emissions from Texas and intends to analyze the Texas emission inventories for remedies in the subsequent planning periods.

6.6. Class I areas potentially impacted by Oklahoma sources

As mentioned previously, DEQ used the same source selection methodology to identify sources within Oklahoma that might affect the visibility of nearby Class I areas. In addition, some neighboring states with Class I areas also identified Oklahoma sources. Copies of correspondence with these states are included in Appendix A. Table 6-6 lists the Class I areas where sources in Oklahoma may reasonably be anticipated to contribute to visibility impairment, according to source selection of DEQ and air pollution control agencies in neighboring states.

Table 6-6: Sources in Oklahoma that may impact other Class I Areas

Class I Area Impacted	Source Name	Source Type	Result of consideration
Caney Creek	IP Valliant	Paper Mill	Emissions decreased*
	Buzzi Unichem Pryor	Cement Plant	Emissions decreased*
	GP Muskogee	Paper Mill	Emissions decreased*
	OG&E River Valley	EGU	Emissions decreased*
	Grand River Energy Center	EGU	four-factor analysis
	Western Farmers Hugo	EGU	four-factor analysis
Upper Buffalo	Western Farmers Hugo	EGU	four-factor analysis
	Grand River Energy Center	EGU	four-factor analysis
	Buzzi Unichem Pryor	Cement Plant	Emissions decreased*
Hercules-Glades	Grand River Energy Center	EGU	four-factor analysis
	Buzzi Unichem Pryor	Cement Plant	Emissions decreased*
	Western Farmers Hugo	EGU	four-factor analysis

*Substantial decreases in emissions have reduced potential impact on visibility at these Class I areas. Four-factor analysis is not necessary for this planning period.

6.6.1. Caney Creek – Arkansas

The Arkansas Division of Environmental Quality (ADEQ) identified two facilities in Oklahoma reasonably anticipated to impair visibility significantly at the Caney Creek Wilderness Area: OG&E Muskogee Generating Station and WFEC Hugo Generating Station. A four-factor analysis was performed by the Hugo Generating Station and can be found in Appendix E. No controls were found to be cost efficient enough to consider further. Muskogee Generating Station converted two coal-fired units to natural gas in response to Planning Period 1 after 2016, the year used for source analysis. Therefore, no further analysis was required of Muskogee Generating Station (further description can be found in Section 5). DEQ consulted with ADEQ and shared four-factor analyses as requested.

DEQ identified six sources with reasonable potential for impacting visibility at the Caney Creek Wilderness Area in Arkansas as shown in Table 6-6, one being the WFEC Hugo Generating Station that ADEQ also identified and was discussed above. A second source, GRDA's GREC already converted one of the coal-fired units to natural gas. A four-factor analysis was performed by GRDA on the remaining coal-fired unit and can be found in Appendix E. No controls were found to be cost efficient enough to consider further. The additional four sources were OG&E River Valley, Georgia Pacific Muskogee, IP Valliant, and Buzzi Unichem Pryor. Each of these sources have had emissions decreases since 2016 that were substantial enough to warrant foregoing additional analysis.

6.6.2. Upper Buffalo – Arkansas

ADEQ identified three facilities reasonably anticipated to impact visibility at the Upper Buffalo Wilderness Area: OG&E Muskogee Generating Station, WFEC Hugo Generating Station, and GRDA GREC. The WFEC Hugo Generating Station performed a four-factor analysis, which can be found in Appendix E. No controls were found to be cost efficient enough to consider further. The GRDA GREC also performed a four-factor analysis, which can be found in Appendix E. No controls were found to be cost efficient enough to consider further. OG&E Muskogee Generating Station added controls after 2016 pursuant to best available retrofit technology. Therefore, no further analysis was required of Muskogee Generating Station (further description can be found in Section 5). The additional source that Oklahoma identified, Buzzi Unichem Pryor, has had emissions decreases since 2016 that were substantial enough to warrant foregoing additional analysis. DEQ consulted with ADEQ and shared four-factor analyses as requested.

6.6.3. Hercules-Glades – Missouri

Missouri Department of Natural Resources (MDNR) identified two sources reasonably anticipated to impair visibility at the Hercules-Glades Class I area: OG&E Muskogee Generating Station and GRDA GREC. A four-factor analysis was performed by the GRDA and can be found in Appendix E. No controls were found to be cost efficient enough to consider further. After 2016, OG&E Muskogee Generating Station added controls pursuant to best available retrofit technology. Therefore, no further analysis was required of OG&E Muskogee Generating Station. Further description can be found in Section 5. Oklahoma identified two additional sources with possible impacts on Hercules-Glades as shown in Table 6-6. The WFEC Hugo Generating Station performed a four-factor analysis, which can be found in Appendix E. No controls were found to be cost efficient enough to consider further. Buzzi Unichem Pryor, has had emissions decreases since 2016 that were substantial enough to warrant foregoing additional analysis. DEQ consulted with MDNR and shared information and analyses as requested. MDNR did not request any further information.

6.6.4. Big Bend – Texas

The Texas Commission on Environmental Quality (TCEQ) did not communicate to DEQ that any sources in Oklahoma were reasonably anticipated to impair visibility at Big Bend National Park. DEQ also did not identify any sources in the state by the method DEQ described in section 6.2.1, that were reasonably anticipated to contribute to visibility impairment at Big Bend National Park.

6.6.5. Guadalupe Mountains – Texas

TCEQ did not communicate any sources in Oklahoma that were reasonably anticipated to contribute to visibility impairment at the Guadalupe Mountains. DEQ's method, described in section 6.2.1, also did not identify any sources in Oklahoma reasonably anticipated to contribute to visibility impairment at the Guadalupe Mountains.

6.7. Facility Closures and Unit Shutdowns

Emission reductions resulting from best available retrofit technology, other controls in the initial Oklahoma implementation plan for regional haze, and other factors since 2007 exceeded expectations for emission reductions and, along with other regulatory and market changes, resulted in the visibility improvement that occurred. OG&E's decision to fuel switch two units at its Muskogee Generating Facility from coal to natural gas and PSO's agreement to shut down two coal units (Unit 4 shut down in 2016; Unit 3 will step down capacity from 2021 until retirement in 2026) at its Northeastern Power Plant are only part of the reason for the immense improvement. As detailed heretofore, multiple Oklahoma facilities have made, or will soon make, major changes to their operations, resulting in considerable emission reductions. Some of the changes are reflected in the current data, whereas other changes will occur prior to the end of the second planning period and are included in 2028 projections and/or will affect future analyses.

Since 2016, the latest year available for CenSARA's area-of-influence analysis, multiple other closures and shutdowns have occurred. Big Brown and Monticello coal-fired power plants, located in Texas, were included when they were each emitting more than 20,000 tons of SO_2 per year but they later closed. Another Texas power plant, Sandow, shut down two of its coal-fired units. Each of these facilities were significant contributors to visibility impairment at the WMWA.

A combination of factors, including economic forces, will likely continue to drive the shifting away from coal as a fuel for electric generation. Whereas the number, distribution, and pace of additional EGU closures or fuel shifting are unpredictable, DEQ expects them to accelerate emission reductions that will continue to improve visibility at Class I areas.

In addition, facilities both large and small make decisions regarding shutdowns of older units as they become obsolete or as economic pressures make it untenable to continue operating the units. Some of these decisions are planned well in advance and some of these decisions are made on shorter notice. DEQ, therefore, is not always made aware of the changes until a permit modification is necessary. Since these shutdowns are not being enforced or required by DEQ, DEQ is not relying on them for its strategy per se but is noting that these developments have resulted in visibility improvements.

6.8. Control Scenarios

Where technically feasible control options were found to be available for the units analyzed as part of a four-factor analysis, the control options were determined to be cost prohibitive in most instances. As shown in Table 6-4 above, when costs were calculated, they were generally well over $5,000/ton of emissions reduced, especially for SO_2 sources. In evaluating the "cost of compliance" factors submitted by the owners/operators of the facilities which were selected for four-factor analyses, DEQ had difficulty finding sufficient clarity in the EPA guidance that would point to a particular cost threshold that would meet the needs of the Regional Haze program in Oklahoma. Because the emission units under evaluation are existing rather than new units, DEQ concluded that Best Available Control Technology (BACT) cost factors would be inappropriate. ODEQ's decision not to rely on BACT cost factors should in no way be interpreted as objecting to relying on control cost information from the RACT/BACT/LAER Clearinghouse to help inform a cost threshold when and where identified as appropriate.

6.8.1. NO_x Controls

DEQ looked to the Cross-State Air Pollution Rule (CSAPR) to inform the selection of an appropriate cost threshold for retrofit NO_x controls. The approach taken by EPA in setting allowance budgets under the CSAPR Update – the rule that sets allowance budgets for electricity generating units (EGUs) subject to the program in Oklahoma – is described in the following excerpt from the Final Rule published in the Federal Register (81 Fed. Reg. 74508, October 26, 2016).

> *The multi-factor test generates a* "*knee in the curve*" *at a point where emission budgets reflect a control stringency with an estimated marginal cost of $1,400 per ton. This level of stringency in emission budgets represents the level at which incremental EGU NO_x reduction potential and corresponding downwind ozone air quality improvements are maximized with respect to marginal cost. That is, the ratio of emission reductions to marginal cost and the ratio of ozone improvements to marginal cost are maximized relative to the other emission budget levels evaluated. The EPA finds that very cost-effective EGU NO_x reductions can make meaningful and timely improvements in downwind ozone air quality to address interstate ozone transport for the 2008 ozone NAAQS for the 2017 ozone season. Further, this evaluation shows that emission budgets reflecting the $1,400 per ton cost threshold do not overcontrol upwind states' emissions relative to either the downwind*

> *air quality problems to which they are linked or the 1 percent contribution threshold that triggered further evaluation. As a result, the EPA is finalizing EGU NO_x ozone season emission budgets developed using uniform control stringency represented by $1,400 per ton. The emission budgets that the EPA is finalizing in FIPs for the CSAPR Update rule are summarized in table I.B–1.*

DEQ is not selecting a $1,400 per ton NO_x cost-of-control threshold; rather, DEQ believes that a NO_x cost-of-control level in the range of $1,400 to $2,000 is consistent with the goals of the Regional Haze program. It should be noted that the appropriateness of using a CSAPR program to satisfy Regional Haze control requirements was affirmed by EPA in the "CSAPR is better than BART" proposed rulemaking. The following language from the summary of the proposed rule (76 Fed. Reg. 82219, December 30, 2011) explains the rationale.

> *The EPA is proposing revisions to rules that pertain to the regional haze program. In this action, the EPA is proposing that the trading program in the recently promulgated Transport Rule, also known as the Cross-State Air Pollution Rule, achieves greater reasonable progress towards the national goal of achieving natural visibility conditions in Class I areas than source-specific Best Available Retrofit Technology (BART) in those states covered by the Transport Rule.*

DEQ concludes that a NO_x cost-of-control threshold in the $1,400 to $2,000 per ton range is appropriate and reasonable. Only the two units at the Mustang Gas Binger Gas Plant were found to be within this range. One unit has already installed NSCR and Mustang Gas will install NSCR on the second unit upon EPA's approval of this SIP as stated in Section 6.2.4.3 above. Removal of engines at ONEOK Lindsay Booster Station and ONEOK Maysville Gas Plant precluded the need to determine cost-effectiveness or add controls. No other cost-effective NO_x controls are available for this implementation plan.

6.8.2. SO_2 Controls

Estimated SO_2 control costs calculated in the submitted four-factor analyses varied greatly but were all found to be in excess of $5,000/ton. DEQ notes that during CenSARA (and other regional planning group) discussions, as well as state-to-state consultations, $5,000/ton has been widely used as a reasonable threshold in evaluating SO_2 compliance costs for Regional Haze. There is no reason to assume that this cost threshold must increase at every subsequent Regional Haze planning period. Texas set this threshold to determine which sources would be included in photochemical modeling for visibility benefits of controls. Arkansas used a 98^{th} percentile approach from BART determinations to set an EGU boiler threshold at $5,086/ton (the highest of four unit-based thresholds set). Evaluating the thresholds used by neighboring states that affect Oklahoma or are affected by Oklahoma as a guidepost is a reasonable approach when setting a reasonable cost threshold.

Given these technical and cost considerations, DEQ affirms that the submitted analyses reached the reasonable conclusions, and this implementation plan revision does not impose a requirement to install further SO_2 controls on the 12 sources subject to the four-factor analysis requirement or on any other sources during this planning period. Nevertheless, EPA modeling projects further visibility improvement at the Wichita Mountains.

6.9. Long-term strategy

Exceptional progress from Planning Period 1 can be attributed to both BART subject units and existing rules implemented by DEQ. The success of Planning Period 1 and high cost of control options in the current planning period led DEQ to develop a long-term strategy (LTS) in the current planning period reliant on existing air program rules and regulations in addition to controls and enforceable shutdowns. In addition to ongoing air pollution control programs, DEQ has in place measures for smoke management and reducing impacts from construction activities.

The Regional Haze Program was developed with long-term goals and periodic updates to planning strategies. This allows for control measures to be implemented as technology improves and costs decline, for more effective emission reductions. In the case of SO_2, BART controls implemented in Planning Period 1 reduced emissions so greatly at a cost that continues to be the most effective use of resources. Future planning periods may see new technologies for SO_2 controls become more cost effective and should be evaluated for implementation at that time.

NO_x emissions have decreased, although not at the magnitude of SO_2 reductions, resulting in the visibility impairment contribution from NO_x being a greater percentage than previously. NO_x emissions are not as heavily attributable to single point sources like SO_2, but instead are spread among many smaller sources. Analyzing the impact of these sources will be key to future implementation periods, including the contribution from mobile sources in large metropolitan areas from which winter air masses flow. DEQ expects future attainment of NAAQS in the Midwest, along with any reduction in mobile source emissions, will greatly improve visibility conditions at the WMWA.

For Planning Period 2, DEQ incorporates into its long-term strategy the ongoing air pollution control programs, the Smoke Management Plan, and the construction regulations in OAC 252:100-29 as discussed below in Sections 6.9.1, 6.9.2, and 6.9.3, respectively. In addition, DEQ incorporates into its long-term strategy, the reductions documented in the four-factor analyses discussed in Section 6.4 above. See also Appendices E, F & G. Specifically, requirements and limitations associated with ONEOK's removal of seven engines and commitment to removing the remaining six before the end of Planning Period 2 (i.e., 12/31/2028) at the Maysville Gas Plant as agreed to in Regional Haze Agreement No. 22-085. The federally enforceable changes will reduce facility-wide NO_x emissions substantially. ONEOK reported 1,093 tons in 2016 and had already reduced NO_x emissions to 148 TPY in 2021. Further reductions will occur when the remaining engines are removed.

6.9.1. Ongoing air pollution control programs

2028 emission projections, used by DEQ to determine a reasonable progress goal, include expected reductions due to ongoing air pollution control programs. These programs include Oklahoma's major source and minor facility permitting program and enforcement program, which will ensure the changes and reductions mentioned for individual sources in Section 6.4 are captured in federally enforceable permits. In addition, implementation of federal emission and equipment standards such as the New Source Performance Standards, and other program elements designed to maintain the National Ambient Air Quality Standards (NAAQS) under Oklahoma's State Implementation Plan. A number of Oklahoma emission sources are subject to the federal Cross-State Air Pollution Rule (CSAPR), as well as other federal rules that reduce emissions by design or effect.

6.9.2. Smoke Management

Prescribed fire is an effective, low-cost land management tool essential to the restoration and perpetuation of native plant communities and the wildlife that inhabit them. Prescribed fire also helps decrease the severity of wildfires by reducing available fuel. In support of this practice, DEQ in coordination with the Oklahoma Department of Agriculture, Food, and Forestry (ODAFF) has adopted, and in 2021 updated, a smoke management plan to minimize air-quality effects of smoke from prescribed burning. The plan can be found at https://www.deq.ok.gov/air-quality-division/smoke-management/. DEQ considers the Smoke

Management Plan to be part of the long-term strategy for Regional Haze in compliance with 40 C.F.R. 51.308(f)(2)(iv)(D). See Appendix G for a copy of Oklahoma's Smoke Management Plan.

6.9.3. Construction Activities

DEQ implements OAC 252:100-29, Control of fugitive dust, to minimize air quality degradation from windblown dust. Regulated activities include construction activities that may stir fugitive dust that reasonably may impair visibility. DEQ considers the OAC 252:100-29, which is approved into Oklahoma's SIP, to be part of the long-term strategy for Regional Haze in compliance with 40 C.F.R. 51.308(f)(2)(iv)(B).

6.10. Modeling the long-term strategy

Photochemical modeling was conducted by EPA to project visibility impairment at Class I areas in 2028. The Western Regional Air Partnership (WRAP) contracted with Ramboll-Environ to conduct modeling for 2028 projections. The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) contracted with the Eastern Research Group (ERG) to conduct modeling for 2028 projections as well. Although DEQ did not provide control scenarios for the aforementioned modeling, the outputs for WMWA given in Table 6-7 nevertheless provide reasonable projections for analysis and URP comparison.

Table 6-7: LTS Modeling

Model sponsor	MIDs (dv)
EPA 2028 Model Projection	16.93
WRAP 2028 Model Projection	16.3
VISTAS 2028 Model Projection	18.10
2028 URP MIDs*	17.36
Average 2015-2019 MIDs	17.58

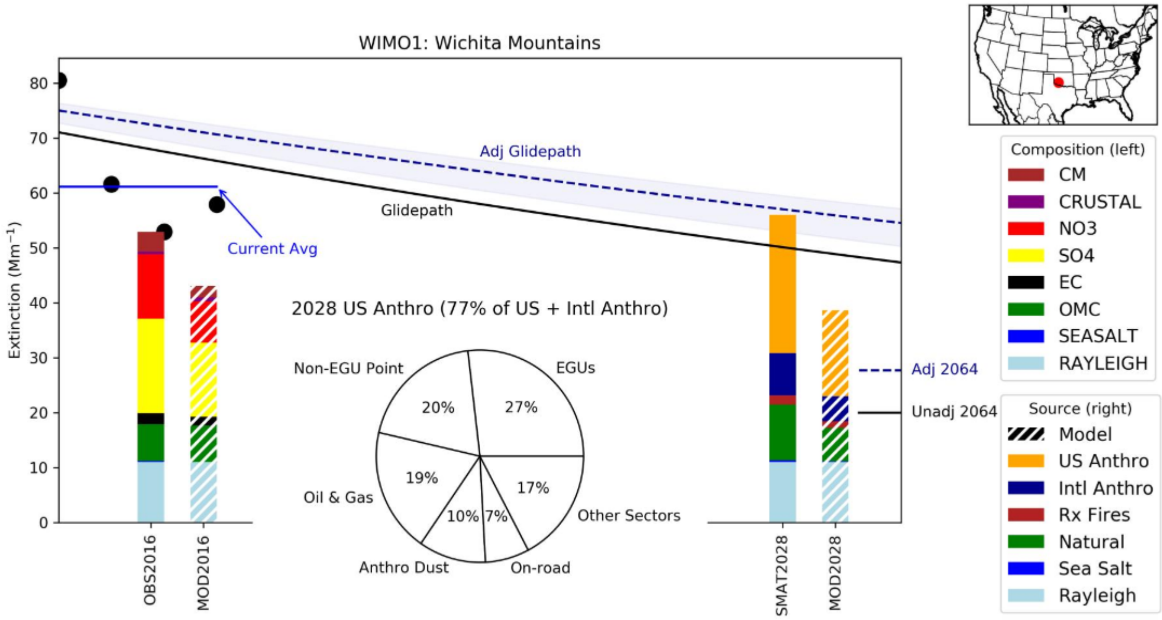
*Using adjusted natural conditions 2064 endpoint

The visibility impairment in the base period of 2014 to 2017 measured 8.39 deciviews in the 20% clearest days and 18.11 deciviews in the 20% most impaired days. These values compare to a modeled 8.14 deciviews in the 20% clearest days and 16.93 deciviews in the 20% most impaired days for 2028. The latter values define the reasonable progress goal for 2028.

The uniform rate of progress (URP) line, drawn from baseline conditions to natural conditions, provides a definitive illustration for the advanced progress Oklahoma has made and continues to make. On the 20% most impaired days, the official natural conditions are 6.92 deciviews. The projected 20% most impaired days in 2028 is modeled at 16.93 deciviews; the uniform rate of progress adjusted for contribution of fire and international emissions is 17.36 deciviews on the 20% most impaired days in 2028.

On the 20% worst days at the Wichita Mountains in 2028, the model assigns 0.14 Mm^{-1} to commercial marine sources on the high seas, 1.50 Mm^{-1} to Canadian anthropogenic sources, 3.77 Mm^{-1} to Mexican anthropogenic sources, and 2.30 Mm^{-1} to anthropogenic sources in other foreign countries. The maximum but not the default target for 2064 includes 1.63 Mm^{-1} for prescribed fires, derived from attribution in the default EPA model.

Figure 6-3: Visibility projections compared to URP Glidepath at the WMWA



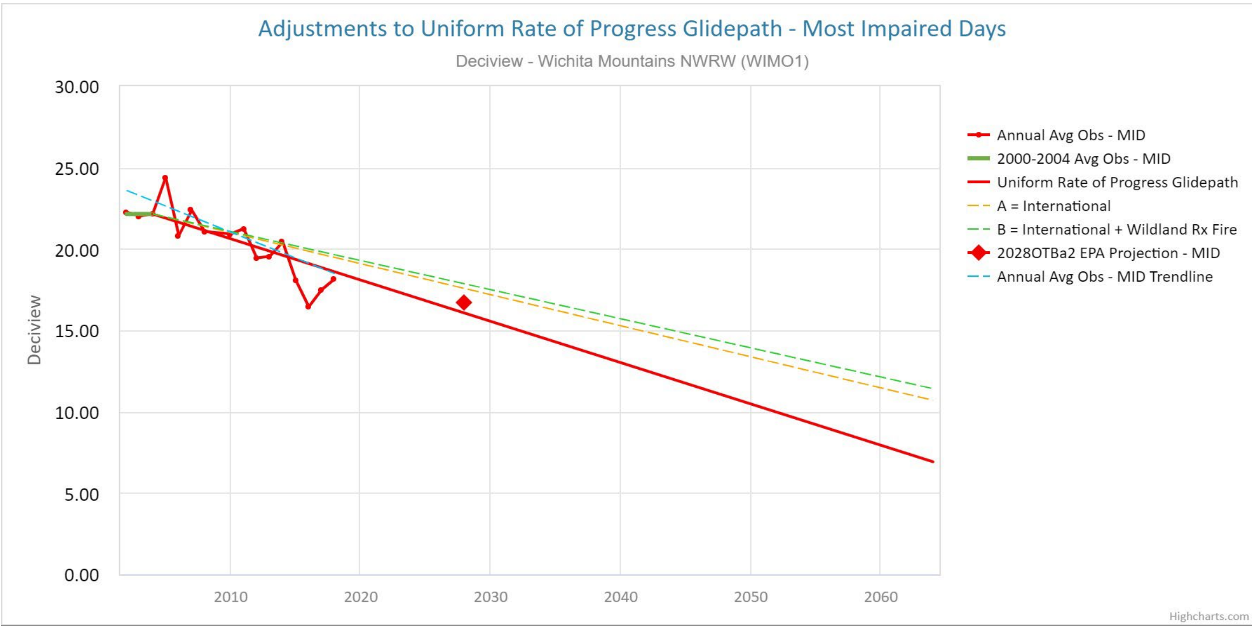
Courtesy: Environmental Protection Agency (technical support document for modeling)

The visibility at the Wichita Mountains met the established RPG for 2018 ahead of schedule. Additional emission reductions certainly occurred after the period in this monitoring report as installation of expected controls and additional shutdowns occurred. This improvement in visibility occurred despite a boom in the petroleum and natural gas industry; enormous increases in production enabled the United States of America to produce more petroleum and natural gas than it consumed for the first time in decades. Moreover, the population of Texas, the major contributing state, continues to increase with a consequent increase in automobile travel and energy consumption. In short, the monitored visibility improvement showcases the success of the air-pollution control programs in Texas, Oklahoma, and other nearby states.

6.11. Natural conditions target

Revisions to the RH Rule allow Oklahoma to modify the target visibility goal for 2064. This new target goal accounts for episodic fires and dust storms and emissions in foreign countries. The targets also use modeled estimates of international anthropogenic emissions, which originate outside the territorial jurisdiction of the United States. EPA calculated the target using five different methods of evaluating output from the same model and the technical support document provides the maximum, minimum, and default target for 2064. DEQ acknowledges these estimates and includes them in this implementation plan revision. Nevertheless, DEQ continues to reserve the right to calculate a better target, including a further refined estimate of natural conditions, in later implementation plan revisions.

Figure 6-4: Natural conditions adjustment and URP Glidepath(s)



Courtesy: Western Regional Air Partnership

7. Reasonable Progress Goal

DEQ determined a reasonable progress goal for this planning period, ending in 2028, of 16.93 deciviews on the 20% most impaired days is appropriate, which represents a further improvement in visibility. This goal equates with EPA's projection for 2028 in its modeling for regional haze. After adjusting for visibility impairment contributions from international emissions and wildland fires, using EPA's default adjustment scenario, this reasonable progress goal for the 20% most impaired days is 0.43 deciviews less than 17.36 deciviews, the visibility factor under the uniform rate of progress for 2028 under the default assumptions of EPA. EPA also provides alternative glidepath targets for 2028 between 16.62 deciviews and 17.79 deciviews, depending on the treatment of modeled international emissions, fires, and dust storms.

Table 7-1: Reasonable Progress Goals vs. Baseline, Planning Period, and Natural Conditions

Metric	Clearest 20% days (dv)	Most impaired 20% days (dv)
Baseline	9.92	22.18
2015-2019	8.65	17.58
2028 Reasonable Progress Goal	8.14	16.93
Natural Conditions	4.20	10.19*

*Adjusted for wildland fire and international contribution. EPA's modeling assessment produced a range of natural condition for the MIDs: 8.33 dv minimum, 10.19 dv default, and 11.27 dv maximum. DEQ has selected the default adjustment for characterizing MID natural conditions at the WMWA.

Given the amount of progress toward natural conditions at the WMWA, the four-factor analyses results, the time left in the implementation of Planning Period 2, and expectation for further emission reductions due to turnover of aging infrastructure, DEQ considers 16.93 dv to be a reasonable goal for visibility in 2028 at the WMWA.

8. Consultation process during SIP development

DEQ is a member of the Central States Air Resources Agencies (CenSARA) alongside its sister air pollution control agencies of Texas, Louisiana, Arkansas, Missouri, Kansas, Nebraska, and Iowa. CenSARA hosted monthly conference calls with representatives of member states, regional tribes, EPA, FLMs, and other multijurisdictional organizations (MJOs) from 2019 through 2022. DEQ participated in this process as part of ongoing consultation between states and federal partners as documented in Appendix A.

8.1. Direct State-to-State Consultation

As discussed in section 6.5 and 6.6, DEQ separately consulted directly with Texas, Arkansas, Missouri, Louisiana, and Nebraska regarding any sources in those states identified with potential contributions to visibility impairment at WMWA, and any Oklahoma sources identified with potential contributions to visibility impairment to Class I areas in those states. Details of the consultation process are documented in Appendix A.

8.2. Federal land manager consultation

In addition to the CenSARA conference calls, DEQ also invited federal land managers from the Fish and Wildlife Service (FWS), National Park Service (NPS), and U.S. Department of Agriculture Forest Service (FS) to participate in conference calls specifically outlining DEQ's planning and progress for addressing regional haze at the WMWA and other Class I areas discussed herein.

On September 30, 2021, draft copies of the Oklahoma Planning Period 2 RH SIP were emailed to FWS, NPS, and FS for the start of the official consultation period required by 40 C.F.R. § 51.308(i)(2). The FLMs were asked to send any comments by November 30, 2021. The consultation period occurred more than 60 days before the public comment period as required by 40 C.F.R. § 51.308(i)(2). A virtual meeting was held with the FWS, NPS, and FS on November 22, 2021, to discuss their comments on the draft. On November 30, 2021, Oklahoma received an emailed letter from FS that included their comments (Appendix H). In accordance with 40 C.F.R. § 51.308(i)(3), formal responses to the comments are included in Appendix H and noted changes have been incorporated into the Oklahoma Planning Period 2 RH SIP where appropriate.

8.3. Tribal consultation

Throughout the development of the Oklahoma Planning Period 2 RH SIP, certain Oklahoma tribes have been invited to participate and have participated in monthly conference calls with CenSARA states to discuss the development of the SIP. Additionally, at the time of the FLM comment period discussed in section 8.2 above, Oklahoma tribes were sent a letter from the Oklahoma Department of Environmental Quality and the Oklahoma Secretary of Energy and Environment with notice of the opportunity to comment on the proposed SIP along with a hardcopy of the proposed SIP. Comments were requested by November 30, 2021, so they could be addressed along with any comments received from the FLMs or EPA prior to the full public review period. No comments were received. Tribal partners will have an additional opportunity to comment on the Oklahoma Planning Period 2 RH SIP during the Public Review period.

8.4. U.S. Environmental Protection Agency

DEQ also engaged in conversations with EPA Region 6 throughout the development of the draft RH SIP. The same draft the FLMs and Tribal Partners received was shared with EPA. EPA supplied comments on the draft SIP on November 30, 2021. EPA's comments can be found in Appendix I. Oklahoma does not agree with all of the comments made by EPA, however, the draft RH SIP has been revised, when and where appropriate, to address these comments.

8.5. Public Review and Comments

DEQ will provide notice of this proposal and a public hearing to receive comments on this proposed SIP revision. The notice of the proposal and the details of the public hearing will be published on DEQ's website and notifications will be sent via GovDelivery to those persons who have requested public notice opportunities. The notice will provide logistical information regarding the public hearing and the length of the public comment period. The public comment period for this SIP revision will be at least thirty days, in accordance with notice requirements under 40 C.F.R. § 51.102.