Appendix 10-2: Estimating Visibility Impacts From Additional Point Source Controls

In order to determine reasonable progress goals for the state of Texas, the TCEQ needed to quantify the visibility benefit of the potentially reasonable set of point source controls that are described in Appendix 10-1. The TCEQ used CENRAP's modeling of additional point source controls as the basis of this estimate.

The CENRAP developed its set of potentially reasonable point source controls and used CMAQ to estimate the visibility benefit of those controls. The TCEQ and CENRAP used the same AirControlNet to develop their control sets. The CENRAP controls extended across all the CENRAP states, not just Texas. CENRAP also assumed a higher cost per ton as potentially reasonable. Table 1 compares the CENRAP control set to the Texas control set. Table 1 shows the annual cost per ton in constant 2005 dollars which define "potentially reasonable point source controls."
The costs are annualized and standardized on 2005 dollars. (Note that under the Texas control scenario only additional controls in Texas are assumed.)

Table 1: Comparison of CENRAP and Texas Control Sets

	CENRAP	Texas
NO_x (tpy) reduction	181,107	27,132
SO_2 (tpy) reduction	725,025	155,873
Total Cost	$2,236,000,000	$324,300,000

Table 2: Projected Visibility Benefit from CENRAP Control Set

Class I Area	2018 (dv)	2018c (dv)	Improvement (dv)
Big Bend	16.63	16.38	0.26
Breton Isle	22.67	17.80	0.46
Caney Creek	22.47	21.46	1.01
Carlsbad Caverns	16.30	16.04	0.26
Guadalupe Mtns	16.30	16.04	0.26
Salt Creek	17.04	16.88	0.15
Upper Buffalo	22.52	21.60	0.91
Wheeler Peak	10.23	10.18	0.05
White Mtn	12.96	12.70	0.26
Wichita Mtns	21.51	20.76	0.75

The projections in Table 2 (and subsequent tables) assume that there will be no change in the coarse mass and soil components of visibility between the base year and 2018.

Table 2 shows visibility impacts under two scenarios. One scenario assumed only "on-the-books" control strategies would be in place by 2018. These results are labeled simply 2018. The other scenario included on-the-books controls plus the CENRAP potentially reasonable control strategy. These results are labeled 2018c.

The Class I areas in Table 2 are of significant interest to Texas. The TCEQ staff used these model results as a framework for estimating the visibility benefits of the potentially reasonable control set developed by the TCEQ.

The CENRAP modeling derived relative response factors (RRF) specific to particular pollutants and Class I areas as per step 3 of section 6.4 of the EPA's "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze" (EPA 2007a). These RRF's were multiplied by the measured 2000 through 2004 concentrations at these Class I areas over the 20 percent worst visibility days to estimate concentrations projected for 2018 over said days, as per step 4 of EPA 2007a.

The TCEQ interpolated the RRFs for sulfate and nitrate calculated from the 2018 and 2018c scenarios for each Class I area to generate the expected RRF's that would be obtained if the Texas potentially reasonable control strategy (2018TXc) were selected. Since the emissions differences between the 2018 and 2018c scenarios involve differences over all of CENRAP while the changes in emissions between the 2018 and 2018TXc scenarios involve only changes within Texas, the TCEQ used the results of the PSAT modeling to obtain Class I area specific interpolation coefficients in order to better apportion the expected impacts. An outline of the procedure used is presented in Appendix 10-4, followed by a more general and rigorous mathematical derivation for those interested. A spreadsheet with all the computations is provided as Appendix 10-5. The resulting projected RRFs (shown in Table 3), and corresponding concentrations, of sulfate and nitrate are between those of the 2018 and 2018c scenarios, as would be expected.[1]

Table 3: RRFs Using the Projected 2018 Impacts with the Texas Control Set on Select Class I Areas

Class I Area	Base g RRF for Sulfate	TXc RRF for Sulfate	Base gc RRF for Sulfate	Base g RRF for Nitrate	TXc RRF for Nitrate	Base gc RRF for Nitrate
Big Bend (BIBE)	0.875	0.847	0.832	1.126	1.111	1.088
Guadalupe Mtnts (GUMO)	0.764	0.706	0.699	1.003	0.997	0.987
Wichita Mts (WIMO)	0.709	0.658	0.616	0.814	0.798	0.758
Salt Creek (SACR)	0.800	0.741	0.744	0.917	0.923	0.931
White Mtn (WHIT)	0.809	0.732	0.729	0.987	0.983	0.975

These daily future year species concentrations are then used in steps 5 through 6 of section 6.4 of EPA 2007a to yield the projected visibility metrics, like mean concentrations, extinction, and haze index (in deciviews) for the most impaired days. A comparison of projected mean sulfate and nitrate concentrations over the most impaired days corresponding to the different RRF's at select Class I areas is presented in Table 4, including the projected impacts if the Texas control scenario (2018TXc) had been modeled.

[1] SACR saw a slight increase in modeled nitrate impact with the additional CENRAP potentially reasonable point source controls. This increase is likely due to the decrease of sulfate competing with the nitrate for the available ammonia.

Table 4: Projected Mean Sulfate and Nitrate Concentrations on Select Class I Areas, for Most Impaired Days, Including Projected Concentrations if Texas Controls Had Been Modeled

Class I Area	2018 Sulfate ($\mu g/m^3$)	2018TXc Sulfate ($\mu g/m^3$)	2018c Sulfate ($\mu g/m^3$)	2018 Nitrate ($\mu g/m^3$)	2018TXc Nitrate ($\mu g/m^3$)	2018c Nitrate ($\mu g/m^3$)
Big Bend (BIBE)	4.55	4.40	4.32	0.525	0.518	0.507
Guadalupe Mtnts (GUMO)	2.28	2.11	2.09	0.657	0.653	0.646
Wichita Mts (WIMO)	4.32	4.01	3.75	2.212	2.170	2.060
Salt Creek (SACR)	2.59	2.39	2.40	1.686	1.698	1.713
White Mtn (WHIT)	1.79	1.62	1.62	0.588	0.586	0.581

The daily future year species concentrations are then used in steps 5 through 6 of section 6.4 of EPA 2007a, using the new IMPROVE Equation, to calculate the projected visibility impact. The use of the new IMPROVE Equation is described in Chapter 4 of the Modeling Technical Support Document contained in Appendix 8-1 of this Regional Haze SIP. A spreadsheet is presented in Appendix 10-6 that shows the calculations of the RRF interpolations all the way through application of the RRFs to obtain the visibility metrics (mean concentrations, extinctions, and haze indices over the most impaired days).

Table 5 shows the estimated impact of the Texas control strategy on the Class I areas of significant interest to Texas.

Table 5: Modeled Visibility Benefit from the Texas Control Set

Class I Area	2018 (dv)	2018 TXc (dv)	Improvement (dv)
Big Bend	16.63	16.47	0.16
Breton Isle	22.67	22.62	0.05
Caney Creek	22.47	22.14	0.33
Carlsbad Caverns	16.30	16.08	0.22
Guadalupe Mtns	16.30	16.08	0.22
Salt Creek	17.04	16.86	0.18
Upper Buffalo	22.52	22.35	0.16
Wheeler Peak	10.23	10.18	0.04
White Mtn	12.96	12.72	0.24
Wichita Mtns	21.51	21.15	0.36

Texas 2018 projections assume that there would be no change in the coarse mass and soil components of visibility between the base year and 2018. The TCEQ finds that this is a reasonable assumption for Big Bend and Guadalupe Mountains. The agency has not determined if it is a reasonable assumption for the other Class I areas shown. However, for consistency, TCEQ is presenting the Texas 2018 projections for those areas.