# Appendix J
# Supplemental Control Strategies Modeling

**Photochemical Modeling for Austin's Early Action Compact:
Analysis of Emission Control Strategies for Ozone Precursors**

Submitted to

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## Executive Summary

Austin has prepared an Early Action Compact (EAC) for submission to the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (U.S. EPA). The objectives of this report are to document the relative effectiveness of reductions of anthropogenic emissions of nitrogen oxides (NOx) and volatile organic compounds (VOC), the effectiveness of emission control strategies for ozone precursors, and the impacts of regional transport on air quality in the Austin area. These studies were conducted using the September 13-20, 1999 CAMx modeling episode with 2007 projected emissions. Relative reduction factors and future 8-hour ozone design values for Continuous Air Monitoring Stations (CAMS) in Austin are calculated for each emission control scenario in accordance with the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999) and the U.S. EPA's *Protocol for Early Action Compacts* (2003).

Comprehensive discussions of the Base Case model development are provided in "Development of the September 13-20, 1999 Base Case Photochemical Model for Austin's Early Action Compact", submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004. Model performance has been evaluated using statistical and graphical metrics for both 1-hour and 8-hour averaged ozone concentrations. The September 13-20, 1999 CAMx photochemical model meets or exceeds established U.S. EPA performance criteria for attainment demonstrations.

Projected 2007 emission inventories were developed for the modeling domain and used with the identical meteorological data and CAMx configuration developed for the Base Case to model the Future Case. Comprehensive discussions of the Future Case model development are provided in "Photochemical Modeling for Austin's Early Action Compact: Development of the September 13-20, 1999 Photochemical Model with 2007 Projected Emissions and Analysis of Future 8-Hour Ozone Design Values", submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004. Modeling based on Austin's predicted 2007 emission inventory indicates that the area will be on the cusp of attainment or non-attainment with the National Ambient Air Quality Standard for 8-hour averaged ozone concentrations.

Emission control strategies have been evaluated that will provide the Austin area with a margin of safety for attaining the standard. Control strategies that were assessed by the Austin area in March 2004 and proposed for implementation to the TCEQ and U.S. EPA, included a vehicle inspection and maintenance program, voluntary NOx reductions at local power plants beyond those already required by Senate Bill 7, implementation of the Texas Emissions Reduction Program (TERP), a commute program, VOC controls on area sources, transportation emission reduction measures (TERMS), and idling restrictions on heavy-duty diesel engines. Comments on Austin's proposed Clean Air Action Plan were received from the U.S. EPA on August 30, 2004. Based on these comments, Austin modified the magnitude of the emissions reductions for I/M, heavy duty vehicle idling

restrictions, low emissions gas cans, and degreasing emissions control scenarios and conducted a new photochemical modeling simulation in September 2004. The results of that simulation were very similar to the results with the original control package proposed in March 2004. An additional modeling simulation was run in October with all the previous adjustments made to the September modeling run, but with the daily emission reductions for local power plants removed. Although local generating facilities have committed to making annual emission reductions, enforceable commitments for daily emission rates are not currently included in the plan; thus, not included in the final modeling demonstration. Most importantly, even without any additional control strategies, the results indicate that the area will be in attainment in 2007. The results presented in this report indicate that all of the emission control scenarios under consideration will facilitate Austin’s progress toward maintaining attainment with the 8-hour NAAQS and reducing population exposure to ozone.

# TABLE OF CONTENTS

**Page**

**TABLES**

**Page**

**FIGURES**

## 1. Background

In accordance with the U.S. EPA's *Protocol for Early Action Compacts* (2003), the Capital Area Planning Council (CAPCO), which coordinates air quality planning activities in the five-county Austin area, submitted preliminary documentation of the development of the September 13-20, 1999 Base Case and 2007 Future Case to the TCEQ and the U.S. EPA in November 2003 and December 2003, respectively, and final documentation in March 2004. The Austin area demonstrated that the model achieves performance criteria established by the U.S. EPA. Modeling based on Austin's predicted 2007 emission inventory indicates that the area will be on the cusp of attainment or non-attainment with the National Ambient Air Quality Standard for 8-hour averaged ozone concentrations.

Comments on Austin's proposed Clean Air Action Plan were received from the U.S. EPA on August 30, 2004. Based on these comments, Austin modified the magnitude of the emissions reductions for I/M, heavy duty vehicle idling restrictions, low emissions gas cans, and degreasing emissions control scenarios and conducted a new photochemical modeling simulation in September 2004. The results of this simulation are very similar to the results with the original control package proposed in March 2004. An additional modeling run was completed in October without the daily emission reductions for AER local power plants due to the enforceable reduction commitments being applicable only to annual emissions. Most importantly, even without any additional control strategies, the results indicate that the area will be in attainment in 2007. The results presented in this report indicate that all of the emission control scenarios under consideration will facilitate Austin's progress toward maintaining attainment with the 8-hour NAAQS and reducing population exposure to ozone.

The objectives of this report are to document the relative effectiveness of anthropogenic NOx or VOC emission reductions, the effectiveness of emission control strategies for ozone precursors, and the impacts of regional transport on air quality in the Austin area. These studies were conducted using the September 13-20, 1999 CAMx modeling episode with 2007 projected emissions. The assessment of emission controls is based on the methodology prescribed by the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999) and the U.S. EPA's *Protocol for Early Action Compacts* (2003). In accordance with this guidance, relative reduction factors and future 8-hour ozone design values for Continuous Air Monitoring Stations (CAMS) in Austin are calculated for each emission control scenario, and the effectiveness of each scenario is evaluated by comparing with results of the Future Case.

### *1.1 The September 13-20, 1999 Base Case and 2007 Future Case CAMx Models*

The area has utilized resources from the State of Texas' Near Non-attainment Areas Program to develop a conceptual model of meteorological conditions during high ozone events in Central Texas. The conceptual model was used to select the September 13-20, 1999 multi-day high ozone episode for development with the Comprehensive Air Quality Model with Extensions (CAMx) photochemical grid model. The September 13-20, 1999 modeling episode fulfills both the requirements of the U.S. EPA's *Draft Guidance on the*

*Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999) and the U.S. EPA's *Protocol for Early Action Compacts* (2003) that require representation of meteorological regimes typical of ozone exceedances. The episode covers one synoptic cycle for ozone in Austin with two initialization days and six high ozone days. It includes two weekend days (September 18$^{th}$ and 19$^{th}$), such that control strategies can be evaluated with different emission characteristics.

The model domain is a nested regional/urban scale 36-km/12-km/4-km grid. The area has conducted extensive refinements and analyses of the MM5 version 3.5 meteorological model configuration, emission inventories, boundary and initial conditions, and dry deposition algorithms, since initiating development of the photochemical model in 2001. In accordance with U.S. EPA guidance, MOBILE6.2-based inventories for 1999 and 2007 on-road mobile source emissions have been developed for the Austin metropolitan area. Emissions for non-road mobile sources for both years were developed using the U.S. EPA's NONROAD2002a model. Emissions from non-road mobile sources, stationary sources, and area sources have been estimated for Austin and other urban areas in the 4-km domain, using local activity data and projections when available. Comprehensive discussions of the model development are provided in "Development of the September 13-20, 1999 Base Case Photochemical Model for Austin's Early Action Compact", submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency in March 2004, and "Photochemical Modeling for Austin's Early Action Compact: Development of the September 13-20, 1999 Photochemical Model with 2007 Projected Emissions and Analysis of Future 8-Hour Ozone Design Values", submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency in March 2004.

Model performance has been evaluated using statistical and graphical metrics for both 1-hour and 8-hour averaged ozone concentrations. The September 13-20, 1999 CAMx photochemical modeling episode meets or exceeds established U.S. EPA performance criteria for attainment demonstrations. Modeling based on Austin's predicted 2007 emission inventory indicates that the area will be on the cusp of attainment or non-attainment with the National Ambient Air Quality Standard for 8-hour averaged ozone concentrations. Although the Austin area is currently in attainment with the 8-hour NAAQS based on ambient data collected from 2001 through 2003, in recognition of the results for the modeled Future Case, the Austin area has evaluated emission control strategies that will provide the area with a margin of safety for attaining the standard in the future.

### *1.2 Assessment of Emission Control Strategies for Ozone Precursors*

The following report describes studies of the relative effectiveness of anthropogenic NOx or VOC emission reductions, the effectiveness of emission control strategies for ozone precursors, and the impacts of regional transport on air quality in the Austin area using the September 13-20, 1999 CAMx modeling episode with 2007 projected emissions. The remainder of the report is subdivided into the following sections:

| Section No. | Description |
|---|---|
| 2. | Model preparation for emission reduction scenarios |
| 3. | Precursor response studies of the relative effectiveness of anthropogenic NOx or VOC emission reductions in the Austin area and the impacts of regional transport on air quality in the Austin area |
| 4. | Relative reduction factors and future design values for emission control scenarios in the Austin area |
| 5. | References |

## 2. Model Preparation for Emission Reduction Scenarios

The model configuration, meteorological fields, boundary and initial conditions, dry deposition algorithms, chemical mechanisms, and biogenic emission inventories remained the same between the September 13-20, 2007 Future Case CAMx modeling episode and the emission reduction scenario modeling. The only differences between the simulations are the reductions made to the 2007 projected anthropogenic emission inventory for each scenario described below.

Austin's 2007 emission inventory, which is the foundation for evaluating the control strategies, is documented in a separate report (CAPCO, 2003) in accordance with EAC reporting requirements. The discussion below summarizes each emission reduction scenario evaluated by the Austin area and describes how the emission reductions associated with each scenario were implemented and processed for CAMx.

### *2.1 Precursor Response Studies*

The objectives of the precursor response studies are to examine the relative sensitivity of maximum predicted daily ozone concentrations in the five-county Austin area and maximum predicted daily ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS38 at Audubon) to reductions in anthropogenic NOx or VOC emissions. The precursor response studies were conducted by reducing all anthropogenic emissions of NOx or VOCs in the emission inventory files for the September 13-20, 2007 Future Case across the five-county Austin area. Because all anthropogenic emissions are targeted and not specific source categories, the results provide a quantitative indication of whether air quality in the area is predicted to be more responsive to reductions in NOx emissions or VOC emissions. Table 1 shows a matrix of eight precursor response simulations conducted for the study. The University of Texas at Austin developed the Fortran 90 software to apply the emission reductions to CAMx-ready emission files. The software is publicly available from UT upon request. Results of the precursor response studies are described in Chapter 3.

### *2.2 Regional Transport Studies*

In order to evaluate the impacts of regional transport on air quality in the Austin area, eleven modeling simulations were conducted in which anthropogenic emissions in each of the eight ozone non-attainment and near non-attainment areas in eastern Texas and in the states of Texas, Louisiana, and Missouri, respectively, were eliminated or 'zeroed'. The non-attainment areas included Houston/Galveston, Beaumont/Port Arthur, and Dallas/Fort Worth. The near non-attainment areas included Austin, Victoria, San Antonio, Corpus Christi, and Tyler/Longview/Marshall. In each 'zero-out' run, anthropogenic emissions of VOCs, $NO_x$, and carbon monoxide (CO) were eliminated from a non-attainment or near non-attainment area, referred to as the source area, and the impacts were then evaluated in the Austin area. Three additional 'zero-out' modeling runs were conducted to evaluate the impacts of transport from sources within Texas (i.e., zero-out of all anthropogenic emissions in Texas) and from sources in Louisiana and

Missouri (i.e., zero-out of all anthropogenic sources in Louisiana and Missouri, respectively).

The University of Texas at Austin developed the Fortran 90 software to apply the emission reductions to CAMx-ready emission files. The software is publicly available from UT upon request. Results, presented in Chapter 3, were analyzed in the form of:

1. Maximum predicted daily 1-hour and 8-hour ozone concentrations, respectively, for the projected 2007 Future Case and Zero-Out Case in the Austin area.
2. Maximum predicted difference in 1-hour and 8-hour ozone concentrations, respectively, between the projected Future Case and Zero-Out Case in the Austin area.

### *2.3 Emission Control Strategy Development*

Five basic emission control programs were considered for Austin's Early Action Compact. Descriptions of these programs along with their associated reductions and source categories are presented in Table 2. Implementation approaches for each emission control program are summarized in Table 3.

The Austin area then evaluated various packages of the five basic programs described in Table 2 by applying the appropriate emission reductions to the 2007 Future Case inventory. Emission reductions for each package were accomplished using the Emission Preprocessor System v.2.0 (EPS2) cntlem module to apply control factors to Austin's 2007 Future Case inventory. These control factor files are available from UT upon request. Results for the following packages are presented in this report:

1. I&M programs in Travis and Williamson Counties only
2. Projected voluntary point source daily emissions reductions in the Austin area
3. Area source VOC reductions in the Austin area
4. TERP implementation in the Austin area
5. All controls excluding low RVP gasoline and I&M in Hays County
6. All controls excluding low RVP gasoline and I&M in Hays County and with Alcoa emissions reduced from 26.7 tpd to 4.44 tpd
7. <u>All controls excluding low RVP gasoline, I&M in Hays County, and commute program reductions</u>
8. All controls excluding low RVP gasoline and I&M in all counties
9. Repeat of control package 7 above using modified emission reductions proposed by the TCEQ and the U.S. EPA in September 2004 for I/M, heavy duty vehicle idling restrictions, low emissions gas cans, and degreasing controls. Modifications were only made with respect to the magnitude of emission reductions for these categories, as shown in Table 2, and did not affect their spatial and temporal distributions.
10. Repeat of control package 9 but removing the daily NOx emission reductions for Austin area power plants.

Reductions of ozone precursor emissions for each package are summarized in Table 4. The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA is underlined. An additional sensitivity test was conducted with point source VOC emissions doubled relative to the 2007 Future Case inventory in the Austin area in order to examine the benefits of emission offsets for New Source Review.

Relative reduction factors and future design values were calculated for each scenario as described in Chapter 4. Tile plots showing differences in maximum predicted daily 8-hour average ozone concentrations between the 2007 future case with no local controls applied and with emission control scenarios under evaluation by the Austin MSA are shown in Appendix A.

**Table 1. Matrix of precursor response simulations conducted with the September 13-20, 2007 Future Case CAMx modeling episode for the Austin area.**

| **Ozone Precursor** | **Anthropogenic Emission Reduction in the Five-County Austin Area (%)** | | | |
|---|---|---|---|---|
| | **15%** | **25%** | **50%** | **75%** |
| NOx | X | X | X | X |
| VOC | X | X | X | X |

**Table 2. Emission reduction programs for ozone precursors considered by the five-county Austin area.***

| Emission Control Scenario | Description | NOx Reduction (tpd) | VOC Reduction (tpd) |
|---|---|---|---|
| **Inspection & Maintenance Program (I&M)** | All gasoline vehicles 2 to 24 years old registered and operated in Travis and Williamson Counties will undergo annual emissions inspection testing at safety inspection stations. Hays County opted out of the I&M program. The OBDII testing program will be used to test 1996 model-year and newer vehicles. The Two-Speed Idle test will be used to test 1995 and older vehicles. On-road remote sensing equipment will be used to identify high-emitting vehicles in Travis and Williamson counties or those commuting from contiguous counties. A passing inspection test or waiver is required to renew vehicle registration or receive a safety inspection sticker. | 2.89<br><br>****3.22 (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** | 3.84<br><br>****3.83 (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** |
| **Stationary Point Sources** | Voluntary reductions of NOx emissions beyond those required by SB7 from local power plants including Austin Energy, Lower Colorado River Authority, University of Texas at Austin. These reductions of daily emissions have been projected by the power companies as a result of improved efficiency in operating parameters. These reductions were not included in the final control case modeling because emissions reductions commitments by power companies were only applicable to annual emission rates. | 7.08 | None |
| **Area Source VOC Controls and Low Reid Vapor Pressure Gasoline** | This group of programs focuses on VOC controls only with no accompanying NOx reductions. Measures in this package include:<br>1. Low emission gas cans: measure to lower emissions of VOCs in the Austin MSA from portable fuel containers that spill, leak, and/or allow permeation (2.60 tpd VOC reduction). **(**0.89 tpd VOC reduction, Sept 2004)**<br>2. Stage I vapor recovery: measure requires additional gas stations and fuel dispensing facilities in the MSA to comply with TCEQ Stage I Vapor Recovery rules by lowering exemption threshold defined in rules from 125,000 | None<br><br>****None (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** | 17.81<br><br>****15.26 (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** |

| | | | |
|---|---|---|---|
| | gallons a month to 25,000 gallons a month (4.88 tpd VOC reduction).<br>3. Degreasing controls: measure regulates degreasing operations by revising TCEQ rules to apply to Austin MSA (6.39 tpd VOC reduction). **(**5.55 tpd VOC reduction, Sept 2004)**<br>4. Autobody refinishing: measure regulates autobody refinishing operations by revising TCEQ rules to apply to Austin MSA (0.05 tpd VOC reduction).<br>5. Cut Back Asphalt: measure restricts use of cut-back asphalt in the Austin MSA through a TCEQ rule revision. (1.03 tpd VOC reduction).<br>6. Low RVP Gasoline: measure lowers gasoline RVP requirement from 7.8 to 7.0 in all MSA counties from May 1 to October 31 (2.87 tpd VOC reduction). | | |
| **Texas Emission Reduction Program (TERP)** | HB 1365 designates five-county Austin MSA as eligible for participation in TERP. TERP is a voluntary program available to public and private fleet operators that operate qualifying equipment. The objective of the program is to provide grants to eligible projects in "affected counties" to offset the incremental cost associated with activities to reduce emissions of NOx from high-emitting mobile diesel sources. | 2.00 | None |
| **Additional Mobile Source Control Measures** | 1. TERMS: Transportation projects designed to reduce vehicle use, improve traffic flow or reduce congestion in various locations in the Austin MSA (0.828 tpd VOC reduction; 0.719 tpd NOx reduction).<br>2. Commute Program: measure requires every existing or future employer with 200 or more employees per location to submit a detailed plan to TCEQ or local designee that demonstrates how the employer will reduce the equivalent of their NOx and VOC commute related emissions by 10% (0.27 tpd NOx reduction; 0.30 tpd VOC reduction).<br>3. Heavy Duty Vehicle Idling Restrictions: measure restricts engine idling of vehicles with a gross vehicle rating of more than 14,000 pounds to five consecutive minutes throughout the Austin MSA (0.19 tpd NOx reduction.) | 1.18<br><br>****1.66 (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** | 1.13<br><br>****1.13 (Sept 2004 revision in accordance with guidance by the TCEQ and the U.S. EPA)** |

| | | | |
|---|---|---|---|
| | **(**0.67 tpd NOx reduction Sept 2004 revision)** | | |

*Total NOx and VOC Reductions are shown for Monday, September 20th 2007.
****The revised emissions reductions were used for control package 9, described above, conducted in September 2004. This simulation is a replicate of the original control package 7 with the modified emissions reductions given in Table 2 above.**

**Table 3. Implementation approaches for emission control programs under consideration by the five-county Austin area.***

| Emission Control Scenario | Counties | Sources/SCCs | NOx Reduction (tpd) | VOC Reduction (tpd) |
|---|---|---|---|---|
| **Inspection & Maintenance Program (I&M)** | Travis and Williamson<br>Hays County opted out of the I&M program) | LDGV<br>LDGT | 2.89<br>****3.22 (Sept 2004 revision)** | 3.84<br>****3.83 (Sept 2004 revision)** |
| [1]**Stationary Point Sources** | Selected power plants in Austin MSA | Austin Energy, Lower Colorado River Authority, University of Texas at Austin. | 7.08 | None |
| **Area Source VOC Controls and Low Reid Vapor Pressure Gasoline in the Five-County Austin MSA** | | | None<br>****None (Sept 2004 revision)** | 17.81<br>****15.26 (Sept 2004 Revision)** |
| Low Emission Gas Cans (Commercial) | Five-county MSA | 2260004016<br>2260004021<br>2260004026<br>2260004031<br>2260004071<br>2265004011<br>2265004016<br>2265004026<br>2265004031<br>2265004041<br>2265004046<br>2265004051<br>2265004056<br>2265004066<br>2265004071<br>2265004076<br>2267004066<br>2270004031<br>2270004046<br>2270004056<br>2270004066<br>2270004071<br>2270004076 | 0.00 | 0.63<br>****0.26 (Sept 2004 revision)** |
| Low Emission Gas Cans (Residential) | Five-county MSA | 2265004010 | 0.00<br>****0.00** | 1.97<br>****0.63** |

[1] Power plant reductions of daily emissions have been projected by the power companies as a result of improved efficiency in operating parameters. These reductions ware not included in the final control case modeling because emissions reductions commitments by power companies were only applicable to annual emission rates.

| | | | | |
|---|---|---|---|---|
| | | | **(Sept 2004 revision)** | **(Sept 2004 revision)** |
| Low RVP Gasoline | Five-county MSA | All nonroad and all on-road mobile sources | 0.00 | 0.17 (nonroad)<br><br>2.70 (on-road) |
| Stage I Vapor Recovery | Five-county MSA | 2501060053 | 0.00 | 4.88 |
| Degreasing Controls | Five-county MSA | 2415300000<br>2415360000<br>2415355000<br>2415330000<br>2415320000<br>2415305000<br>2415325000<br>2415340000<br>2415345000<br>2415365000<br>2415310000<br>2415335000 | 0.00<br>****0.00 (Sept 2004 revision)** | 6.39<br>****5.55 (Sept 2004 revision)** |
| Autobody Refinishing | Five-county MSA | 2401070000<br>2401001025<br>2401005000 | 0.00 | 0.05 |
| Cutback Asphalt | Five-county MSA | 2461020000 | 0.00 | 1.03 |
| **TERP** | Five-county MSA | All Nonroad and on-road mobile HDDV sources | 0.87 (non-road)<br><br>1.13 (on-road) | 0.00 |
| **Additional Mobile Source Control Measures** | Five-county MSA | TERMS: All on-road mobile<br><br>Idling: HDDV and HDGV<br><br>Commute: LDGV, LDGT, LDDV, LDDT, MC | TERMS: 0.72<br><br>Idling: 0.19<br>****0.67 (Sept 2004 revision)**<br><br>Commute: 0.27 | TERMS: 0.83<br><br>Idling: None<br>****None (Sept 2004 revision)**<br><br>Commute: 0.30 |

*Total NOx and VOC Reductions are shown for Monday, September 20th 2007.
****The revised emissions reductions were used for control package 9, described above, conducted in September 2004. This simulation is a replicate of the original control package 7 with the modified emissions reductions given in Table 2 above.**

**Table 4. Packages of the five basic emission control programs described in Table 2 that were evaluated by the Austin area using the 2007 Future Case.* The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA in the Clean Air Action Plan is shown underlined.**

| Emission Control Package | NOx Reduction (tpd) | VOC Reduction (tpd) |
|---|---|---|
| Inspection & Maintenance Program (I&M) in Travis and Williamson Counties only | 2.89 | 3.84 |
| Voluntary Point Source Reductions in the Austin area | 7.08 | None |
| Area Source VOC Controls and Low Reid Vapor Pressure Gasoline | None | 17.81 |
| Texas Emission Reduction Program (TERP) | 2.00 | None |
| All controls listed in Table 2 excluding low RVP Gasoline and I&M in Hays County | 13.15 | 19.91 |
| All controls listed in Table 2 excluding low RVP Gasoline and I&M in Hays County and with Alcoa Emissions reduced from 26.7 tpd to 4.44 tpd | 35.37 | 19.91 |
| All controls listed in Table 2 excluding low RVP Gasoline and I&M in Hays County, and commute program reductions | 12.88 | 19.61 |
| All controls listed in Table 2 excluding low RVP Gasoline and I&M in all counties | 10.26 | 16.07 |
| **All controls listed in Table 2 excluding low RVP Gasoline and I&M in Hays County, and commute program reductions (September 2004 revision)** | 13.69 | 17.05 |
| **All controls listed in Table 2 excluding low RVP Gasoline and I&M in Hays County, commute program reductions, and daily power plant emission reductions (October 2004 revision)** | 6.61 | 17.05 |

*Total NOx and VOC Reductions are shown for Monday, September 20th 2007.

## 3. Precursor Response Studies of the Relative Effectiveness of Anthropogenic NOx or VOC Emission Reductions in the Austin Area and the Impacts of Regional Transport on Air Quality in the Austin Area

Precursor response studies provided a quantitative indication of whether the Austin area may be more responsive to reductions in NOx emissions or VOC emissions. The results became the foundation for studies of specific emission control programs discussed in the next chapter. This chapter of the report includes the results of both the precursor response and regional transport studies. Analyzing these results simultaneously rather than independently provided a more comprehensive perspective of the types of controls (i.e., NOx or VOC) and the relative importance of local versus regional controls on air quality in the Austin area.

Daily results of the precursor response studies conducted for the Austin area are shown in Figures 1-6. Results for the model initialization days were not included in the analysis. It is important that the reader note variations in scales on the plot for September 20 relative to the rest of the episode days. This was done intentionally to account for higher peak predicted 8-hour ozone concentrations on September 20.

Regardless of prevailing meteorological conditions and the magnitude of ozone precursor emissions, reductions of anthropogenic NOx emissions were predicted to be more effective than VOC reductions for reducing both area-wide peak 8-hour ozone concentrations and peak 8-hour daily ozone concentrations near the Austin monitors during this episode. These results suggested that although there are predicted to be air quality benefits from reducing anthropogenic VOC concentrations in the Austin area, emission control strategies that included NOx reductions would be important components of Austin's air quality plan.

It appeared, however, that the effectiveness of local NOx emissions reductions, while clearly beneficial for air quality in the Austin area, could level off under certain conditions. On three episode days, Friday, September 17, Saturday, September 18 and Sunday, September 19, differences between area-wide peak predicted 8-hour ozone concentrations from a 50% reduction in anthropogenic NOx emissions and a 75% reduction in anthropogenic NOx emissions were less than 0.1 ppb. Although this trend was not observed in grid cells near Austin's monitors during the episode, which are used in the modeled attainment test, it was, nonetheless, important to consider these results with the overall perspective of air quality planning in the Austin area.

Regional transport studies lent preliminary evidence for the hypothesis that high regional background concentrations on some episode days were predicted to limit the effectiveness of local NOx reductions for reducing area-wide peak 8-hour ozone concentrations. Air quality impacts in the Austin area of zeroing emissions in each of the non-attainment and near non-attainment areas and in Texas, Louisiana, and Missouri, respectively are summarized in Table 5. Tile plots showing differences in maximum predicted daily 8-hour average ozone concentrations between the 2007 future case with no local controls applied and with each zero-out simulation are presented in a separate report "Analysis of the Impacts of Regional Transport on Air Quality in the Austin and Victoria Areas using the September 13-20, 1999 Photochemical Modeling Episode with 2007 Projected Emissions", to be submitted by The University of Texas at Austin to the Capital Area Planning Council, the City of Victoria, and the Texas Commission on Environmental Quality in April 2004.

Results of the regional transport studies actually showed that on all episode days except for September 20, maximum predicted daily 8-hour ozone concentrations from a 75% reduction in anthropogenic NOx emissions in the five-county Austin area were nearly identical to maximum daily 8-hour ozone concentrations when all anthropogenic emissions in the five-county area were eliminated ('zero-out Austin'). On two episode days, September 18 and September 19, maximum predicted daily 8-hour ozone concentrations from a 50% reduction in anthropogenic NOx emissions in the five-county Austin area were nearly identical to maximum daily 8-hour ozone concentrations when all anthropogenic emissions in the five-county area were eliminated. Thus, eliminating both anthropogenic NOx and VOC emissions in the Austin area on most episode days, except September 20, provided little additional benefit for reducing area-wide peak 8-hour ozone concentrations beyond reductions of NOx emissions alone by 50%-75%. Ozone formation during this particular episode, which is a nearly ideal example of the typical multi-day high ozone event described in the conceptual model for the Austin area, is predicted to be NOx-limited.

The notable difference on September 20 relative to the other episode days was the predominance of southwesterly flow and minimal transport of air from the continental United States and southeastern Texas into the Austin area, which can be observed in the 32-hour back trajectories for the episode shown in Figure 7. Ozone concentrations averaged over 8-hours at Austin's Audubon monitor did not exceed 70 ppb; area-wide peak predicted 8-hour ozone concentrations and peak predicted 8-hour ozone concentrations at Austin's Murchison monitor were in close agreement. Local reductions of NOx emissions on this day were markedly more effective than on other episode days The difference in area-wide peak 8-hour ozone concentrations in the Austin area between the future case and Austin zero-out simulation was 18 ppb (88 ppb-70 ppb shown in Table 5), which was 10 ppb greater than on any other episode day. Similarly, the maximum difference in 8-hour ozone concentrations between the two cases within the Austin area was 29 ppb, which was 5 ppb greater than on any other episode day.

The Texas and Louisiana zero-out simulations provided striking examples of the potential importance of regional emission controls for improving air quality in Austin. Peak area-wide 8-hour ozone concentrations in Austin decreased by as much as 33 ppb and 4 ppb, as a result of eliminating anthropogenic emissions in eastern Texas and Louisiana, respectively. The average area-wide maximum 8-hour ozone concentration in the Austin area after all Texas sources were removed was 57.5 ppb, while the average difference between the area-wide maximum 8-hour ozone concentrations from the Texas zero-out simulation and the 2007 Future Case was 23.3 ppb. The average difference between the area-wide maximum 8-hour ozone concentrations from the Louisiana zero-out simulation and the 2007 Future Case in the Austin area was 2.5 ppb, which was greater than that from any near non-attainment or non-attainment area in Texas. This value for Missouri was 0.7 ppb, which was also greater than that from any near non-attainment or non-attainment area in Texas except Houston. Although these studies applied unrealistic levels of controls on anthropogenic emission sources and results should not be viewed as an absolute indication of the magnitude of ozone reductions in the region, they suggested the value of examining both local and regional approaches for improving air quality.

**Figure 1. Maximum predicted 8-hour ozone concentrations on September 15 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS25 at Audubon).**

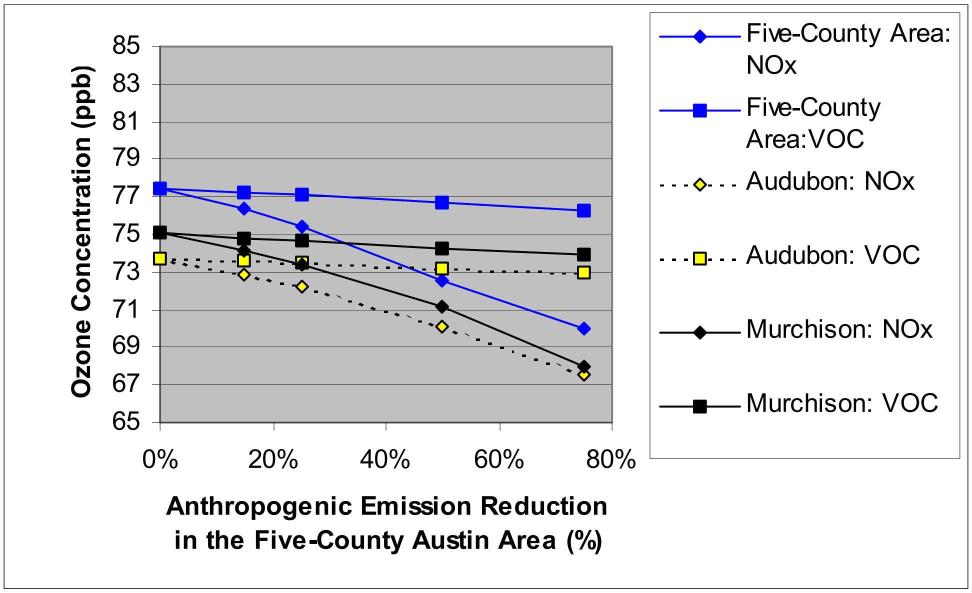


**Figure 2. Maximum predicted 8-hour ozone concentrations on September 16 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS25 at Audubon).**

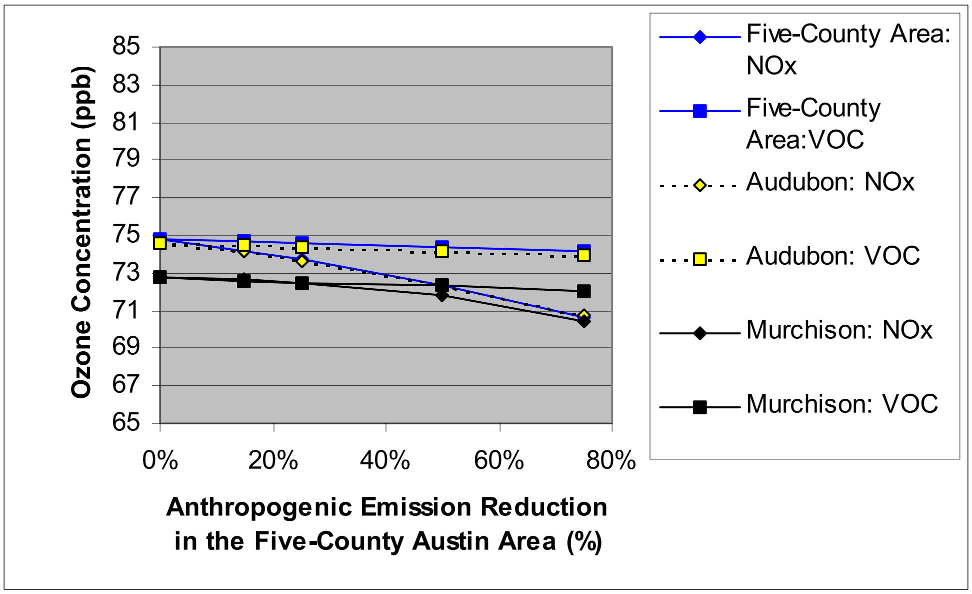


**Figure 3. Maximum predicted 8-hour ozone concentrations on September 17 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS25 at Audubon).**

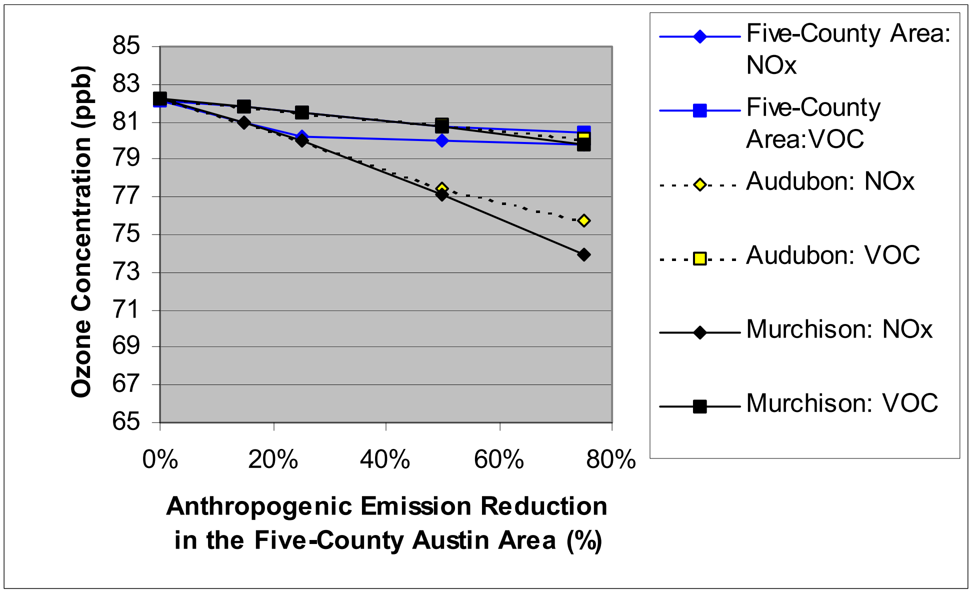


**Figure 4. Maximum predicted 8-hour ozone concentrations on September 18 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS25 at Audubon).**

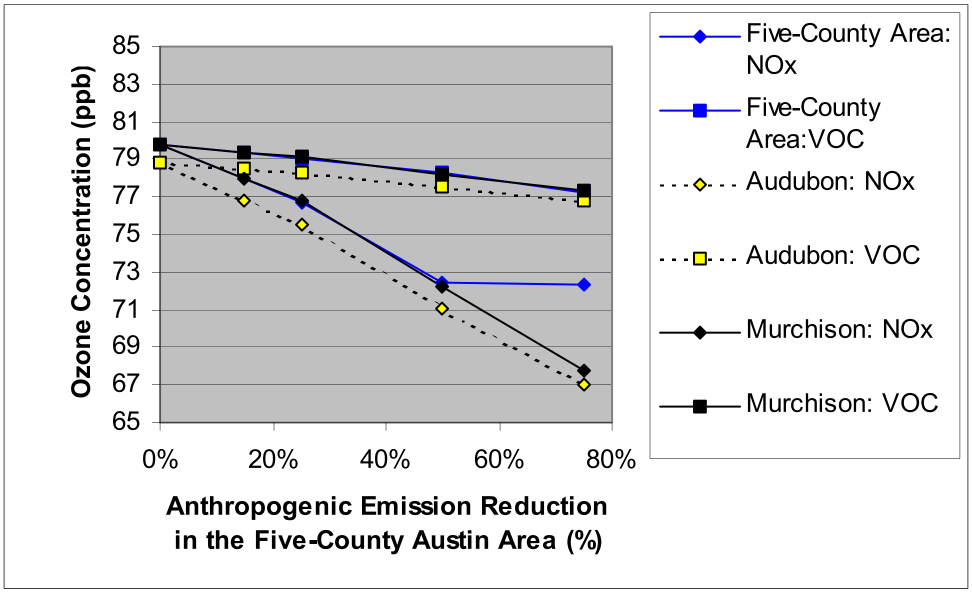


**Figure 5. Maximum predicted 8-hour ozone concentrations on September 19 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's two Continuous Air Monitoring Stations (i.e., CAMS3 at Murchison Middle School and CAMS25 at Audubon).**

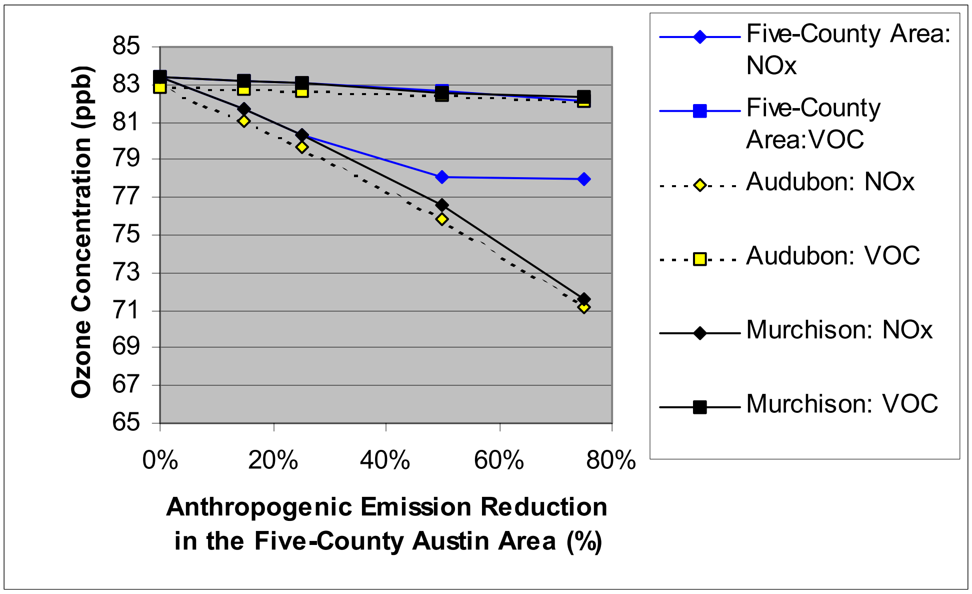


**Figure 6. Maximum predicted 8-hour ozone concentrations on September 20 as function of anthropogenic NOx or VOC emissions reductions in the five-county Austin area. Results are shown for the maximum predicted daily 8-hour ozone concentrations in the five-county Austin area and the maximum predicted daily 8-hour ozone concentrations in 7x7 grids around Austin's CAMS3 monitor at Murchison Middle School. Maximum predicted ozone concentrations at Austin's CAMS25 at Audubon did not exceed 70 ppb on September 20.**

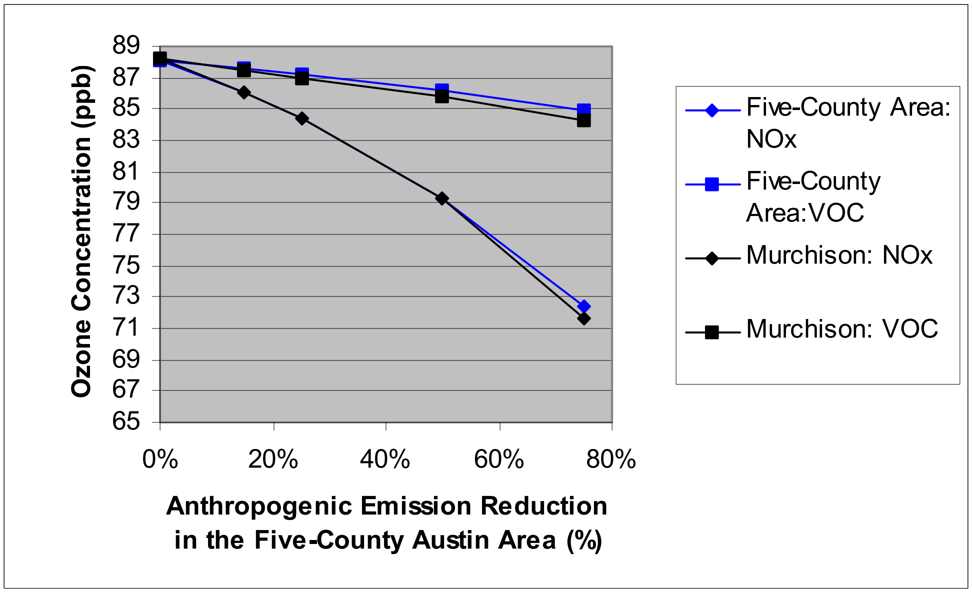


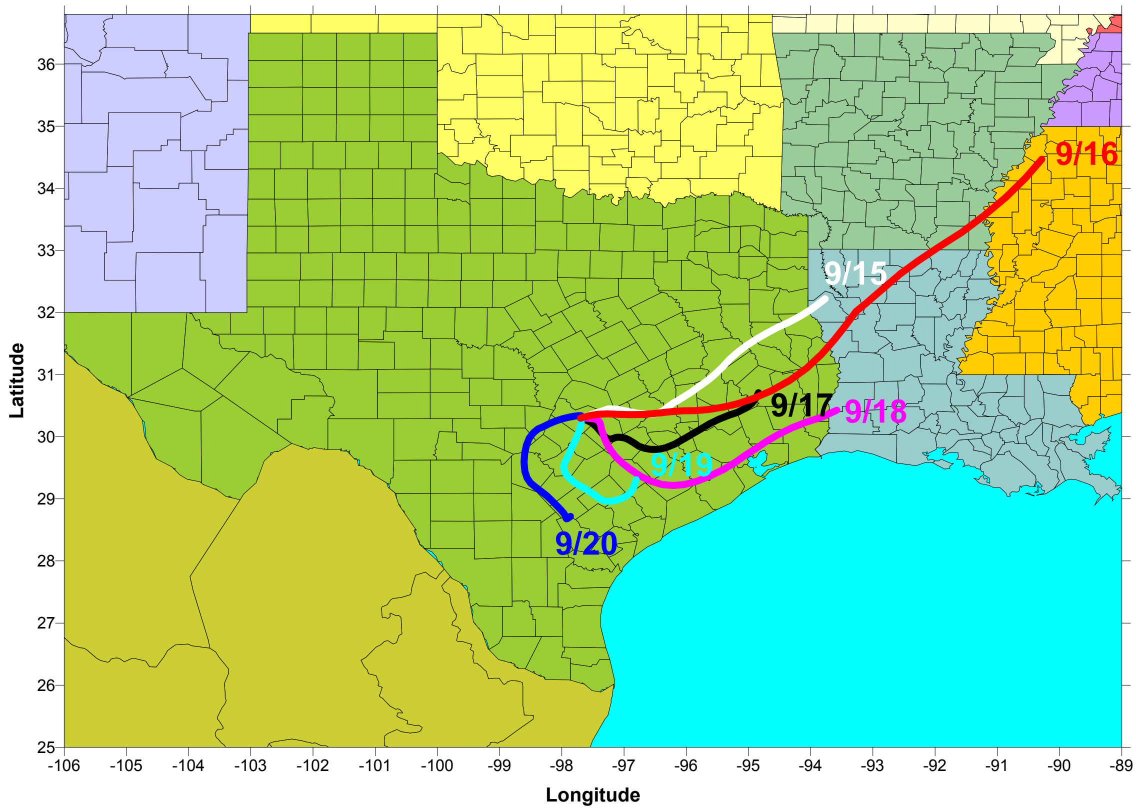
**Table 5a. Impacts of eliminating ('zeroing') anthropogenic emissions in non-attainment and near non-attainment areas in eastern Texas on air quality in the Austin area. Peak predicted 8-hour ozone concentrations from the Future Case ('Initial') and the zero-out simulation ('Zero') are shown, as well as the maximum difference in 8-hour ozone concentrations ('MaxD') between the two cases within the five-county Austin area.**

| | | Zero-out Austin | | | Zero-out San Antonio | | | Zero-out Victoria | | | Zero-out Corpus Christi | | | Zero-out Houston | | | Zero-out Beaumont | | | Zero-out Dallas | | | Zero-out Tyler | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Day** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** |
| 1-hr avg. $O_3$ Conc. (ppb) | 070915 | 88 | 78 | 26 | 88 | 88 | 1 | 88 | 88 | 0 | 88 | 88 | 0 | 88 | 88 | 1 | 88 | 88 | 0 | 88 | 88 | 0 | 88 | 88 | 11 |
| | 070916 | 78 | 74 | 16 | 78 | 78 | 0 | 78 | 78 | 0 | 78 | 78 | 0 | 78 | 78 | 13 | 78 | 78 | 2 | 78 | 78 | 0 | 78 | 78 | 10 |
| | 070917 | 94 | 87 | 31 | 94 | 94 | 2 | 94 | 94 | 0 | 94 | 94 | 0 | 94 | 93 | 17 | 94 | 93 | 2 | 94 | 94 | 1 | 94 | 94 | 7 |
| | 070918 | 92 | 89 | 37 | 92 | 92 | 3 | 92 | 92 | 0 | 92 | 92 | 0 | 92 | 91 | 16 | 92 | 92 | 2 | 92 | 92 | 0 | 92 | 92 | 1 |
| | 070919 | 97 | 86 | 32 | 97 | 96 | 20 | 97 | 97 | 10 | 97 | 97 | 0 | 97 | 93 | 18 | 97 | 97 | 2 | 97 | 97 | 0 | 97 | 97 | 0 |
| | 070920 | 95 | 77 | 36 | 95 | 95 | 11 | 95 | 95 | 8 | 95 | 95 | 5 | 95 | 94 | 6 | 95 | 95 | 2 | 95 | 95 | 5 | 95 | 95 | 1 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8-hr avg. $O_3$ Conc. (ppb) | 070915 | 77 | 70 | 16 | 77 | 77 | 0 | 77 | 77 | 0 | 77 | 77 | 0 | 77 | 77 | 0 | 77 | 77 | 0 | 77 | 77 | 0 | 77 | 77 | 6 |
| | 070916 | 75 | 70 | 13 | 75 | 75 | 0 | 75 | 75 | 0 | 75 | 75 | 0 | 75 | 75 | 9 | 75 | 75 | 2 | 75 | 75 | 0 | 75 | 75 | 6 |
| | 070917 | 82 | 79 | 22 | 82 | 82 | 1 | 82 | 82 | 0 | 82 | 82 | 0 | 82 | 82 | 12 | 82 | 82 | 2 | 82 | 82 | 1 | 82 | 82 | 6 |
| | 070918 | 80 | 72 | 24 | 80 | 80 | 2 | 80 | 80 | 1 | 80 | 80 | 0 | 80 | 79 | 15 | 80 | 80 | 2 | 80 | 80 | 0 | 80 | 79 | 1 |
| | 070919 | 83 | 78 | 19 | 83 | 83 | 14 | 83 | 83 | 4 | 83 | 83 | 2 | 83 | 79 | 15 | 83 | 83 | 2 | 83 | 83 | 0 | 83 | 83 | 0 |
| | 070920 | 88 | 70 | 29 | 88 | 88 | 7 | 88 | 88 | 4 | 88 | 88 | 4 | 88 | 87 | 5 | 88 | 88 | 2 | 88 | 88 | 1 | 88 | 88 | 0 |

**Table 5b. Impacts of eliminating ('zeroing') anthropogenic emissions in eastern Texas, Louisiana, and Missouri, respectively, on air quality in the Austin area. Peak predicted 8-hour ozone concentrations from the Future Case ('Initial') and the zero-out simulation ('Zero') are shown, as well as the maximum difference in 8-hour ozone concentrations ('MaxD') between the two cases within the five-county Austin area.**

| | | Zero-Out Texas | | | Zero-Out Louisiana | | | Zero-Out Missouri | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Day** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** | **Initial** | **Zero** | **MaxD** |
| 1-hr avg. $O_3$ Conc. (ppb) | 070915 | 88 | 61 | 32 | 88 | 84 | 9 | 88 | 87 | 2 |
| | 070916 | 78 | 58 | 21 | 78 | 76 | 9 | 78 | 77 | 3 |
| | 070917 | 94 | 64 | 39 | 94 | 90 | 9 | 94 | 92 | 3 |
| | 070918 | 92 | 60 | 43 | 92 | 91 | 8 | 92 | 91 | 2 |
| | 070919 | 97 | 61 | 44 | 97 | 95 | 5 | 97 | 97 | 1 |
| | 070920 | 95 | 57 | 45 | 95 | 94 | 2 | 95 | 95 | 1 |
| | | | | | | | | | | |
| 8-hr avg. $O_3$ Conc. (ppb) | 070915 | 77 | 59 | 21 | 77 | 73 | 7 | 77 | 77 | 2 |
| | 070916 | 75 | 56 | 19 | 75 | 73 | 8 | 75 | 74 | 3 |
| | 070917 | 82 | 61 | 28 | 82 | 78 | 8 | 82 | 80 | 3 |
| | 070918 | 80 | 57 | 30 | 80 | 78 | 7 | 80 | 79 | 1 |
| | 070919 | 83 | 57 | 30 | 83 | 81 | 4 | 83 | 83 | 1 |
| | 070920 | 88 | 55 | 39 | 88 | 87 | 2 | 88 | 88 | 0 |

**Figure 7. 32-Hour Back-Trajectories for September 15, 1999 through September 20, 1999**



## 4. Relative Reduction Factors and Future Design Values for Emission Control Scenarios in the Austin Area

The *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS, U.S. EPA Office of Air Quality Planning and Standards, EPA-454/R-99-004, May 1999* describes a methodology for conducting an attainment test under the 8-hour ozone NAAQS. The methodology is dependent upon three critical elements:

1. Current design values (DV)
2. Relative reduction factors (RRFs)
3. Future design values (DV).

The methodology used to calculate relative reduction factors for Austin's 2007 Future Case model and emission control scenario evaluation is based on a protocol and software developed by ENVIRON. The implementation protocol submitted by ENVIRON has received approval from U.S. EPA's Office of Air Quality Planning and Standards. The protocol along with current design values for the Austin area are discussed in "Photochemical Modeling for Austin's Early Action Compact: Development of the September 13-20, 1999 Photochemical Model with 2007 Projected Emissions and Analysis of Future 8-Hour Ozone Design Values, submitted by The Capital Area Planning Council to the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency, March 2004". Portions of that discussion are repeated below for the sake of clarity.

### *4.1 Methodology*

In accordance with U.S. EPA guidance, future design values for an area are determined by scaling base-year design values by relative reduction factors. The calculation is carried out for each monitor. In addition, a screening calculation is also carried out to identify grid cells with consistently high ozone and estimate scaled DVs for these screening cells. Screening cells were not identified from Austin's 2007 Future Case model. The attainment test is passed if all the future year scaled DVs are less than 85 ppb.

Relative reduction factors and future design values are calculated according to the following methodology for cells associated with monitor sites:

1. Find the daily maximum 8-hour ozone in an *n* x *n* block of cells (n =7 for a 4-km grid in accordance with U.S. EPA guidance) around each monitor for both the Base Case and Future Case. Repeat for each modeling day.
2. Exclude days when the Base Case daily maximum 8-hour ozone was below 70 ppb.
3. Average the daily maximum 8-hour ozone across days for the Base Case and Future Case, respectively.
4. Calculate the relative reduction factor:
$$\text{RRF} = \frac{\text{average Future Case daily maximum ozone concentration}}{\text{average Base Case daily maximum ozone concentration}}$$
5. Calculate the predicted future design value
Future DV = Current year DV x RRF.

6. Repeat 1-5 for each monitor

Austin had two CAMS stations in operation during 1999, the CAMS 3 site, located at Murchison Middle School and the CAMS 38 Audubon site, located about 18 miles northwest of downtown Austin. U.S. EPA guidance (1999) specifies that the current-year design value for the attainment test is the highest of (1) the design value for the three-years straddling the year of the most current emission inventory for the area or (2) the three-year period used for the non-attainment designation. Austin's most current emission inventory is for 1999, thus, the current design value would be based on ambient data collected during 1998-2000. The design value for the Murchison monitor based on ambient data for 1998-2000 is 87 ppb. The design value for the Audubon monitor for 1998-2000 is 89 ppb. The approach based on the three years used for the non-attainment designation would require the use of ambient data collected during 2001-2003. The design value for the Murchison monitor based on ambient data for 2001-2003 is 84 ppb. The design value for the Audubon monitor for 2001-2003 is 80 ppb. It is important to note that Austin would be designated as attainment based on data collected during 2001-2003. For purposes of this report, current design values are calculated using both the 1998-2000 and 2001-2003 periods, respectively, in accordance with U.S. EPA guidance.

### *4.2 Relative Reduction Factors and Future Design Values for Emission Control Scenarios*

Figures 8-13 show differences in predicted daily maximum 8-hour averaged ozone concentrations between the case with all emission control measures that will be adopted for Austin's EAC and the 2007 Future Case with no local controls applied. Relative reduction factors and future design values for the 2007 Future Case and the emission control scenarios are shown in Table 6 and 7 for the Murchison and Audubon monitoring stations, respectively. Daily relative reduction factors for each monitor are shown in Tables 8 and 9.

The results of the September 2004 remodeling of the emissions control measures that will be adopted for Austin's EAC are provided in the next to last row of Tables 6-9. The September 2004 revision incorporated modified emissions reductions for I/M, heavy duty vehicle idling restrictions, low emissions gas cans, and degreasing controls as summarized in Table 2. The September 2004 results are very similar to the previous emission control package proposed to the TCEQ and the U.S. EPA in March 2004, which was expected because only slight differences in the magnitude of the emissions reductions estimates were made, with no changes in their spatial or temporal distributions. An additional modeling run done in October 2004 indicated that removing the daily emission reductions for local power plants would increase the relative reduction factors, but not jeopardize the attainment demonstration, as noted in the last row of Tables 6-9..

Spatial distributions of differences between predicted daily maximum 8-hour ozone concentrations indicate that on some episode days, small disbenefits or increases in ozone concentrations with emission reductions, may occur in a small number of selected cells close to the urban core of Austin and near isolated point sources. These disbenefits do not appear to affect relative reduction factors near monitors (i.e., all RRFs indicate a reduction in ozone concentrations).

Austin is predicted to be on the cusp of attainment or non-attainment with the 8-hour NAAQS. However, these results are based on emission reductions in 2007 that are supposed to occur in Texas outside of the Austin area and in areas outside of Texas. If these reductions do not occur, the regional transport studies suggested that 8-hour ozone concentrations in the Austin area could possibly exceed the standard.

In recognition of these results, emission control strategies have been evaluated that will provide the Austin area with a margin of safety for attaining the standard. Control strategies assessed include a vehicle inspection and maintenance program, voluntary NOx reductions at local power plants beyond those already required by SB7, implementation of the Texas Emissions Reduction Program (TERP), a commute program, VOC controls on area sources, transportation emission reduction measures (TERMS), and idling restrictions on heavy-duty diesel engines. Although regional emission controls in eastern Texas may be beneficial for improving Austin area air quality, the area focused on the analysis and implementation of local emission control programs for their Early Action Compact. The results indicate that Austin's emission control program will facilitate its progress toward maintaining attainment with the 8-hour NAAQS and reducing population exposure to ozone.

**Figure 8. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 15 between the 2007 Future Case with no local controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

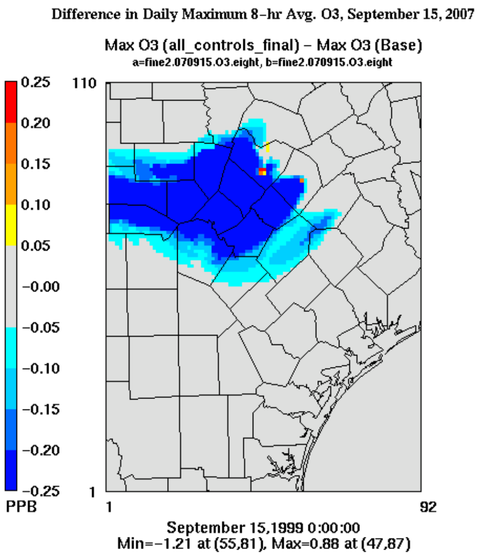



**Figure 9. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 16 between the 2007 Future Case with no local controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

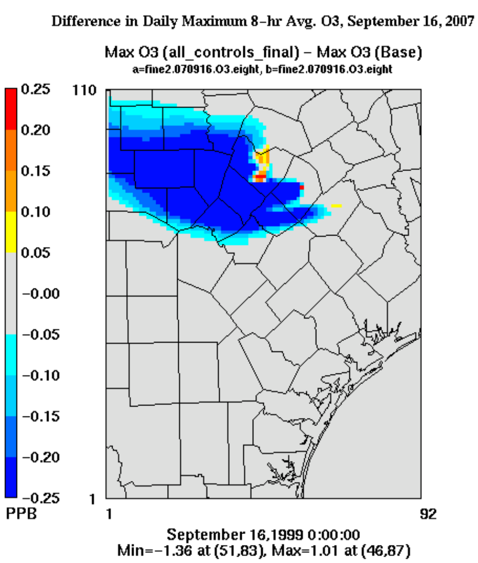


**Figure 10. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 17 between the 2007 Future Case with no local controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

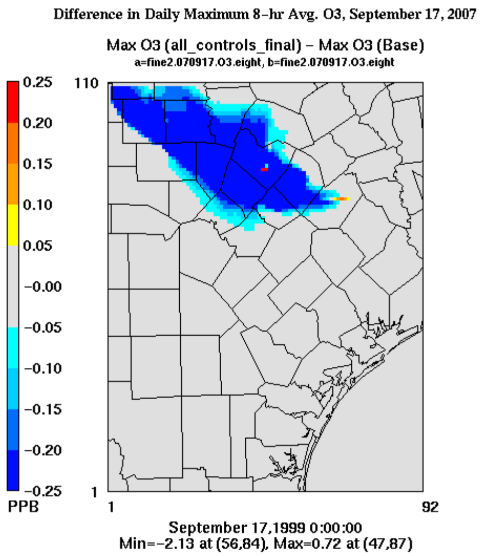



**Figure 11. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 18 between the 2007 Future Case with no local controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

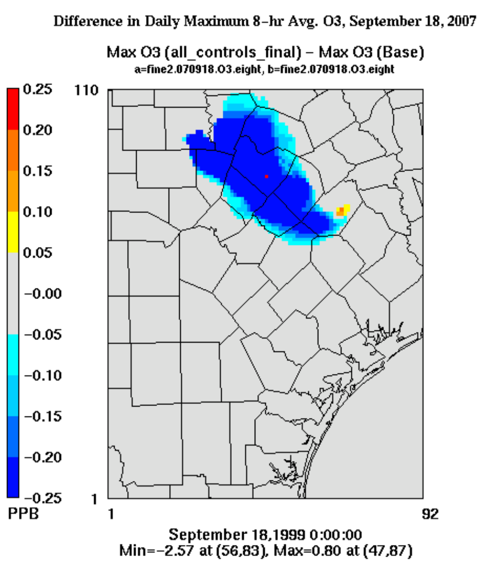



**Figure 12. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 19 between the 2007 Future Case with no local**

**controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

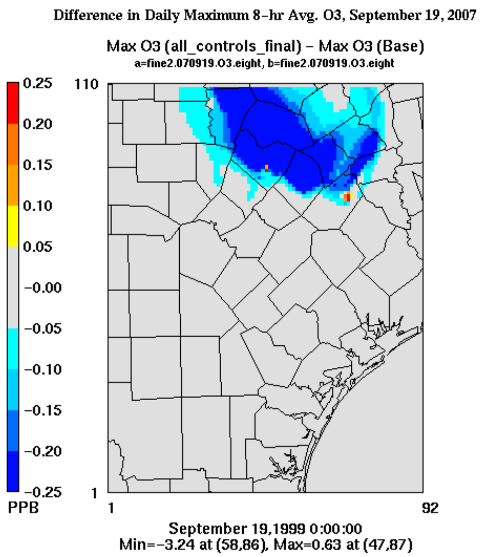



**Figure 13. Difference in predicted daily maximum 8-hour averaged ozone concentrations on September 20 between the 2007 Future Case with no local controls applied and with all emission controls applied for the Austin area excluding low RVP gasoline, I&M in Hays County, and the commute program.**

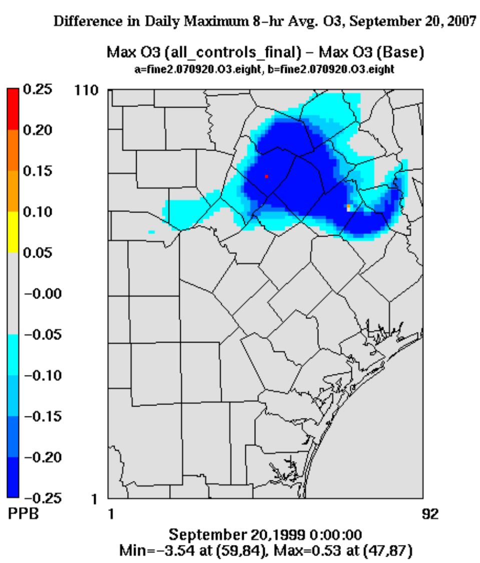



**Table 6. Relative reduction factors and future design values at Austin's Murchison monitor. The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA is underlined. Note that future design values would be truncated based on the modeled attainment test protocol in the U.S. EPA's *Draft***

***Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999).**

| Emission Control Scenario | Modeled Average Base-Year Daily Maximum Ozone Concentration (ppbv) | Modeled Average Future-Year Daily Maximum Ozone Concentration (ppbv) | RRF | Current Design Value (ppbv) | Future Design Value (ppbv)* |
|---|---|---|---|---|---|
| 2007 Future Case | 84.6 | 80.2 | 0.948 | 87 (1998-2000)<br>84 (2000-2003) | 82.48 (1998-2000)<br>79.63 (2000-2003) |
| Inspection & Maintenance Program in Travis and Williamson Counties (I&M) | 84.6 | 79.9 | 0.944 | 87 (1998-2000)<br>84 (2000-2003) | 82.13 (1998-2000)<br>79.30 (2000-2003) |
| Stationary Point Sources | 84.6 | 79.8 | 0.943 | 87 (1998-2000)<br>84 (2000-2003) | 82.04 (1998-2000)<br>79.21 (2000-2003) |
| Area Source VOC Controls and Low Reid Vapor Pressure Gasoline | 84.6 | 80.0 | 0.945 | 87 (1998-2000)<br>84 (2000-2003) | 82.22 (1998-2000)<br>79.38 (2000-2003) |
| Texas Emission Reduction Program (TERP) | 84.6 | 80.1 | 0.947 | 87 (1998-2000)<br>84 (2000-2003) | 82.39 (1998-2000)<br>79.55 (2000-2003) |
| All controls listed above excluding low RVP and I&M in Hays County | 84.6 | 79.1 | 0.934 | 87 (1998-2000)<br>84 (2000-2003) | 81.26 (1998-2000)<br>78.46 (2000-2003) |
| All controls listed above excluding low RVP and I&M in Hays County and with Alcoa emissions | 84.6 | 78.5 | 0.927 | 87 (1998-2000)<br>84 | 80.65 (1998-2000)<br>77.87 |

| | | | | | |
|---|---|---|---|---|---|
| reduced from 26.7 tpd to 4.44 tpd | | | | (2000-2003) | (2000-2003) |
| All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions | 84.6 | 79.1 | 0.934 | 87 (1998-2000)<br>84 (2000-2003) | 81.26 (1998-2000)<br>78.46 (2000-2003) |
| All controls listed above excluding low RVP gasoline and I&M in all counties | 84.6 | 79.4 | 0.938 | 87 (1998-2000)<br>84 (2000-2003) | 81.61 (1998-2000)<br>78.79 (2000-2003) |
| Doubling point source emissions of VOCs in the Austin area | 84.6 | 80.3 | 0.949 | 87 (1998-2000)<br>84 (2000-2003) | 82.56 (1998-2000)<br>79.72 (2000-2003) |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions (September 2004 revision)** | 84.6 | 79.0 | 0.934 | 87 (1998-2000)<br>84 (2000-2003) | 81.26 (1998-2000)<br>78.46 (2000-2003) |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, commute program reductions, and stationary point sources (October 2004 revision)** | 84.6 | 79.5 | 0.939 | 87 (1998-2000)<br>84 (2000-2003) | 81.69 (1998-2000)<br>78.88 (2000-2003) |

*Note that future design values would be truncated based on the modeled attainment test protocol in the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999).

**Table 7. Relative reduction factors and future design values at Austin's Audubon monitor. The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA is underlined. Note that future design values would be truncated based on the modeled attainment test protocol in the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999).**

| Emission Control Scenario | Modeled Average Base-Year Daily Maximum Ozone Concentration (ppbv) | Modeled Average Future-Year Daily Maximum Ozone Concentration (ppbv) | RRF | Current Design Value (ppbv) | Future Design Value (ppbv) |
|---|---|---|---|---|---|
| 2007 Future Case | 81.0 | 76.7 | 0.948 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 84.37<br>(1998-2000)<br><br>75.84<br>(2000-2003) |
| Inspection & Maintenance Program (I&M) in Travis and Williamson Counties | 81.0 | 76.4 | 0.944 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 84.02<br>(1998-2000)<br><br>75.52<br>(2000-2003) |
| Stationary Point Sources | 81.0 | 76.5 | 0.944 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 84.02<br>(1998-2000)<br><br>75.52<br>(2000-2003) |
| Area Source VOC Controls and Low Reid Vapor Pressure Gasoline | 81.0 | 76.6 | 0.946 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 84.19<br>(1998-2000)<br><br>75.68<br>(2000-2003) |
| Texas Emission Reduction Program (TERP) | 81.0 | 76.6 | 0.946 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 84.19<br>(1998-2000)<br><br>75.68<br>(2000-2003) |
| All controls listed above excluding low RVP and I&M in Hays County | 81.0 | 75.8 | 0.937 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 83.39<br>(1998-2000)<br><br>74.96<br>(2000-2003) |
| All controls listed above excluding low RVP and I&M in Hays County and with Alcoa emissions | 81.0 | 75.3 | 0.930 | 89<br>(1998-2000)<br><br>80<br>(2000-2003) | 82.77<br>(1998-2000)<br><br>74.40<br>(2000-2003) |

| | | | | | |
|---|---|---|---|---|---|
| reduced from 26.7 tpd to 4.44 tpd | | | | | |
| All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions | 81.0 | 75.9 | 0.937 | 89 (1998-2000)<br><br>80 (2000-2003) | 83.39 (1998-2000)<br><br>74.96 (2000-2003) |
| All controls listed above excluding low RVP gasoline and I&M in all counties | 81.0 | 76.1 | 0.940 | 89 (1998-2000)<br><br>80 (2000-2003) | 83.66 (1998-2000)<br><br>75.20 (2000-2003) |
| Doubling point source emissions of VOCs in the Austin area | 81.0 | 76.8 | 0.948 | 89 (1998-2000)<br><br>80 (2000-2003) | 84.37 (1998-2000)<br><br>75.84 (2000-2003) |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions (September 2004 revision)** | 81.0 | 75.8 | 0.936 | 89 (1998-2000)<br><br>80 (2000-2003) | 83.30 (1998-2000)<br><br>74.88 (2000-2003) |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, commute program reductions, and stationary point sources (October 2004 revision)** | 81.0 | 76.1 | 0.940 | 89 (1998-2000)<br><br>80 (2000-2003) | 83.66 (1998-2000)<br><br>75.20 (2000-2003) |

*Note that future design values would be truncated based on the modeled attainment test protocol in the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS* (1999).

**Table 8. Daily reduction factors at Austin's Murchison monitor. The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA is underlined**

| Emission Control Scenario | NOx Reduction (tpd) | VOC Reduction (tpd) | Daily RRF | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 9/15 | 9/16 | 9/17 | 9/18 | 9/19 | 9/20 |
| 2007 Future Case | None | None | 0.964 | 0.964 | 0.947 | 0.945 | 0.931 | 0.942 |
| Inspection & Maintenance Program (I&M) | 2.89 | 3.84 | 0.962 | 0.964 | 0.943 | 0.939 | 0.927 | 0.937 |
| Stationary Point Sources | 7.08 | None | 0.963 | 0.964 | 0.945 | 0.934 | 0.922 | 0.935 |
| Area Source VOC Controls and Low Reid Vapor Pressure Gasoline | None | 17.81 | 0.962 | 0.963 | 0.944 | 0.94 | 0.929 | 0.937 |
| Texas Emission Reduction Program (TERP) | 2.00 | None | 0.963 | 0.964 | 0.946 | 0.943 | 0.93 | 0.94 |
| All controls listed above excluding low RVP and I&M in Hays County | 13.15 | 19.91 | 0.957 | 0.963 | 0.936 | 0.921 | 0.913 | 0.922 |
| All controls listed above excluding low RVP and I&M in Hays County and with Alcoa emissions reduced from 26.7 tpd to 4.44 tpd | 35.37 | 19.91 | 0.949 | 0.934 | 0.929 | 0.921 | 0.913 | 0.922 |
| <u>All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions</u> | 12.88 | 19.61 | 0.957 | 0.963 | 0.936 | 0.922 | 0.914 | 0.923 |
| All controls listed above excluding low RVP gasoline and I&M in all counties | 10.26 | 16.07 | 0.959 | 0.963 | 0.94 | 0.927 | 0.918 | 0.927 |
| Doubling point source emissions of VOCs in the Austin area | - | - | 0.965 | 0.964 | 0.948 | 0.946 | 0.932 | 0.943 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions (September 2004 revision)** | 13.69 | 17.06 | 0.956 | 0.963 | 0.936 | 0.921 | 0.913 | 0.923 |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, commute program reductions, and stationary point sources (October 2004 revision)** | 6.61 | 17.06 | 0.958 | 0.963 | 0.938 | 0.932 | 0.923 | 0.929 |

**Table 9. Daily reduction factors at Austin's Audubon monitor. The final package adopted by the five-county Austin MSA and submitted to the TCEQ and the U.S. EPA is underlined**

| Emission Control Scenario | NOx Reduction (tpd) | VOC Reduction (tpd) | Daily RRF | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 9/15 | 9/16 | 9/17 | 9/18 | 9/19 | 9/20 |
| 2007 Future Case | None | None | 0.968 | 0.954 | 0.94 | 0.933 | 0.928 | 0.972 |
| Inspection & Maintenance Program (I&M) | 2.89 | 3.84 | 0.965 | 0.952 | 0.936 | 0.927 | 0.922 | 0.97 |
| Stationary Point Sources | 7.08 | None | 0.967 | 0.954 | 0.938 | 0.925 | 0.92 | 0.971 |
| Area Source VOC Controls and Low Reid Vapor Pressure Gasoline | None | 17.81 | 0.966 | 0.953 | 0.937 | 0.93 | 0.927 | 0.971 |
| Texas Emission Reduction Program (TERP) | 2.00 | None | 0.966 | 0.953 | 0.938 | 0.931 | 0.926 | 0.97 |
| All controls listed above excluding low RVP and I&M in Hays County | 13.15 | 19.91 | 0.962 | 0.95 | 0.929 | 0.912 | 0.911 | 0.966 |
| All controls listed above excluding low RVP and I&M in Hays County and with Alcoa emissions reduced from 26.7 tpd to 4.44 tpd | 35.37 | 19.91 | 0.954 | 0.923 | 0.922 | 0.911 | 0.911 | 0.965 |
| <u>All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions</u> | 12.88 | 19.61 | 0.962 | 0.95 | 0.929 | 0.913 | 0.912 | 0.966 |
| All controls listed above excluding low RVP gasoline and I&M in all counties | 10.26 | 16.07 | 0.964 | 0.951 | 0.933 | 0.919 | 0.917 | 0.968 |
| Doubling point source emissions of VOCs in the Austin area | - | - | 0.968 | 0.954 | 0.941 | 0.934 | 0.928 | 0.972 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, and commute program reductions (September 2004 revision)** | 13.69 | 17.06 | 0.962 | 0.949 | 0.928 | 0.912 | 0.911 | 0.966 |
| **All controls listed above excluding low RVP gasoline and I&M in Hays County, commute program reductions, and stationary point sources (October 2004 revision)** | 6.61 | 17.06 | 0.962 | 0.949 | 0.931 | 0.920 | 0.918 | 0.967 |

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