TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AGENDA ITEM REQUEST

for State Implementation Plan Revision Adoption

AGENDA REQUESTED: June 3, 2015

DATE OF REQUEST: May 15, 2015

INDIVIDUAL TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED: Joyce Spencer-Nelson, (512) 239-5017

CAPTION: Docket No. 2014-1262-SIP. Consideration of the adoption of revisions to the Dallas-Fort Worth (DFW) Attainment Demonstration State Implementation Plan (SIP) revision to meet the 2008 Eight-Hour Ozone National Ambient Air Quality Standard. The counties affected include Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise.

Because of a United States Court of Appeals for the District of Columbia Circuit decision that changed the attainment deadlines for the 2008 eight-hour ozone NAAQS after proposal, this SIP revision includes the work completed to date to demonstrate that the DFW area will attain the 2008 eight-hour ozone NAAQS by 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. Additionally, this SIP revision includes a commitment to develop a 2017 attainment year SIP revision for the DFW 2008 eight-hour ozone nonattainment area. This SIP revision includes a photochemical modeling analysis, a weight of evidence analysis, a reasonably available control technology (RACT) analysis, and a reasonably available control measures analysis that reflect the previously applicable 2018 attainment year. This SIP revision also incorporates two rulemakings to fulfill RACT requirements for any sources identified in the DFW area that are not already subject to the existing 30 Texas Administrative Code Chapters 115 and 117 rules. (Kathy Singleton, Terry Salem) (Non-rule Project No. 2013-015-SIP-NR)

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Copy to CCC Secretary? NO X YES

Texas Commission on Environmental Quality
Interoffice Memorandum

To: Commissioners **Date:** May 15, 2015

Thru: Bridget C. Bohac, Chief Clerk
Richard A. Hyde, P.E., Executive Director

From: Steve Hagle, P.E., Deputy Director
Office of Air

Docket No.: 2014-1262-SIP

Subject: Commission Approval for Adoption of the Dallas-Fort Worth (DFW) 2008 Eight-Hour Ozone Nonattainment Area Attainment Demonstration (AD) State Implementation Plan (SIP) Revision

DFW 2008 Eight-Hour Ozone Standard AD SIP Revision
SIP Project No. 2013-015-SIP-NR

Background and reason(s) for the SIP Revision:
The Federal Clean Air Act (FCAA) requires states to submit plans to demonstrate attainment of the National Ambient Air Quality Standards (NAAQS) for nonattainment areas within the state. On May 1, 2012, the 10-county DFW area, consisting of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties, was designated a moderate nonattainment area for the 2008 eight-hour ozone standard. The attainment date for the DFW moderate nonattainment area was established in the United States Environmental Protections Agency's (EPA) implementation rule for the 2008 ozone NAAQS published in the *Federal Register* (FR) on May 21, 2012 (77 FR 30160) and was set as December 31, 2018. Attainment of the standard (expressed as 0.075 parts per million) is achieved when an area's design value does not exceed 75 parts per billion (ppb).

For areas classified as moderate, states are required to submit SIP revisions that demonstrate attainment of the 2008 eight-hour ozone NAAQS by July 20, 2015. The commission approved proposal of an AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area on December 10, 2014. The proposed DFW AD SIP revision included all applicable FCAA and EPA requirements known at the time of proposal.

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31 attainment date for the 2008 0zone NAAQS. As part of the EPA's *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements*; *Final Rule* (2008 ozone standard SIP requirements rule), published in the *Federal Register* on March 6, 2015 (80 FR 12264), the EPA modified 40 Code of Federal Regulations §51.1103 consistent with the D.C. Circuit Court decision to establish attainment dates that run from the effective date of designation, i.e., July 20, 2012, rather than the end of the 2012 calendar year. As a result, the attainment date for the DFW moderate nonattainment area has changed from December 31, 2018 to July 20, 2018. In addition, because the attainment

year ozone season is the ozone season immediately preceding a nonattainment area's attainment date, the attainment year for the DFW moderate nonattainment area has changed from 2018 to 2017.

Due to the timing of the court's ruling and the EPA's subsequent rulemaking action, it was not possible to complete all work necessary for this DFW AD SIP revision to demonstrate attainment in 2017. Therefore, this DFW AD SIP revision includes the work completed to date to demonstrate that the DFW nonattainment area will attain the 2008 eight-hour ozone NAAQS by 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. The DFW AD SIP revision also commits to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, a reasonably available control measures (RACM) analysis, and a Motor Vehicle Emissions Budget (MVEB).

Because no additional analysis was needed to complete the contingency plan for attainment, Section 4.9: *Contingency Plan* was revised to reflect a 2017 attainment year.

Scope of the SIP Revision:
This memo applies to the DFW AD SIP Revision for the 2008 Ozone NAAQS requirement under a moderate ozone nonattainment classification. There is also a new reasonable further progress (RFP) demonstration required for the DFW nonattainment area, the details of which are covered in a separate memo (Project No. 2013-014-SIP-NR).

A.) Summary of what the SIP revision will do:
The DFW AD SIP revision uses photochemical modeling and corroborative analysis to demonstrate that the area will attain the 2008 eight-hour ozone standard by the original December 31, 2018 attainment deadline. As discussed above, the SIP revision also commits to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. This DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by 2018 based on a photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a weight of evidence (WoE) analysis. The peak ozone design value in 2018 for the DFW nonattainment area is projected to be 76 ppb using older EPA guidance from 2007 and 75 ppb using newer guidance released by the EPA in December 2014. The DFW AD SIP revision also commits to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year.

This DFW AD SIP revision incorporates two rulemakings (Rule Project Numbers 2013-048-115-AI and 2013-049-117-AI) to fulfill reasonably available control technology (RACT) requirements for all control techniques guidelines (CTG) emission source categories and all non-CTG major sources of VOC and NO_X as required by FCAA, §172(c)(1) and §182(b)(2). The major source threshold for moderate nonattainment areas is a potential to

emit (PTE) 100 tons per year (tpy) or more of either NO_X or VOC. The PTE 100 tpy major source threshold applies in the newly designated Wise County. A PTE 50 tpy major source threshold is retained for the remaining nine counties, which are currently classified as a serious nonattainment area under the 1997 eight-hour ozone NAAQS. The state has previously adopted Chapter 115 VOC and Chapter 117 NO_X rules to satisfy RACT requirements for sources in the nine-county the DFW nonattainment area as part of the SIP for the 1997 eight-hour ozone standard. The rulemakings satisfy RACT requirements for Wise County and for any sources identified in the DFW nonattainment area that are not already subject to the existing rules.

B.) Scope required by federal regulations or state statutes:
The DFW AD SIP revision as proposed was consistent with the requirements of FCAA, §182(b)(1) and the EPA's 2008 ozone standard SIP requirements rule, published in the FR on March 6, 2015 (80 FR 12264). The FCAA-required SIP elements, include analyses for RACT and RACM, a MVEB, and a contingency plan. Consistent with EPA guidance, this DFW AD SIP revision also includes a modeled AD and a WoE analysis. As discussed above, due to the change in the required attainment date after proposal of this DFW AD SIP revision, the modeled AD, WoE, RACM, and MVEB elements must be updated to address the 2017 attainment year.

On December 3, 2014, the EPA released *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze*. The major update in this guidance recommends future year ozone design value (DV_F) calculations per monitor on the 10 days of the baseline episode with the highest modeled ozone values. The proposed DFW AD SIP revision was based on the previous modeling guidance for the 1997 eight-hour ozone standard that recommended DV_F calculations per monitor on all baseline episode days modeled above a specific threshold such as 75 ppb. The revised guidance includes additional minor changes, but these do not affect the modeling inputs.

C.) Additional staff recommendations that are not required by federal rule or state statute:
The EPA made the 2014 Motor Vehicle Emissions Simulator model (MOVES2014) available on July 31, 2014 and officially released the MOVES2014 version of the model as a replacement to MOVES2010b for SIP applications on October 7, 2014 (70 FR 60343). An update was released on October 27, 2014. The October 27, 2014 update fixed a significant error in the new non-road portion of MOVES2014; addressed a number of minor issues with the on-road portion of MOVES2014; improved the installation process; and included small performance improvements. The October 27, 2014 version of MOVES2014 was used for all on-road emission inventories. The on-road emissions inventories included with the photochemical modeling included in the proposed DFW AD SIP revision were developed with the older MOVES2010b model. Staff recommends the adoption of the updated MOVES2014 based modeling to minimize any subsequent issues with transportation conformity determinations that will be required to use MOVES2014.

Statutory authority:
The authority to propose and adopt SIP revisions is derived from the following sections of Texas Health and Safety Code, Chapter 382, Texas Clean Air Act (TCAA), §382.002, which provides that the policy and purpose of the TCAA is to safeguard the state's air resources from pollution; §382.011, which authorizes the commission to control the quality of the state's air; and §382.012, which authorizes the commission to prepare and develop a general, comprehensive plan for the control of the state's air. This DFW AD SIP revision is required by FCAA, §110(a)(1) and implementing rules in 40 Code of Federal Regulations Part 51.

Under the 1997 eight-hour ozone standard, the DFW nonattainment area is required to continue to meet the mandates of FCAA, §172(c)(2) and §182(c)(2)(B) and requirements established under Phase II of the EPA's implementation rule for the 1997 eight-hour ozone NAAQS (70 FR 71615) for nonattainment areas classified as serious.

Effect on the:
A.) Regulated community
The affected regulated community will be those associated with the rulemakings that are part of this DFW AD SIP revision. For further information, see the executive summaries for the following rulemakings, which are scheduled to be adopted concurrently with this DFW AD SIP revision.

- Rule Project No. 2013-049-117-AI; NO_X RACT Rules for the DFW 2008 Eight-Hour Ozone Nonattainment Area
- Rule Project No. 2013-048-115-AI; VOC RACT Rules for the DFW 2008 Eight-Hour Ozone Nonattainment Area
- Rule Project No. 2014-007-101-AI; Chapter 101 Emissions Banking and Trading Rulemaking with DERC Flow Control

B.) Public:
The general public in the DFW ozone nonattainment area would benefit from improved air quality as a result of lower ozone levels.

C.) Agency programs:
If the rules associated with this DFW AD SIP revision are adopted, the Office of Compliance and Enforcement would be involved in enforcing NO_X RACT Rules (Rule Project No. 2013-049-117-AI) and VOC RACT Rules (Rule Project No. 2013-048-115-AI) for the DFW 2008 Eight-Hour Ozone Nonattainment Area. Similarly, the Environmental Assistance Division could face an increased workload if the demand for compliance assistance increases as a result of new control measures.

Stakeholder meetings:
A public information meeting to provide information on the development of revisions to the SIP for the 2008 eight-hour ozone NAAQS in the 10-county DFW nonattainment area was held on September 5, 2013 at the North Central Texas Council of Governments (NCTCOG), in Arlington, Texas. Stakeholders were asked to submit any ideas or suggestions to staff prior to proposal of the DFW AD SIP revision. NCTCOG and EPA representatives also provided updates on local and federal initiatives.

Public comment:
The public comment period opened on December 26, 2014 and was originally scheduled to close on January 30, 2015. However, a supplement[1] to the proposed DFW AD SIP revision was issued by the Texas Commission on Environmental Quality (TCEQ) on January 12, 2015 to provide additional technical detail regarding updates to anthropogenic emission inventory inputs and calculation of future ozone design values based on results from photochemical modeling that became available after the DFW AD SIP revision was approved for proposal by the commission on December 10, 2014. Due to the supplemental technical information, the comment period for the proposed DFW AD SIP revision was extended to February 11, 2015 to allow for a full 30-day comment period for all components of the proposed DFW AD SIP package.

The commission conducted a public hearing in Arlington on January 15, 2015, at 6:30 p.m., and in Austin on January 22, 2015, at 10:00 a.m. During the comment period, staff received comments from the Children's Health System of Texas, the DFW Regional Concerned Citizens, Dallas County Medical Society, Downwinders at Risk, State Representative Lon Burnam, the Greater Fort Worth Sierra Club, the Health and Wellness Alliance for Children, the League of Women Voters of Dallas, the Lone Star Chapter of the Sierra Club, Mayor John Monaco of the City of Mesquite, the North Texas Chapter of American Solar Energy Society, the Regional Transportation Council, the Texas Medical Association, Public Citizen, the Sierra Club, Solar Turbines Incorporated, Sustainable Energy and Economic Development Coalition, the Texas Pipeline Association, the EPA, and 56 individuals. Summaries of public comments and TCEQ responses are included as part of the DFW AD SIP revision.

Generally, the comments stated that the DFW AD SIP revision would not bring the DFW nonattainment area into attainment of the 2008 eight-hour ozone standard. Numerous commenters stated that the DFW AD SIP revision contains no changes to bring the DFW nonattainment area into compliance with the eight-hour ozone standard the EPA published in the FR on December 14, 2014 (79 FR 75234). The comments also focused on the adverse health effects of ozone and requested that the agency add more regulations.

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[1] The supplemental information issued on January 12, 2015 is provided in *Appendix I: Technical Supplement to the December 10, 2014 proposal of the Dallas-Fort Worth* Attainment Demonstration *State Implementation Plan Revision for the 2008 Eight-Hour Ozone Standard Nonattainment Area* of this SIP revision.

The Sierra Club, Downwinders at Risk, and several individuals commented that the TCEQ should embrace its regulatory role and ensure that Texas is taking the necessary steps to bring the area in line with public health standards. They stated that the TCEQ's approach has not succeeded and the TCEQ should adopt all RACM including selective catalytic reduction for cement kilns and coal-fired electric generating units and electric compressors for oil and gas development to bring the DFW nonattainment area into attainment as expeditiously as practicable.

The EPA made numerous comments related to the D.C. Circuit Court decision and indicated that all applicable elements of the proposed DFW AD SIP revision should be revised to reflect the 2017 attainment year. The EPA expressed concern about the ability of the DFW nonattainment area to attain the 2008 ozone standard in 2018 based on the modeling and WoE analyses and even more concern about the ability of the area to attain the standard in 2017. The EPA also suggested that the TCEQ's rules for cement kilns be revised to reflect a RACT level of control.

Significant changes from proposal:
As a result of the D.C. Circuit Court decision, the attainment date for the DFW moderate nonattainment area has changed from December 31, 2018 to July 20, 2018. Therefore, this AD SIP revision includes the work completed to date with a commitment to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year.

While the 2018 on-road emissions inventories remain included in this DFW AD SIP revision, the TCEQ is not submitting them to the EPA for approval as a 2018 MVEB. The 2018 on-road emissions inventories included in this DFW AD SIP revision do not meet the requirement for a required 2017 attainment year MVEB. Until the TCEQ submits and the EPA finds adequate AD SIP MVEBs for a 2017 attainment year, the 2017 milestone year MVEBs established by the DFW Reasonable Further Progress SIP Revision for the 2008 Eight-Hour Ozone Standard (Project Number 2013-014-SIP-NR), if found adequate, can be used for transportation planning and conformity purposes.

The proposed DFW AD SIP revision was based on the previous modeling guidance for the 1997 eight-hour ozone standard that recommended DV_F calculations per monitor on all baseline episode days modeled above a specific threshold such as 75 ppb. Based on the EPA's proposed revisions to the modeling guidance, this DFW AD SIP revision also includes DV_F calculations per monitor on the 10 days of the baseline episode with the highest modeled ozone values.

The October 27, 2014 version of MOVES2014 was used to develop on-road emissions inventories for this DFW AD SIP revision. The on-road emissions inventories included with the photochemical modeling included in the proposed DFW AD SIP revision were developed with the older MOVES2010b model.

Version 1.6.1 of the Texas NONROAD (TexN) emissions model for estimation of non-road emissions estimates became available on July 30, 2014. The non-road emissions inventories included with the proposed DFW AD SIP revision were developed with version 1.6.1 of TexN.

This DFW AD SIP revision also includes results of a study completed on August 1, 2014 that updated emission rates for hydraulic pump engines and mud degassing activities associated with oil and gas production. The oil and gas emissions estimates included with the proposed DFW AD SIP revision were developed with older emission factors for this type of activity. In addition, this DFW AD SIP revision includes revised 2013 historical production data that became available after proposal from the Railroad Commission of Texas, which impacted 2018 projections of emissions from natural gas compressor engines.

Potential controversial concerns and legislative interest:
Due to the timing of the D.C. Circuit Court ruling and finalization of the 2008 ozone SIP requirements rule, the SIP development schedule did not allow for a full update of the DFW AD SIP revision to address the change in attainment year from 2018 to 2017. In its comments, the EPA indicated that all applicable elements of this revision should be updated to reflect a 2017 attainment year. To resolve this issue, the DFW AD SIP revision includes a commitment to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, a RACM analysis, and an MVEB.

Also in its comments, the EPA indicated that the proposed RACT analysis for cement kilns should be reevaluated. In particular, the EPA indicated that the retirement of the higher emitting wet kilns and operation of more energy efficient and lower emitting dry kilns in Ellis County makes it necessary for the TCEQ to revisit its NO_X cap limit, set forth in 2007 at 17.4 tons per day. The EPA further indicated that failure to conduct a thorough RACT analysis for cement kilns, which would include appropriate emission limits, would prevent it from approving the RACT portion of the attainment plan submittal.

Does this SIP revision affect any current policies or require development of new policies?
No.

What are the consequences if this SIP revision does not go forward? Are there alternatives to this SIP revision?
The commission could choose to not comply with requirements to develop and submit this DFW AD SIP revision to the EPA. If the DFW AD SIP revision is not submitted by July 20, 2015, the EPA could impose sanctions on the state and promulgate a federal implementation plan (FIP). Sanctions could include transportation funding restrictions, grant withholdings, and 200% emissions offsets requirements for new construction and

major modifications of stationary sources in the DFW nonattainment area. The EPA could impose such sanctions and implement a FIP until the state submitted and the EPA approved a replacement DFW 2008 eight-hour ozone AD SIP revision for the area.

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REVISIONS TO THE STATE OF TEXAS AIR QUALITY
IMPLEMENTATION PLAN FOR THE CONTROL OF OZONE AIR
POLLUTION

DALLAS-FORT WORTH EIGHT-HOUR OZONE
NONATTAINMENT AREA

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. BOX 13087
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DALLAS-FORT WORTH ATTAINMENT DEMONSTRATION STATE IMPLEMENTATION PLAN REVISION FOR THE 2008 EIGHT-HOUR OZONE STANDARD NONATTAINMENT AREA

PROJECT NUMBER 2013-015-SIP-NR

Adoption
June 3, 2015

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EXECUTIVE SUMMARY

On March 12, 2008, the United States Environmental Protection Agency (EPA) strengthened the eight-hour ozone standard from 0.08 parts per million (ppm) to 0.075 ppm. Under the 0.075 ppm (75 parts per billion) standard, the EPA designated Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties as nonattainment with a moderate classification, effective July 20, 2012. These 10 counties form the Dallas-Fort Worth (DFW) 2008 eight-hour ozone standard moderate nonattainment area. The attainment date for moderate nonattainment areas was established in the EPA's implementation rule for the 2008 ozone National Ambient Air Quality Standard (NAAQS), published in the *Federal Register* (FR) on May 21, 2012 (77 FR 30160), and was set as December 31, 2018.

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31 attainment date for the 2008 0zone NAAQS. As part of the EPA's *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements*; *Final Rule* (2008 ozone standard SIP requirements rule), published in the *Federal Register* on March 6, 2015 (80 FR 12264), the EPA modified 40 Code of Federal Regulations (CFR) §51.1103 consistent with the D.C. Circuit Court decision to establish attainment dates that run from the effective date of designation, i.e., July 20, 2012, rather than the end of the 2012 calendar year. As a result, the attainment date for the DFW moderate nonattainment area has changed from December 31, 2018 to July 20, 2018. In addition, because the attainment year ozone season is the ozone season immediately preceding a nonattainment area's attainment date, the attainment year for the DFW moderate nonattainment area has changed from 2018 to 2017.

The proposed DFW attainment demonstration (AD) SIP revision was developed based on the EPA's May 21, 2012 implementation rule for the 2008 ozone NAAQS (77 FR 30160), which set 2018 as the attainment year for areas classified as moderate. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 ozone NAAQS is July 20, 2015, which the EPA has not altered.

Due to the timing of the court's ruling and the EPA's subsequent rulemaking action, it was not possible to complete all work necessary for this DFW AD SIP revision to demonstrate attainment in 2017. Therefore, this AD SIP revision includes the work completed to date to demonstrate that the DFW nonattainment area will attain the 2008 eight-hour ozone NAAQS by 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. The AD SIP revision also commits to develop a new DFW AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, a reasonably available control measures (RACM) analysis, and a Motor Vehicle Emissions Budget (MVEB). Because no additional analysis was needed to complete the contingency plan for attainment, Chapter 4: *Control Strategies and Required Elements*, Section 4.9: *Contingency Plan* was revised to reflect a 2017 attainment year.

This DFW AD SIP revision for the 2008 Ozone NAAQS also provides ozone reduction trends analyses and other supplementary data and information to demonstrate that the DFW 10-county nonattainment area will attain the 2008 eight-hour ozone standard by the December 31, 2018 attainment date, as originally proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. This analysis is still relevant for the future 2017 analysis. The quantitative and qualitative corroborative analyses in Chapter 5: *Weight of Evidence* demonstrate attainment of the 2008 eight-hour ozone standard and progress toward attainment

by the new 2017 attainment year. As proposed, this DFW AD SIP revision includes base case modeling of an eight-hour ozone exceedance episode that occurred during June and August/September 2006. These time periods were chosen because they are representative of the times of the year that ozone exceedances have historically been monitored within the DFW nonattainment area. The model performance evaluation of the 2006 base case indicates the modeling is suitable for use in conducting the modeling attainment test. The modeling attainment test was applied by modeling a 2006 baseline year and 2018 future year to project 2018 eight-hour ozone design values.

Table ES-1: *Summary of 2006 Baseline and 2018 Future Year Anthropogenic Modeling Emissions for DFW* lists the anthropogenic modeling emissions in tons per day (tpd) by source category for the 2006 baseline and 2018 future year for nitrogen oxides (NO_X) and volatile organic compounds (VOC) ozone precursors. The differences in modeling emissions between the 2006 baseline and the 2018 future year reflect the net of growth and reductions from existing controls. The existing controls include both state and federal measures that have already been promulgated. The electric utility emissions for the 2006 ozone season are an average of actual emission measurements, while the 2018 electric utility emission projections are based on the maximum ozone season caps required under Phase II of the Clean Air Interstate Rule (CAIR). On-road emission estimates for the proposed DFW AD SIP revision were developed with the 2010b version of the Motor Vehicle Emission Simulator (MOVES2010b) model, but the on-road emission estimates for this DFW AD SIP revision were developed with the MOVES2014 model. Non-road emission estimates for the proposed DFW AD SIP revision were developed with the 1.6 version of the Texas NONROAD (TexN) model, but the non-road emission estimates for this DFW AD SIP revision were developed with version 1.6.1 of TexN. The oil and gas production emission estimates for the 2018 future year changed between proposal and adoption based on updated information from the Railroad Commission of Texas (RRC) along with improved emissions estimation methodologies.

Table ES-1: Summary of 2006 Baseline and 2018 Future Year Anthropogenic Modeling Emissions for DFW

DFW Nonattainment Area Source Type	2006 NO_X (tpd)	2018 NO_X (tpd)	2006 VOC (tpd)	2018 VOC (tpd)
On-Road	284.27	119.69	116.50	62.20
Non-Road	98.06	42.13	64.69	33.02
Area Sources	29.02	30.76	290.46	284.94
Off-Road – Locomotives	29.97	17.86	1.72	0.89
Off-Road – Airports	12.78	13.06	4.46	3.55
Oil and Gas – Production	61.84	8.31	43.72	24.24
Oil and Gas – Drill Rigs	18.23	2.82	1.16	0.21
Point – Oil and Gas	11.53	16.37	21.82	26.02
Point – Electric Utilities	9.63	16.91	1.03	4.44
Point – Cement Kilns	22.08	17.64	1.94	0.78
Point – Other	14.31	6.62	25.65	20.43
Total	591.72	292.17	573.15	460.72

Table ES-2: *Summary of Modeled 2006 Baseline and 2018 Future Year Eight-Hour Ozone Design Values for DFW Monitors* lists the eight-hour ozone design values in parts per billion (ppb) for the 2006 baseline year design value (DV_B) and 2018 future year design value (DV_F) for

the regulatory ozone monitors in the DFW nonattainment area. In accordance with EPA modeling guidance from April 2007, the 2018 DV_F figures presented have been rounded to one decimal place and then truncated. Incorporation of the updated on-road, non-road, and oil and gas production emission estimates resulted in changes to the 2018 DV_F figures between the DFW AD SIP revision proposal and adoption. However, these DV_F changes do not necessarily appear for each monitor after the rounding and truncating steps are taken. Since the modeling cannot provide an absolute prediction of future year ozone design values, additional information from corroborative analyses are used in assessing whether the area will attain the ozone standard by December 31, 2018.

Table ES-2: Summary of Modeled 2006 Baseline and 2018 Future Year Eight-Hour Ozone Design Values for DFW Monitors

2006 DFW Nonattainment Area Monitor and Continuous Air Monitoring Station (CAMS) Code	DFW Monitor Alpha Code	2006 Baseline Design Value (ppb)[#]	Relative Response Factor	2018 Future Design Value (ppb)
Denton Airport South - C56	DENT	93.33	0.8221	76
Eagle Mountain Lake - C75	EMTL	93.33	0.8130	75
Grapevine Fairway - C70	GRAP	90.67	0.8349	75
Keller - C17	KELC	91.00	0.8250	75
Fort Worth Northwest - C13	FWMC	89.33	0.8254	73
Frisco - C31	FRIC	87.67	0.8340	73
Dallas North #2 - C63	DALN	85.00	0.8425	71
Parker County - C76	WTFD	87.67	0.8123	71
Dallas Executive Airport - C402	REDB	85.00	0.8338	70
Cleburne Airport - C77	CLEB	85.00	0.8267	70
Arlington Municipal Airport - C61	ARLA	83.33	0.8337	69
Dallas Hinton Street - C401	DHIC	81.67	0.8432	68
Granbury - C73	GRAN	83.00	0.8161	67
Midlothian Tower - C94*	MDLT*	80.50	0.8347	67
Pilot Point - C1032*	PIPT*	81.00	0.8224	66
Rockwall Heath - C69	RKWL	77.67	0.8463	65
Midlothian OFW - C52*	MDLO*	75.00	0.8355	62
Greenville - C1006	GRVL	75.00	0.8263	62
Kaufman - C71	KAUF	74.67	0.8333	62

*PIPT, MDLT, and MDLO did not measure enough data from 2004 through 2008 to calculate a complete DV_B. The DV_B shown uses all available data.

[#]The 2006 DV_B is different from the 2006 regulatory design value (DV_R). Figure 3-1: 2006 *Baseline Design Value Calculation* illustrates how the 2006 DV_B is calculated using the three years of DV_R data.

This DFW AD SIP revision for the 2008 Ozone NAAQS also provides ozone reduction trends analyses and other supplementary data and information to demonstrate that the DFW 10-county nonattainment area will attain the 2008 eight-hour ozone standard by the December 31, 2018 attainment date, as originally proposed, and to demonstrate progress toward attainment

by the new 2017 attainment year. This analysis is still relevant for the future 2017 analysis. The quantitative and qualitative corroborative analyses in Chapter 5 demonstrates attainment of the 2008 eight-hour ozone standard and progress toward attainment by the new 2017 attainment year. Additional technical information is summarized below.

This DFW AD SIP revision incorporates two rulemakings (Rule Project Numbers 2013-048-115-AI and 2013-049-117-AI) to fulfill reasonably available control technology (RACT) requirements for all control techniques guidelines (CTG) emission source categories and all non-CTG major sources of VOC and NO_X as required by the Federal Clean Air Act (FCAA), §172(c)(1) and §182(b)(2). The major source threshold for moderate nonattainment areas is a potential to emit 100 tons per year (tpy) or more of either NO_X or VOC. The 100 tpy major source threshold applies in the newly designated Wise County. A 50 tpy major source threshold is retained for the remaining nine counties, which are currently classified as a serious nonattainment area under the 1997 eight-hour ozone NAAQS. These counties must continue to apply the more stringent threshold. The commission has previously adopted Chapter 115 VOC and Chapter 117 NO_X rules to satisfy RACT requirements for sources in the nine-county DFW nonattainment area as part of the SIP for the one-hour ozone standard and the 1997 eight-hour ozone standard. The rulemakings would satisfy RACT requirements for Wise County and for any sources identified in the DFW nonattainment area that are not already subject to the existing rules.

This DFW AD SIP revision also includes the following FCAA-required SIP elements: a reasonably available control measures analysis, a RACT analysis, MVEBs, and a contingency plan. The MVEB can be found in Table 4-2: *2018 Attainment Demonstration MVEB[1] for the 10-County DFW Area*.

An MVEB must be used in transportation conformity analyses. Areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. An MVEB represents the on-road mobile source emissions that have been modeled for the AD, and includes all of the on-road control measures. Timing did not allow for the development and inclusion of a complete AD based on 2017, so the on-road emissions inventories included in this DFW AD SIP revision are for a 2018 MVEB. Until the Texas Commission on Environmental Quality (TCEQ) submits and the EPA finds adequate AD SIP MVEBs for a 2017 attainment year, the 2017 milestone year MVEBs established by the DFW Reasonable Further Progress SIP Revision for the 2008 Eight-Hour Ozone Standard (Project Number 2013-014-SIP-NR), if found adequate, can be used for transportation planning and conformity purposes.

This DFW AD SIP revision includes Wise County as part of the DFW 2008 eight-hour ozone standard nonattainment area since it was designated as nonattainment by the EPA in the final designations rule published in the *Federal Register* on May 21, 2012 (77 FR 30088). However, the TCEQ and other concerned parties are currently challenging whether the EPA's inclusion of Wise County in the DFW 2008 eight-hour ozone nonattainment area was lawful. These challenges are currently pending in the United States Court of Appeals for the District of Columbia Circuit.

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[1] The MVEB can be found in Table 4-2: *2018 Attainment Demonstration [1]MVEB for the 10-County DFW Area*.

In addition to revisions made in response to the D.C. Circuit Court's ruling, which changed the attainment deadline for the DFW nonattainment area, several other revisions to this DFW AD SIP revision were made after proposal.

The EPA made the 2014 version of the Motor Vehicle Emissions Simulator (MOVES) model (MOVES2014) available on July 31, 2014; officially released the MOVES2014 version of the model as a replacement to MOVES2010b for SIP applications on October 7, 2014 (70 FR 60343). An update was released on October 27, 2014. The October 27, 2014 update fixed a significant error in the new non-road portion of MOVES2014; addressed a number of minor issues with the on-road portion of MOVES2014; improved the installation process; and included small performance improvements. The October 27, 2014 version of MOVES2014 was used for all on-road emission inventories. The on-road emissions inventories included with the photochemical modeling included in the proposed DFW AD SIP revision were developed with the older MOVES2010b model.

Additionally, on December 3, 2014, the EPA released *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze*. The major update in this guidance recommends future ozone DV_F calculations per monitor on the 10 days of the baseline episode with the highest modeled ozone values. The proposed DFW AD SIP revision was based on the previous modeling guidance for the 1997 eight-hour ozone standard that recommended DV_F calculations per monitor on all baseline episode days modeled above a specific threshold such as 75 ppb. The revised guidance includes additional minor changes, but these do not affect the modeling inputs.

Version 1.6.1 of the Texas NONROAD (TexN) emissions model for estimation of non-road emissions estimates became available on July 30, 2014. The non-road emissions inventories included with the proposed DFW AD SIP revision were developed with version 1.6 of TexN, while version 1.6.1 was used to estimated non-road emissions for this DFW AD SIP revision.

A study contracted to Eastern Research Group, Inc. (ERG) was completed on August 1, 2014 that updated emission rates for hydraulic pump engines and mud degassing activities associated with oil and gas production. The oil and gas emissions estimates included with the proposed DFW AD SIP revision were developed with older emission factors for this type of activity. In addition, revised 2013 historical production data became available from the Railroad Commission of Texas (RRC), which impacted 2018 projections of emissions from natural gas compressor engines. The changes in the anthropogenic emissions estimates resulting from these updates are discussed in Chapter 2: *Anthropogenic Emissions Inventory (EI) Description*, Section 2.6: *Emissions Inventory (EI) Improvement*.

For this DFW AD SIP revision, the photochemical model was run for both 2006 and 2018 using these updated EI inputs. The 2018 DV_F calculations are provided using both the older methodology for all modeled days above 75 ppb and the new draft guidance methodology of using only the 10 highest days. A weight of evidence (WoE) range of 73-78 ppb is inferred from the older guidance, and use of the older "all days" attainment test results in a peak ozone design value of 76 ppb that falls within this 73-78 ppb range. The results reported in Table ES-2 are based on this older "all days" attainment test. The newer guidance does not specify a WoE range, and instead requires that the DV_F figures be "close to the NAAQS." The newer "top 10 days" attainment test results in a peak ozone design value of 75 ppb that meets this requirement. Differences in the application of these two tests are more thoroughly described in Chapter 3: *Photochemical Modeling*, Section 3.7.2: *Future Baseline Modeling*.

The TCEQ is committed to developing and applying the best science and technology towards addressing and reducing ozone formation as required in the DFW and other ozone nonattainment areas in Texas. This DFW AD SIP revision also includes a description of how the TCEQ continues to use new technology and investigate possible emission reduction strategies and other practical methods to make progress in air quality improvement.

SECTION V-A: LEGAL AUTHORITY

General

The Texas Commission on Environmental Quality (TCEQ) has the legal authority to implement, maintain, and enforce the National Ambient Air Quality Standards (NAAQS) and to control the quality of the state's air, including maintaining adequate visibility.

The first air pollution control act, known as the Clean Air Act of Texas, was passed by the Texas Legislature in 1965. In 1967, the Clean Air Act of Texas was superseded by a more comprehensive statute, the Texas Clean Air Act (TCAA), found in Article 4477-5, Vernon's Texas Civil Statutes. The legislature amended the TCAA in 1969, 1971, 1973, 1979, 1985, 1987, 1989, 1991, 1993, 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, and 2013. In 1989, the TCAA was codified as Chapter 382 of the Texas Health and Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is the principal authority in the state on matters relating to the quality of air resources. In 1991, the legislature abolished the TACB effective September 1, 1993, and its powers, duties, responsibilities, and functions were transferred to the Texas Natural Resource Conservation Commission (TNRCC). With the creation of the TNRCC, the authority over air quality is found in both the Texas Water Code and the TCAA. Specifically, the authority of the TNRCC is found in Chapters 5 and 7. Chapter 5, Subchapters A - F, H - J, and L, include the general provisions, organization, and general powers and duties of the TNRCC, and the responsibilities and authority of the executive director. Chapter 5 also authorizes the TNRCC to implement action when emergency conditions arise and to conduct hearings. Chapter 7 gives the TNRCC enforcement authority. In 2001, the 77th Texas Legislature continued the existence of the TNRCC until September 1, 2013, and changed the name of the TNRCC to the TCEQ. In 2009, the 81st Texas Legislature, during a special session, amended section 5.014 of the Texas Water Code, changing the expiration date of the TCEQ to September 1, 2011, unless continued in existence by the Texas Sunset Act. In 2011, the 82nd Texas Legislature continued the existence of the TCEQ until 2023.

The TCAA specifically authorizes the TCEQ to establish the level of quality to be maintained in the state's air and to control the quality of the state's air by preparing and developing a general, comprehensive plan. The TCAA, Subchapters A - D, also authorize the TCEQ to collect information to enable the commission to develop an inventory of emissions; to conduct research and investigations; to enter property and examine records; to prescribe monitoring requirements; to institute enforcement proceedings; to enter into contracts and execute instruments; to formulate rules; to issue orders taking into consideration factors bearing upon health, welfare, social and economic factors, and practicability and reasonableness; to conduct hearings; to establish air quality control regions; to encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the federal government; and to establish and operate a system of permits for construction or modification of facilities.

Local government authority is found in Subchapter E of the TCAA. Local governments have the same power as the TCEQ to enter property and make inspections. They also may make recommendations to the commission concerning any action of the TCEQ that affects their territorial jurisdiction, may bring enforcement actions, and may execute cooperative agreements with the TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA and the rules or orders of the commission.

Subchapters G and H of the TCAA authorize the TCEQ to establish vehicle inspection and maintenance programs in certain areas of the state, consistent with the requirements of the Federal Clean Air Act; coordinate with federal, state, and local transportation planning agencies to develop and implement transportation programs and measures necessary to attain and maintain the NAAQS; establish gasoline volatility and low emission diesel standards; and fund and authorize participating counties to implement vehicle repair assistance, retrofit, and accelerated vehicle retirement programs.

Applicable Law

The following statutes and rules provide necessary authority to adopt and implement the state implementation plan (SIP). The rules listed below have previously been submitted as part of the SIP.

Statutes

All sections of each subchapter are included, unless otherwise noted.

Texas Health and Safety Code, Chapter 382	September 1, 2013
Texas Water Code	September 1, 2013

Chapter 5: Texas Natural Resource Conservation Commission

- Subchapter A: General Provisions
- Subchapter B: Organization of the Texas Natural Resource Conservation Commission
- Subchapter C: Texas Natural Resource Conservation Commission
- Subchapter D: General Powers and Duties of the Commission
- Subchapter E: Administrative Provisions for Commission
- Subchapter F: Executive Director (except §§5.225, 5.226, 5.227, 5.2275,5.231, 5.232, and 5.236)
- Subchapter H: Delegation of Hearings
- Subchapter I: Judicial Review
- Subchapter J: Consolidated Permit Processing
- Subchapter L: Emergency and Temporary Orders (§§5.514, 5.5145, and 5.515 only)
- Subchapter M: Environmental Permitting Procedures (§5.558 only)

Chapter 7: Enforcement

- Subchapter A: General Provisions (§§7.001, 7.002, 7.0025, 7.004, and 7.005 only)
- Subchapter B: Corrective Action and Injunctive Relief (§7.032 only)
- Subchapter C: Administrative Penalties
- Subchapter D: Civil Penalties (except §7.109)
- Subchapter E: Criminal Offenses and Penalties: §§7.177, 7.179-7.183

Rules

All of the following rules are found in 30 Texas Administrative Code, as of the following latest effective dates:

Chapter 7: Memoranda of Understanding, §§7.110 and 7.119	December 13, 1996 and May 2, 2002
Chapter 19: Electronic Reporting	March 15, 2007
Chapter 35: Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	July 20, 2006

Chapter 39: Public Notice, §§39.402(a)(1) - (6), (8), and (10) - (12), 39.405(f)(3) and (g), (h)(1)(A) - (4), (6), (8) - (11), (i) and (j), 39.407, 39.409, 39.411(a), (e)(1) - (4)(A)(i) and (iii), (4)(B), (5)(A) and (B), and (6) - (10), (11)(A)(i) and (iii) and (iv), (11)(B) - (F), (13) and (15), and (f)(1) - (8), (g) and (h), 39.418(a), (b)(2)(A), (b)(3), and (c), 39.419(e), 39.420 (c)(1)(A) - (D)(i)(I) and (II), (D)(ii), (c)(2), (d) - (e), and (h), and 39.601 - 39.605	April 17, 2014
Chapter 55: Requests for Reconsideration and Contested Case Hearings; Public Comment, §§55.150, 55.152(a)(1), (2), (5), and (6) and (b), 55.154(a), (b), (c)(1) - (3), and (5), and (d) - (g), and 55.156(a), (b), (c)(1), (e), and (g)	June 24, 2010
Chapter 101: General Air Quality Rules	April 17, 2014
Chapter 106: Permits by Rule, Subchapter A	April 17, 2014
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter	February 6, 2014
Chapter 112: Control of Air Pollution from Sulfur Compounds	July 16, 1997
Chapter 113: Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants	May 14, 2009
Chapter 114: Control of Air Pollution from Motor Vehicles	May 21, 2015
Chapter 115: Control of Air Pollution from Volatile Organic Compounds	October 2, 2014
Chapter 116: Permits for New Construction or Modification	July 31, 2014
Chapter 117: Control of Air Pollution from Nitrogen Compounds	May 2, 2013
Chapter 118: Control of Air Pollution Episodes	March 5, 2000
Chapter 122: §122.122: Potential to Emit	April 17, 2014
Chapter 122: §122.215: Minor Permit Revisions	June 3, 2001
Chapter 122: §122.216: Applications for Minor Permit Revisions	June 3, 2001
Chapter 122: §122.217: Procedures for Minor Permit Revisions	December 11, 2002
Chapter 122: §122.218: Minor Permit Revision Procedures for Permit Revisions Involving the Use of Economic Incentives, Marketable Permits, and Emissions Trading	June 3, 2001

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ABY	adjusted base year
ACT	alternative control techniques
AD	attainment demonstration
AGL	above ground level
APCA	Anthropogenic Precursor Culpability Assessment
AQRP	Air Quality Research Program
ARD	Acid Rain Database
ARLA	Arlington Monitor (C61)
Auto-GC	automated gas chromatograph
BACT	best available control technology
BELD	Biogenic Emissions Landuse Database
BOEMRE	United States Bureau of Ocean Energy Management Service
BPA	Beaumont-Port Arthur
CAIR	Clean Air Interstate Rule
CAMS	continuous air monitoring station
CAMx	Comprehensive Air Model with Extension(s)
CB05	Carbon Bond 05
CB6	Carbon Bond 6
CFR	Code of Federal Regulations
CISL	Computational and Information Systems Laboratory
CLEB	Cleburne Monitor (C77)
CLVL	Clarksville Monitor (C648)
CO	carbon monoxide
CSAPR	Cross-State Air Pollution Rule
CTG	control techniques guidelines
D.C.	District of Columbia
DALN	Dallas North Monitor (C63)
DACM	AirCheckTexas Drive a Clean Machine
DENT	Denton Monitor (C56)
DERC	discrete emission reduction credit
DERI	Diesel Emissions Reduction Incentive Program
DFW	Dallas-Fort Worth
DHIC	Dallas Hinton Monitor (C401)

DV_B	baseline year design value
DV_F	future year design value
DV_R	regulatory design value
EDMS	Emissions Dispersion Modeling System
EE	energy efficiency
EE/RE	energy efficiency and renewable energy
EGU	electric generating unit
EI	emissions inventory
EIQ	emissions inventory questionnaire
EMTL	Eagle Mountain Lake Monitor (C75)
EPA	United States Environmental Protection Agency
EPS	Emissions Processing System
ERG	Eastern Research Group, Inc.
ESL	environmental speed limit
FCAA	Federal Clean Air Act
FINN	Fire Inventory of NCAR
FR	*Federal Register*
FTP	File Transfer Protocol
FRIC	Frisco Monitor (C31)
FWMC	Fort Worth Northwest Monitor (C13)
FY	fiscal year
GCIP	Continental-International Project
GDF	gasoline dispensing facility
GEOS-Chem	Goddard Earth Observing Station global atmospheric model with Chemistry
GEWEX	Global Energy and Water Cycle Experiment
GloBEIS	Global Biosphere Emissions and Interactions System
gm/hp-hr	grams per horsepower-hour
GOES	Geostationary Operational Environmental Satellite
GRAN	Granbury Monitor (C73)
GRAP	Grapevine Monitor (C70)
GRVL	Greenville Monitor (C1006)
GSE	ground support equipment
GWEI	Gulf-Wide Emissions Inventory
HB	House Bill

HECT	Highly Reactive Volatile Organic Compound Emissions Cap and Trade
HGB	Houston-Galveston-Brazoria
hp	horsepower
HPMS	Highway Performance Monitoring System
HRVOC	highly reactive volatile organic compounds
I/M	inspection and maintenance
ICI	industrial, commercial, and institutional
INEGI	National Institute of Statistics and Geography
IOP	increment-of-progress
ITHS	Italy High School (C60)
KAUF	Kaufman Monitor (C71)
KELC	Keller Monitor (C17)
km	kilometer
Kv	vertical diffusity
KVPATCH	landuse based minimum Kv for all domains
LAI	leaf area index
LAIv	fractional vegetated leaf area index
LANDFIRE	Landscape Fire and Resource Management
LCC	Lambert Conformal Conic
LIRAP	Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program
m	meter
m/s	meters per second
MATS	Modeled Attainment Test Software
MACT	maximum achievable control technology
MDA8	maximum daily average eight-hour
MDLO	Midlothian Old Fort Worth Monitor (C52)
MDLT	Midlothian Tower Monitor (C94)
MECT	Mass Emissions Cap and Trade
MEGAN	Model of Emissions of Gases and Aerosols from Nature
MM5	Mesoscale Meteorological Model, Fifth Generation
MMBTU	million British Thermal Units
MMcf	million cubic feet
MNB	Mean Normalized Bias
MNGE	Mean Normalized Gross Error

MODIS	Moderate-Resolution Imaging Spectroradiometer
MOVES	Motor Vehicle Emission Simulator
MOZART	Model for Ozone and Related Chemical Tracers
MPE	model performance evaluation
mph	miles per hour
MVEB	motor vehicle emissions budget
NAAQS	National Ambient Air Quality Standard
NCAR	National Center for Atmospheric Research
NCEP	National Center for Environmental Prediction
NCore	National Core network
NCTCOG	North Central Texas Council of Governments
NEI	National Emissions Inventory
NLCD	National Land Cover Dataset
NMIM	National Mobile Inventory Model
NO_2	nitrogen dioxide
NOAH	National Centers for Environmental Prediction, Oregon State, Air Force, and Hydrologic Research Laboratory
NO_X	nitrogen oxides
NPRI	National Pollutant Release Inventory
NSPS	New Source Performance Standards
OMI	Ozone Monitoring Instrument
ORVR	Onboard Refueling Vapor Recovery
OSAT	Ozone Source Apportionment Technology
PAR	photosynthetically active radiation
PBL	planetary boundary layer
PEI	periodic emissions inventory
PFT	plant functional types
PiG	Plume-in-Grid
PIPT	Pilot Point Monitor (C1032)
PLTN	Palestine Monitor (C647)
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
ppb	parts per billion
ppm	parts per million
PUCT	Public Utility Commission of Texas
RACM	reasonably available control measures

RACT	reasonably available control technology
RE	renewable energy
REDB	Dallas Executive Airport Monitor (C402)
RFG	reformulated gasoline
RFP	reasonable further progress
RKWL	Rockwall Health Monitor (C69)
ROP	rate-of-progress
RRC	Railroad Commission of Texas
RRF	relative response factor
RRTM	Rapid Radiative Transfer Model
RVP	Reid vapor pressure
SAGA	San Augustine Airport Monitor (C646)
SB	Senate Bill
SECO	State Energy Conservation Office
SEER	Seasonal Energy Efficiency Ratio
SIC	standard industrial classification
SIP	state implementation plan
SLAMS	State and Local Air Monitoring Stations
SO_2	sulfur dioxide
STARS	State of Texas Air Reporting System
TAC	Texas Administrative Code
TACB	Texas Air Control Board
TATU	TCEQ Attainment Test for Unmonitored Areas
TCAA	Texas Clean Air Act
TCEQ	Texas Commission on Environmental Quality (commission)
TCFP	Texas Clean Fleet Program
TCM	transportation control measure
TDM	travel demand model
TERP	Texas Emission Reduction Plan
TexAER	Texas Air Emissions Repository
TexAQS II	Texas Air Quality Study 2006
TexN	Texas NONROAD
TNMOC	total non-methane organic carbon
TNRCC	Texas Natural Resource Conservation Commission
tpd	tons per day

tpy	tons per year
TTI	Texas Transportation Institute
TUC	Texas Utilities Code
TxDOT	Texas Department of Transportation
TxLED	Texas Low Emission Diesel
U.S.	United States
UMA	unmonitored area
UPA	Unpaired Peak Accuracy
VMEP	Voluntary Mobile Emissions Reduction Program
VMT	vehicle miles traveled
VNA	Voroni Neighbor Averaging
VOC	volatile organic compounds
WoE	weight of evidence
WPS	Weather Research and Forecasting Model Preprocessing System
WRF	Weather Research and Forecasting Model
WTFD	Weatherford Parker County Monitor (C76)
YSU	Yonsei University

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CHAPTER 1: GENERAL

1.1 BACKGROUND

The *History of the Texas State Implementation Plan*, a comprehensive overview of the state implementation plan (SIP) revisions submitted to the United States Environmental Protection Agency (EPA) by the State of Texas, is available on the Introduction to the SIP Web page (http://www.tceq.texas.gov/airquality/sip/sipintro.html#what-is-the-history) on the Texas Commission on Environmental Quality's (TCEQ) Web site (http://www.tceq.texas.gov/).

1.2 INTRODUCTION

The following history of the one-hour and eight-hour ozone standards and summaries of the Dallas-Fort Worth (DFW) area one-hour and 1997 eight-hour ozone SIP revisions are provided to give context and greater understanding of the complex issues involved in DFW's ozone challenge.

1.2.1 One-Hour National Ambient Air Quality Standard (NAAQS) History

The EPA established the one-hour ozone NAAQS of 0.08 parts per million (ppm) in the April 30, 1971 issue of the *Federal Register* (FR) (36 FR 8186). The EPA revised the one-hour ozone standard to 0.12 ppm on February 8, 1979 (44 FR 4202). The DFW one-hour ozone nonattainment area (Collin, Dallas, Denton, and Tarrant Counties) was designated in 1991 as moderate in accordance with the 1990 Federal Clean Air Act (FCAA) Amendments (56 FR 56694). As a moderate nonattainment area, the DFW area was required to demonstrate attainment of the one-hour ozone standard by November 15, 1996. Ambient air monitoring data for the years 1994 through 1996, however, showed that the one-hour ozone standard was exceeded more than one day per year over the three-year period. As a result, the EPA reclassified the DFW area from a moderate to a serious nonattainment area (effective March 20, 1998) for failure to attain the one-hour ozone standard by the November 1996 deadline (63 FR 8128). The EPA required the State of Texas to submit a SIP revision within one year that demonstrated attainment of the one-hour ozone NAAQS and addressed FCAA requirements for serious ozone nonattainment areas.

1.2.1.1 March 1999

The TCEQ submitted the Attainment Demonstration for the Dallas-Fort Worth Ozone Nonattainment Area SIP revision, which contained a rate-of-progress (ROP) demonstration, to the EPA on March 18, 1999. The photochemical modeling contained in the revision indicated that additional reductions in nitrogen oxides (NO_X) emissions would be needed to attain the standard by November 1999. The following rules were developed and included in the SIP revision:

- reasonably available control technology (RACT) for NO_X point sources;
- nonattainment new source review for NO_X point sources; and
- revisions resulting from the change in the major source threshold for RACT applicability for volatile organic compounds (VOC).

Additionally, the commission indicated that, due to time constraints, the ROP demonstration for the serious classification, would not incorporate all rules that were necessary to bring the DFW nonattainment area into attainment by the November 1999 deadline and that a complete

attainment demonstration (AD) would be submitted in the spring of 2000. The EPA determined that the AD and ROP demonstration were incomplete.

Additional local control strategies were necessary for the DFW nonattainment area to reach attainment. To develop further control strategy options to augment the federal and state programs in the AD and ROP SIP revision, the DFW area established the North Texas Clean Air Steering Committee. The committee members included local elected officials, business leaders, and other community stakeholders. This committee identified specific control strategies for review by technical subcommittee members.

1.2.1.2 April 2000

On April 19, 2000, the commission adopted a SIP revision and associated rules for the DFW one-hour ozone AD. The April 2000 One-Hour Ozone Attainment Demonstration SIP revision contained a number of control strategies and the following elements:

- a modeling demonstration that showed air quality in the DFW nonattainment area was influenced at times by transport from the Houston-Galveston-Brazoria (HGB) nonattainment area (Under the EPA's July 16, 1998 transport policy[2], if photochemical modeling demonstrated that emissions from an upwind area located in the same state and with a later attainment date interfered with the downwind area's ability to attain, the downwind area's attainment date could be extended to no later than that of the upwind area. For the DFW nonattainment area, following this policy would extend the attainment date to November 15, 2007, the same attainment date as the HGB area.);
- photochemical modeling of specific control measures and future state and national rules for attainment of the one-hour ozone standard in the DFW nonattainment area by the attainment deadline of November 15, 2007;
- identification of the VOC and NO_X emissions reductions necessary to attain the one-hour ozone standard by 2007. The reductions of 141 tons per day (tpd) NO_X from federal measures and 225 tpd NO_X from state measures resulted in a total of 366 tpd NO_X reductions for the AD;
- a 2007 motor vehicle emissions budget (MVEB) for transportation conformity; and
- a commitment to perform and submit a mid-course review by May 1, 2004.

At the time it was submitted, the April 2000 One-Hour Ozone Attainment Demonstration SIP revision allowed the EPA to determine that the DFW nonattainment area should not be reclassified from serious to severe under the conditions of the EPA's July 16, 1998 transport policy.

1.2.1.3 August 2001

The next commission action was required by legislative mandate. Senate Bill (SB) 5, passed by the 77th Texas Legislature in May 2001, required the repeal of two rules contained in the April 2000 one-hour AD SIP revision. The first rule restricted the use of construction and industrial equipment (non-road, heavy-duty diesel equipment rated at 50 horsepower (hp) or greater). The second rule required the replacement of diesel-powered construction, industrial, commercial, and lawn and garden equipment rated at 50 hp or greater with newer Tier 2 or Tier 3 equipment. The Texas Emissions Reduction Plan (TERP) grant incentive program established

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[2] Additional information on the EPA's *Guidance on Extension of Attainment Dates for Downwind Transport Areas* is available at http://www.epa.gov/ttn/oarpg/t1/memoranda/transpor.pdf.

by SB 5 replaced the NO_X emissions reductions previously claimed for the two programs. The commission implemented the legislative mandate of SB 5 by submitting the rule repeals as part of a SIP revision adopted in August 2001.

1.2.1.4 March 2003

On March 5, 2003, the SIP was further revised to include the following:

- the adoption of revised 30 Texas Administrative Code (TAC) Chapter 117 NO_X emission limits for cement kilns;
- the estimation of NO_X reductions from energy efficiency measures, using a methodology that was to be further refined before energy efficiency credit was formally requested in the SIP revision; and
- the commitment to perform modeling with MOBILE6, the latest version of the EPA's emission factor model for mobile sources at that time.

Meanwhile, the EPA's July 16, 1998, transport policy, on which the extension of the DFW nonattainment area's attainment date to November 15, 2007 was based, was challenged by environmental groups. A suit was filed challenging the extension of the Beaumont-Port Arthur (BPA) area's attainment date based on transport from the HGB area. On December 11, 2002, the United States Fifth Circuit Court of Appeals ruled that the EPA was not authorized to extend the BPA area's attainment date based on transport. The EPA published a final action in the *Federal Register* on March 30, 2004 reclassifying the BPA area to serious with an attainment date of November 15, 2005 and requiring a new AD to be submitted by April 30, 2005. Although the court decision was specifically for the BPA area, the direct implication for the DFW nonattainment area was that the EPA could not approve extensions of the DFW one-hour ozone attainment date past 1999, the date mandated by the FCAA for serious areas. In addition, the EPA did not approve the April 2000 One-Hour Ozone DFW Attainment Demonstration SIP revision.

1.2.1.5 EPA Determination of One-Hour Ozone Attainment

Since the early 1990s, when the DFW area was designated as nonattainment for the one-hour ozone standard, much has been done to bring the area into attainment with federal air quality standards. Contributions to improved air quality in the DFW nonattainment area include: TCEQ-implemented control strategies, local control strategies adopted by the North Central Texas Council of Governments (NCTCOG), and on-road and non-road mobile source measures implemented by the EPA. Despite the EPA's lack of approval for multiple SIP revisions, air quality in the DFW nonattainment area continued to improve.

By 2006, ambient monitoring data reflected attainment of the one-hour standard. On October 16, 2008, the EPA published final determination (73 FR 61357) that the DFW area one-hour ozone nonattainment counties (Collin, Dallas, Denton, and Tarrant) had attained the one-hour ozone standard with a design value of 124 parts per billion (ppb), based on verified 2004 through 2006 monitoring data.

1.2.2 1997 Eight-Hour Ozone NAAQS History

In 1997, the EPA revised the NAAQS for ozone, setting it at 0.08 ppm averaged over an eight-hour time frame. The final 1997 eight-hour ozone NAAQS was published in the *Federal Register* on July 18, 1997 (62 FR 38856) and became effective on September 16, 1997. On April 30, 2004, the EPA finalized its designations and promulgated the first phase of its implementation rule for the 1997 eight-hour ozone standard (69 FR 23951). These actions became effective on June 15, 2004. The EPA designated the nine-county (Collin, Dallas, Denton, Ellis, Johnson, Kaufman,

Parker, Rockwall, and Tarrant Counties) DFW area as nonattainment for the standard with a moderate classification. The TCEQ was required to submit a SIP revision for the 1997 eight-hour ozone NAAQS to the EPA by June 15, 2007, and demonstrate attainment of the standard by June 15, 2010. In the November 29, 2005 issue of the *Federal Register* (70 FR 71612), the EPA published its second phase of the implementation rule for the 1997 eight-hour ozone NAAQS, which addressed the control obligations that apply to areas designated nonattainment for the standard.

In Phase I of its implementation rule (40 Code of Federal Regulations (CFR) §51.905(a)(ii)) and subsequent guidance, the EPA provided three options for areas such as the DFW nonattainment area that did not have an approved one-hour ozone attainment plan at the time of designation:

A. submit a one-hour AD SIP revision no later than one year after designation (by June 15, 2005);
B. submit an eight-hour ozone plan no later than one year after designation (by June 15, 2005) that provided a 5% increment of emissions reductions from the area's 2002 emissions baseline, in addition to federal and state measures already approved by the EPA, and achieve those reductions by June 15, 2007; or
C. submit an eight-hour ozone AD by June 15, 2005.

Texas selected option B, the 5% increment-of-progress (IOP) plan, as a technically sound and expeditious approach to initiating the reductions ultimately needed for attainment of the eight-hour ozone standard. The 5% IOP SIP revision, adopted by the commission on April 27, 2005 contained several elements:

- 2002 periodic emissions inventory (EI) for the nine-county DFW eight-hour ozone nonattainment area;
- a 5% reduction in emissions from the 2002 EI baseline;
- identification of the control measures to achieve the necessary NO_X and VOC emission reductions; and
- MVEBs for use in transportation conformity demonstrations.

1.2.2.1 May 23, 2007

The commission adopted the May 2007 DFW Attainment Demonstration SIP revision and the reasonable further progress (RFP) SIP revision for the DFW nonattainment area on May 23, 2007. These SIP revisions were the first step in addressing the 1997 eight-hour ozone standard in the DFW nonattainment area.

This eight-hour ozone SIP revision for the DFW nonattainment area contained photochemical modeling and weight of evidence (WoE), including corroborative analysis and additional measures not included in the model. In addition to the existing control strategies in the DFW nonattainment area, the SIP revision included new rules for the following sources:

- DFW nonattainment area cement kilns;
- DFW nonattainment area electric generating utilities (EGU);
- DFW nonattainment area industrial, commercial, and institutional major sources;
- DFW nonattainment area minor sources; and
- East Texas combustion sources in 33 counties beyond the DFW nonattainment area.

The SIP revision included additional commitments for a Voluntary Mobile Emissions Reduction Program (VMEP) and transportation control measures (TCM). The revision also contained the reasonably available control measure (RACM) analysis, RACT analysis, contingency measures, emissions inventories, and MVEBs.

On July 14, 2008, the EPA proposed conditional approval (73 FR 40203) of the May 2007 DFW AD SIP Revision, providing that final conditional approval was contingent upon the State of Texas adopting and submitting to the EPA an approvable contingency plan SIP revision for the DFW nonattainment area. The Dallas-Fort Worth Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard (Contingency Measures Plan) was adopted by the commission on November 5, 2008 and submitted to the EPA on November 15, 2008. The SIP revision identified measures to satisfy the EPA's 3% reduction contingency requirement for 2010 for the DFW nonattainment area, to apply in the event that the DFW nonattainment area failed to meet the 1997 eight-hour ozone standard by the attainment deadline.

An additional condition stipulated by the EPA for final approval of the May 2007 DFW AD SIP Revision was that the TCEQ adopt and submit rule and SIP revisions to implement an enforceable mechanism to limit the use of discrete emission reduction credits (DERC) in the DFW nonattainment area by March 1, 2009. The DFW AD SIP Revision for the 1997 Eight-Hour Ozone Standard DERC Program incorporated rulemaking that amended Chapter 101, Subchapter H, Division 4: *Discrete Emission Credit Banking and Trading* rules to set a limit on DERC use for the DFW nonattainment area.

On January 14, 2009, the EPA published final conditional approval of components of the 2007 AD SIP revision, including the May 2007 DFW AD SIP revision, the April 2008, and November 2008 supplements. The approval provided conditional approval of the 2009 attainment MVEBs, RACM demonstration, and failure-to-attain contingency plan, full approval of local VMEP and TCMs, full approval of the VOC RACT demonstrations for the one-hour and 1997 eight-hour ozone standards, and a statement that all control measures and reductions relied upon to demonstrate attainment were approved by the EPA.

On March 10, 2010, the commission adopted the DFW RACT Update, 30 TAC Chapter 117 Rule Revision Noninterference Demonstration, and Modified Failure-to-Attain Contingency Plan SIP Revision. This SIP revision incorporated several actions adopted by the commission, and supplemented the 1997 eight-hour ozone AD by demonstrating that the revised Chapter 117 rule does not interfere with the DFW AD SIP Revision.

On August 25, 2010, the commission adopted a SIP revision to convert an environmental speed limit (ESL) control strategy to a TCM for the 1997 eight-hour ozone standard in the DFW nonattainment area. The EPA approved this revision to the SIP for the DFW ozone nonattainment area to recategorize a local ESL control measure as a TCM effective on March 10, 2014.

1.2.2.2 Reclassification to Serious for the 1997 Eight-Hour Ozone Standard

The DFW 1997 eight-hour ozone standard nonattainment area is currently classified as serious nonattainment. In 2009, the monitored design value (complete ozone season prior to the attainment date) for the DFW nonattainment area was 86 ppb. Effective January 19, 2011, the EPA finalized a determination that the DFW nonattainment area did not attain the 1997 eight-hour ozone standard by June 15, 2010, the deadline set by the Phase I implementation guidance for the 1997 ozone standard for areas classified as moderate (75 FR 79302). Based on that determination, the EPA reclassified the DFW nonattainment area to serious and set a January

19, 2012 deadline for the state to submit an AD SIP revision that addressed the 1997 eight-hour ozone standard serious nonattainment area requirements, including RFP. The DFW nonattainment area's new attainment date for the 1997 eight-hour ozone standard was as expeditiously as practicable, but no later than June 15, 2013 which required that only data through 2012 could be used to determine attainment under the EPA's rules.

As required by the FCAA, the TCEQ published a notice in the *Texas Register*, on May 21, 2010, (http://www.sos.state.tx.us/texreg/pdf/backview/0521/0521is.pdf), implementing the area's contingency measures for failure to attain the 1997 eight-hour ozone standard by the June 15, 2010 deadline.

Concurrent with the 2011 AD SIP revision, the commission adopted revised and new RACT requirements to address the following control techniques guidelines (CTG) documents issued by the EPA from 2006 through 2008 (Rule Project Number 2010-016-115-EN): Flexible Package Printing; Industrial Cleaning Solvents; Large Appliance Coatings; Metal Furniture Coatings; Paper, Film, and Foil Coatings; Miscellaneous Industrial Adhesives; Miscellaneous Metal and Plastic Parts Coatings; and Auto and Light-Duty Truck Assembly Coatings. Concurrent with this AD SIP revision, the commission also adopted revised and new RACT requirements for VOC storage tanks (Rule Project Number 2010-025-115-EN).

This 2011 AD SIP revision included an MVEB for 2012 that represented the on-road mobile source emissions that were modeled for the AD. The DFW area's metropolitan planning organization must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. Additionally, this 2011 AD SIP revision showed that by 2012, the DFW nonattainment area would meet other serious nonattainment area requirements, including an enhanced Inspection and Maintenance Program (which had already been implemented in all nine counties), Stage II vapor recovery systems at gas stations (which had already been implemented in Collin, Dallas, Denton, and Tarrant Counties), a Clean Fuel Fleet Program (which is not required if emissions reductions from the National Low-Emissions Vehicle Program are more than what would be achieved under such a program), TCMs (which have already been implemented in all nine counties), and enhanced monitoring.

1.2.3 2008 Eight-Hour Ozone NAAQS

On March 12, 2008, the EPA lowered the primary and secondary eight-hour ozone NAAQS to 0.075 ppm (73 FR 16436). On May 21, 2012, the EPA published in the *Federal Register* final designations for the 2008 eight-hour ozone standard of 0.075 ppm. A ten-county DFW area including Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties was designated nonattainment and classified moderate under the 2008 eight-hour ozone NAAQS, effective July 20, 2012.

1.2.4 Current AD SIP Revision for the 2008 Ozone NAAQS

The attainment date for moderate nonattainment areas was established in the EPA's implementation rule for the 2008 ozone NAAQS, published in the *Federal Register* on May 21, 2012 (77 FR 30160), and was set as December 31, 2018. On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31 attainment date for the 2008 0zone NAAQS. As part of the EPA's *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements*; *Final Rule* (2008 ozone standard SIP requirements rule), published in the *Federal Register* on March 6, 2015 (80 FR 12264), the EPA modified 40 CFR §51.1103 consistent with the D.C. Circuit Court decision to establish attainment dates that run from the effective date of designation, i.e., July 20, 2012, rather than the end of the 2012 calendar year.

As a result, the attainment date for the DFW moderate nonattainment area has changed from December 31, 2018 to July 20, 2018. In addition, because the attainment year ozone season is the ozone season immediately preceding a nonattainment area's attainment date, the attainment year for the DFW moderate nonattainment area has changed from 2018 to 2017.

The proposed DFW AD SIP revision was developed based on the EPA's May 21, 2012 implementation rule for the 2008 ozone NAAQS (77 FR 30160), which set 2018 as the attainment year for areas classified as moderate. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 ozone NAAQS is July 20, 2015, which the EPA has not altered.

Due to the timing of the court's ruling and the EPA's subsequent rulemaking action, it was not possible to complete all work necessary for this DFW AD SIP revision to demonstrate attainment in 2017. Therefore, this DFW AD SIP revision includes the work completed to date to demonstrate that the DFW nonattainment area will attain the 2008 eight-hour ozone NAAQS by 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year.

In response to the D.C. Circuit Court's decision and subsequent EPA guidance, the TCEQ commits to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, corroborative analysis, a RACM analysis, and an MVEB. Because no additional analysis was needed to complete the contingency plan for attainment, Chapter 4: *Control Strategies and Required Elements*, Section 4.9: *Contingency Plan*, was revised to reflect a 2017 attainment year.

As proposed, this DFW AD SIP revision uses photochemical modeling and corroborative analysis to demonstrate that the area will attain the 2008 eight-hour ozone standard by the original December 31, 2018 attainment deadline. This DFW AD SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by 2018 based on a photochemical modeling analysis of reductions in NO_X and VOC emissions from existing control strategies and a WoE analysis.

This DFW AD SIP revision also incorporates two rulemakings (Rule Project Numbers 2013-048-115-AI and 2013-049-117-AI) to fulfill RACT requirements for all CTG emission source categories and all non-CTG major sources of VOC and NO_X as required by FCAA, §172(c)(1) and §182(b)(2). The major source threshold for moderate nonattainment areas is a potential to emit 100 tons per year (tpy) or more of either NO_X or VOC. The 100 tpy major source threshold applies in the newly designated Wise County. A 50 tpy major source threshold is retained for the remaining nine counties, which are currently classified as a serious nonattainment area under the 1997 eight-hour ozone NAAQS and therefore must continue to apply this more stringent threshold. The state has previously adopted Chapter 115 VOC and Chapter 117 NO_X rules to satisfy RACT requirements for sources in the nine-county DFW nonattainment area as part of the SIP for the 1997 eight-hour ozone standard. In 2008, the EPA approved the DFW NO_X rules in 30 TAC Chapter 117 (73 FR 73562). In 2009, the EPA approved the DFW VOC rules in 30 TAC Chapter 115 and NO_X rules for cement kilns in 30 TAC Chapter 117 as meeting the FCAA RACT requirements (74 FR 1903 and 74 FR 1927). In 2014, the EPA approved the 30 TAC Chapter 115 rules for offset lithographic printing and VOC storage tanks as meeting the FCAA RACT requirements (79 FR 45105 and 53299). The rulemakings would satisfy RACT requirements for Wise County and for any sources identified in the DFW nonattainment area that are not already subject to the existing rules.

An MVEB must be used in transportation conformity analyses. Areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. An MVEB represents the on-road mobile source emissions that have been modeled for the AD, and includes all of the on-road control measures. Timing did not allow for the development and inclusion of a complete AD based on 2017, so the on-road emissions inventories included in this DFW AD SIP revision are for a 2018 MVEB. Until the Texas Commission on Environmental Quality (TCEQ) submits and the EPA finds adequate AD SIP MVEBs for a 2017 attainment year, the 2017 milestone year MVEBs established by the DFW Reasonable Further Progress SIP Revision for the 2008 Eight-Hour Ozone Standard (Project Number 2013-014-SIP-NR), if found adequate, can be used for transportation planning and conformity purposes.

This DFW AD SIP revision includes Wise County as part of the DFW 2008 eight-hour ozone standard nonattainment area since it was designated as nonattainment by the EPA in the final designations rule published in the Federal Register on May 21, 2012 (77 FR 30088). However, the TCEQ and other concerned parties are currently challenging whether the EPA's inclusion of Wise County in the DFW 2008 eight-hour ozone nonattainment area was lawful. These challenges are currently pending in the United States Court of Appeals for the District of Columbia Circuit.

1.2.5 Existing Ozone Control Strategies

Existing control strategies implemented to address the one-hour and eight-hour ozone standards are expected to continue to reduce emissions of ozone precursors in the DFW nonattainment area and positively impact progress toward attainment of the 1997 eight-hour ozone standard and the 2008 eight-hour ozone standard. The one-hour and eight-hour ozone design values for the DFW nonattainment area from 1991 through 2013 are illustrated in Figure 1-1: *One-Hour and Eight-Hour Ozone Design Values and DFW Population*. Both design values have decreased over the past 23 years. The 2013 one-hour ozone design value was 108 ppb, representing a 23% decrease from the value for 1991 (140 ppb). The 2013 eight-hour ozone design value was 87 ppb, a 17% decrease from the 1991 value of 105 ppb. These decreases occurred despite a 66% increase in area population, as shown in Figure 1-1. As of 2014, the eight-hour ozone design value for the DFW nonattainment area is 81 ppb, which reflects a 23% decrease since 1991.

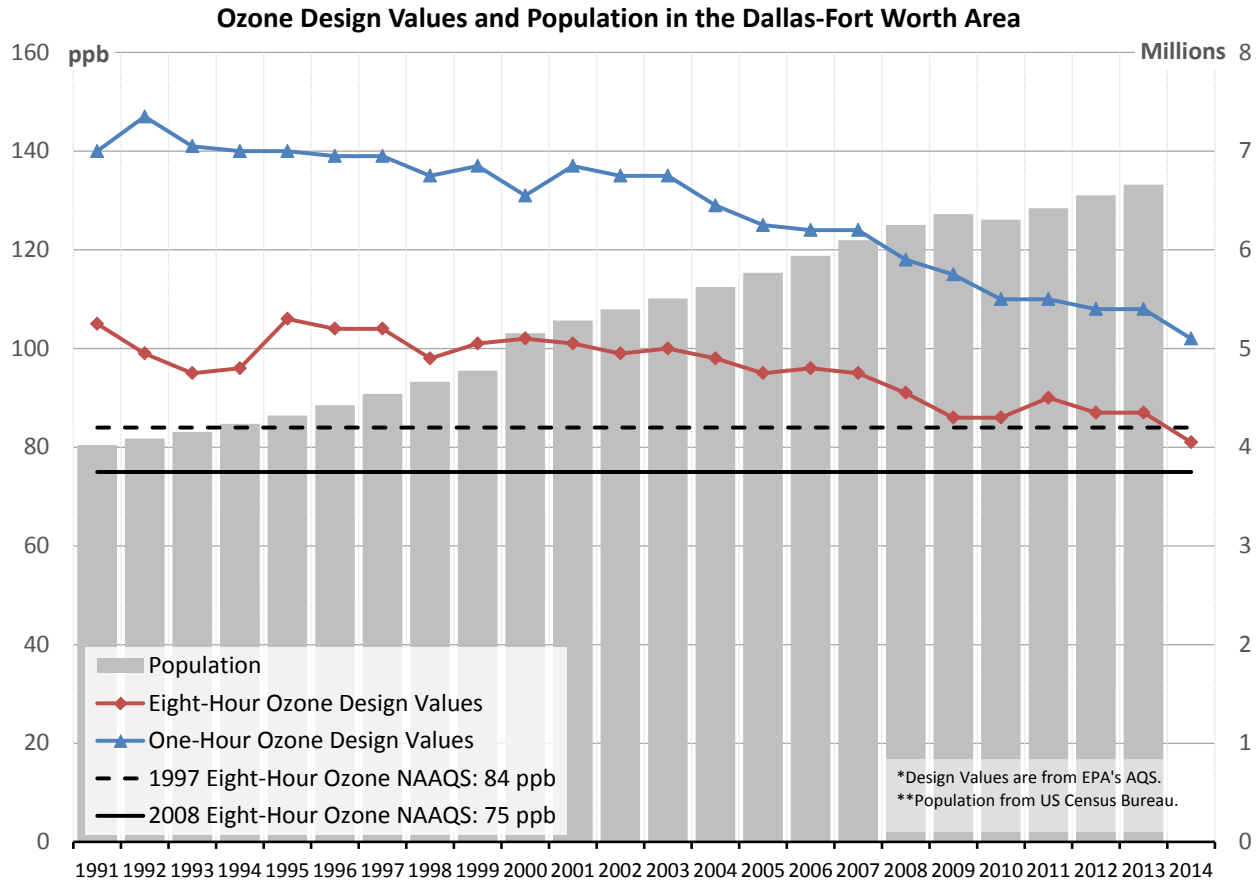

Figure 1-1: One-Hour and Eight-Hour Ozone Design Values and DFW Population

1.3 HEALTH EFFECTS

In 2008, the EPA revised the primary ozone standard to 0.075 ppm. To support the 2008 eight-hour primary ozone standard, the EPA provided information that suggested that health effects may potentially occur at levels lower than the previous 0.080 ppm standard. Breathing relatively high levels of ground-level ozone can cause acute respiratory problems like cough and decreases in lung function and can and can aggravate the symptoms of asthma. Repeated exposures to high levels of ozone can potentially make people more susceptible to allergic responses and lung inflammation.

Children are at a relatively higher risk from exposure to ozone when compared to adults, since they breathe more air per pound of body weight than adults and because children's respiratory systems are still developing. Children also spend a considerable amount of time outdoors during summer and during the start of the school year (August through October) when high ozone levels are typically recorded. Adults most at risk from exposures to elevated ozone levels are people working or exercising outdoors and individuals with preexisting respiratory diseases.

1.4 STAKEHOLDER PARTICIPATION AND PUBLIC HEARINGS

1.4.1 DFW Air Quality Technical Committee Meetings

The NCTCOG hosts periodic meetings of the Air Quality Technical Committee. The purpose of this committee is to exchange information and provide a forum for public input on air quality issues in the DFW nonattainment area. Agenda topics include the status of DFW photochemical modeling development, research initiatives, and control strategy review in preparation for the

DFW AD SIP revision for the 2008 Ozone NAAQS. The committee includes representatives from industry, county and city government, environmental groups, and the public. More information about this committee is available on the NCTGOC's Air Quality Technical Committee Web page (http://www.nctcog.org/trans/committees/AQTC/index.asp).

1.5 PUBLIC HEARING AND COMMENT INFORMATION

The public comment period opened on December 26, 2014 and was originally scheduled to close on January 30, 2015. However, a supplement[3] to the proposed DFW AD SIP revision was issued by the TCEQ on January 12, 2015 to provide additional technical detail regarding updates to anthropogenic EI inputs and calculation of future ozone design values based on results from photochemical modeling that became available after the DFW AD SIP revision was approved for proposal by the commission on December 10, 2014. Due to the supplemental technical information, the comment period for the proposed DFW AD SIP revision was extended to February 11, 2015 to allow for a full 30-day comment period for all components of the proposed DFW AD SIP revision package. Notice of public hearings for this DFW AD SIP revision was published in the *Texas Register* and various newspapers. Written comments were accepted via mail, fax, and through the eComments system (http://www5.tceq.state.tx.us/rules/ecomments).

The commission conducted public hearings in Arlington on January 15, 2015, at 6:30 p.m., and in Austin on January 22, 2015, at 10:00 a.m. During the comment period, staff received comments from the Children's Health System of Texas, the DFW Regional Concerned Citizens, the Dallas County Medical Society, Downwinders at Risk, State Representative Lon Burnam, the Greater Fort Worth Sierra Club, the Health and Wellness Alliance for Children, the League of Women Voters of Dallas, the Lone Star Chapter of the Sierra Club, Mayor John Monaco of the City of Mesquite, the North Texas Chapter of American Solar Energy Society, the Regional Transportation Council, the Texas Medical Association, Public Citizen, the Sierra Club, Solar Turbines Incorporated, Sustainable Energy and Economic Development Coalition, Texas Pipeline Association, the EPA, and 56 individuals. Summaries of public comments and TCEQ responses are included as part of this DFW AD SIP revision.

An electronic version of the DFW AD SIP revision for the 2008 Ozone NAAQS and appendices can be found at the TCEQ's Texas State Implementation Plan Web page (http://www.tceq.texas.gov/airquality/sip/texas-sip).

1.6 SOCIAL AND ECONOMIC CONSIDERATIONS

For a detailed explanation of the social and economic issues involved with any of the measures, please refer to the preambles that precede each rule package accompanying this DFW AD SIP revision.

1.7 FISCAL AND MANPOWER RESOURCES

The state has determined that its fiscal and manpower resources are adequate and will not be adversely affected through the implementation of this plan.

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[3] The supplemental information issued on January 12, 2015 is provided in *Appendix I: Technical Supplement to the December 10, 2014 proposal of the Dallas-Fort Worth* Attainment Demonstration *State Implementation Plan Revision for the 2008 Eight-Hour Ozone Standard Nonattainment Area* of this DFW AD SIP revision.

CHAPTER 2: ANTHROPOGENIC EMISSIONS INVENTORY (EI) DESCRIPTION

2.1 INTRODUCTION

The Federal Clean Air Act Amendments of 1990 require that attainment demonstration (AD) emissions inventories (EIs) be prepared for ozone nonattainment areas. Ground-level ozone is produced when volatile organic compounds (VOC) and nitrogen oxides (NO_X) undergo photochemical reactions. The Texas Commission on Environmental Quality (TCEQ) maintains an EI of up-to-date information on NO_X and VOC sources. The EI identifies the types of emissions sources present in an area, the amount of each pollutant emitted, and the types of process and control devices employed at each plant or source category. The EI provides data for a variety of air quality planning tasks, including establishing baseline emission levels, calculating emission reduction targets, control strategy development for reducing emissions, emission inputs into air quality simulation models, and tracking actual emissions. These EIs are critical for the efforts of state, local, and federal agencies to demonstrate attainment of the National Ambient Air Quality Standards.

This chapter discusses general EI development for each of the anthropogenic source categories. Chapter 3: *Photochemical Modeling* details specific EIs and emissions inputs developed for the Dallas-Fort Worth (DFW) area ozone photochemical modeling.

2.2 POINT SOURCES

Stationary point source emissions data are collected annually from sites that meet the reporting requirements of 30 Texas Administrative Code (TAC) §101.10. To collect the data, the TCEQ provides detailed reporting instructions and tools for completing and submitting emissions inventory questionnaires (EIQ). Companies either download and complete a paper EIQ or submit EI data using a Web-based system. Companies are required to report emissions data and to provide sample calculations used to determine the emissions. Information characterizing the process equipment, the abatement units, and the emission points are also required.

All data submitted in the EIQ are reviewed for quality assurance purposes and then stored in the State of Texas Air Reporting System database. At the end of the annual reporting cycle, point source emissions data are reported to the United States Environmental Protection Agency (EPA) for inclusion in the National Emissions Inventory (NEI).

2.3 AREA SOURCES

Stationary sources that do not meet the reporting requirements for point sources are classified as area sources. Area sources are small-scale industrial, commercial, and residential sources that use materials or perform processes that generate emissions. Examples of sources of VOC emissions include the following: oil and gas production facilities, printing processes, industrial coating and degreasing operations, gasoline service station underground tank filling, and vehicle refueling operations. Examples of typical fuel combustion sources include the following: oil and gas production facilities, stationary source fossil fuel combustion at residences and businesses, outdoor burning, structural fires, and wildfires.

Emissions for area sources are calculated as county-wide totals rather than as individual sources. Area source emissions are typically calculated by applying an EPA-established emission factor (emissions per unit of activity) by the appropriate activity or activity surrogate responsible for generating emissions. Population is one of the more commonly used activity surrogates for area source calculations. Other activity data commonly used are the amount of gasoline sold in an area, employment by industry type, and crude oil and natural gas production.

The air emissions data from the different area source categories are collected, reviewed for quality assurance, stored in the Texas Air Emissions Repository database system, and compiled to develop the statewide area source EI. This area source periodic emissions inventory (PEI) is reported every third year (triennially) to the EPA for inclusion in the NEI. The TCEQ submitted the most recent PEI for calendar year 2011.

2.4 NON-ROAD MOBILE SOURCES

Non-road vehicles do not normally operate on roads or highways and are often referred to as off-road or off-highway vehicles. Non-road emissions sources include, but are not limited to: agricultural equipment; commercial and industrial equipment; construction and mining equipment; lawn and garden equipment; aircraft and airport equipment; locomotives; and commercial marine vessels. A Texas-specific version of the EPA's latest NONROAD 2008a model, called the Texas NONROAD (TexN) model, was used to calculate emissions from all non-road mobile source equipment and recreational vehicles, with the exception of airports, locomotives, and drilling rigs used in upstream oil and gas exploration activities. While the TexN model utilizes input files and post-processing routines to estimate Texas specific emissions estimates, it retains the EPA NONROAD 2008a model to conduct the basic emissions estimation calculations. Several input files provide necessary information to calculate and allocate emission estimates. The inputs used in the TexN model include emission factors, base year equipment population, activity, load factor, meteorological data, average lifetime, scrappage function, growth estimates, emission standard phase-in schedule, and geographic and temporal allocation. TexN 1.6.1 was used to estimate non-road emissions for this DFW AD SIP revision.

Because emissions for airports and locomotives are not included in either the NONROAD model or the TexN model, the emissions for these categories are estimated using other EPA-approved methods and guidance. Emissions for the source categories that are not in the EPA NONROAD 2008a model are estimated using other EPA-approved methods and guidance documents. Airport emissions are calculated using the Federal Aviation Administration's Emissions and Dispersion Modeling System, Locomotive emission estimates for Texas are based on specific fuel usage data derived from railway segment level gross ton mileage activity (line haul locomotives) and hours of operation (yard locomotives) provided directly by the Class I railroad companies operating in Texas. Although emissions for oilfield drilling rigs are included in the NONROAD model, alternate emissions estimates were developed for that source category in order to develop more accurate inventories. The equipment populations for drilling rigs were set to zero in the TexN model to avoid double counting emissions from these sources.

2.5 ON-ROAD MOBILE SOURCES

On-road mobile sources consist of passenger cars, passenger trucks, motorcycles, buses, heavy-duty trucks, and other motor vehicles traveling on public roadways. On-road mobile source ozone precursor emissions are usually categorized as combustion-related emissions or evaporative hydrocarbon emissions. Combustion-related emissions are estimated for vehicle engine exhaust, and evaporative hydrocarbon emissions are estimated for the fuel tank and other non-tailpipe sources from the vehicle. To calculate emissions, both the rate of emissions per unit of activity (emission factors) and the number of units of activity must be determined.

Emission factors for this DFW AD SIP revision were developed using the EPA's Motor Vehicle Emission Simulator (MOVES) 2014 model. The MOVES2014 model may be run using national default information or may be modified to simulate data specific to the DFW nonattainment area, such as control programs, driving behavior, meteorological conditions, and vehicle characteristics. Because modifications influence the emission factors calculated by the

MOVES2014 model, to the extent that local values are available, parameters that are used reflect local conditions rather than national default values. The localized inputs used for the on-road mobile EI development include vehicle speeds for each roadway link, temperature, humidity, vehicle age distributions for each vehicle type, percentage of miles traveled for each vehicle type, type of inspection and maintenance program, fuel control programs, and gasoline vapor pressure controls.

To estimate on-road mobile source emissions, emission factors calculated by the MOVES2014 model must be multiplied by the level of vehicle activity. On-road mobile source emission factors are expressed in units of grams per mile, grams per vehicles (evaporative), and grams per hour (extended idle mode); therefore, the activity information that is required to complete the inventory calculation is vehicle miles traveled (VMT) in units of miles per day, vehicle populations, and source hours idling. The level of vehicle travel activity is developed using travel demand models (TDM) run by the Texas Department of Transportation or by the local metropolitan planning organizations. The TDMs are validated against a large number of ground counts, i.e., traffic passing over counters placed in various locations throughout a county or area. For SIP inventories, VMT estimates are calibrated against outputs from the federal Highway Performance Monitoring System, a model built from a different set of traffic counters. Vehicle populations are derived from the Texas Department of Motor Vehicle registration database and national estimates for vehicle source type population ratios.

In addition to the number of miles traveled on each roadway link, the speed on each roadway type or segment is also needed to complete an on-road EI. Roadway speeds, required inputs for the MOVES2014 model, are calculated by using the activity volumes from the TDM and a post-processor speed model.

2.6 EI IMPROVEMENT

The TCEQ EI reflects years of emissions data improvement, including extensive point and area source inventory reconciliation with ambient emissions monitoring data. The following projects have significantly improved the DFW point source and area source inventory for oil and gas related activities in recent years.

- TCEQ Work Order Nos. 582-7-84003-FY-10-26 and 582-7-84005-FY-10-29 quantified NO_X and VOC emissions from various oil and gas processes and produced water storage tanks at upstream oil and gas operations in the DFW nonattainment area, which the TCEQ has added to the area source inventory.
- The TCEQ conducted a special inventory of companies that own or operate leases or facilities associated with Barnett Shale oil and gas operations. The TCEQ conducted the special EI under the authority of 30 TAC §101.10(b)(3) to determine the location, number, and type of emission sources associated with upstream and midstream oil and gas operations in the Barnett Shale. The results of the special inventory were used to improve the compressor engine population profile in the DFW nonattainment area. This improved profile was used in determining the area source emissions estimates for this source category.
- The TCEQ conducted two surveys of pneumatic devices at oil and gas wells. The first survey was conducted in 2011 and focused on the DFW nonattainment area. The second survey was conducted in 2012 and focused on the remainder of the state. The results of the 2011 pneumatic device survey were used to update emission factors and activity data (including the average number of pneumatic devices per well) in the DFW nonattainment area. In addition, revised bleed rate information from the EPA's Oil and Gas Emission Estimation Tool was used in the development of the emission factors.

- TCEQ Work Order No. 582-11-99776-FY11-05 developed improved drilling rig emissions characterization profiles. The drilling rig emissions characterization profiles from this study were combined with drilling activity data obtained from the Railroad Commission of Texas (RRC) to develop area source emissions estimates for this source category.
- TCEQ Work Order No. 582-11-99776-FY12-12 developed projection factors for oil and gas sources from a 2011 baseline year through 2035. Using historical data from the RRC, different projection methodologies were considered with the most robust one being based on the Hubbert peak curve theory. Yearly production factors are provided for the Barnett, Eagle Ford, and Haynesville shale formations, with separate factors for oil, natural gas, and condensate. The Barnett Shale factors were used for the DFW nonattainment area.
- TCEQ Work Order No. 582-11-99776-FY12-11 refined emissions factors and methods to estimate emissions from condensate storage tanks for area source inventory development at the county-level. The project developed region-specific emission factors and control factors for eight geographic regions in the state.
- A study contracted to Eastern Research Group, Inc. (ERG) was completed on August 1, 2014 that updated emission rates for hydraulic pump engines and mud degassing activities associated with oil and gas production. The oil and gas emissions estimates included with the proposed DFW AD SIP revision were developed with older emission factors for this type of activity. In addition, revised 2013 historical production data became available from the Railroad Commission of Texas (RRC), which impacted 2018 projections of emissions from natural gas compressor engines. These updated RRC data sets were used for projecting the 2018 oil and gas emission estimates included with this DFW AD SIP revision.

In addition to these projects, the TCEQ annually updates and publishes *Emissions Inventory Guidelines* (RG-360), a comprehensive guidance document that explains all aspects of the point source EI process. The latest version of this document is available on the TCEQ's Point Source Emissions Inventory Web site (http://www.tceq.state.tx.us/implementation/air/industei/psei/psei.html). Currently, six technical supplements provide detailed guidance on determining emissions from potentially underreported VOC emissions sources such as cooling towers, flares, and storage tanks.

CHAPTER 3: PHOTOCHEMICAL MODELING

3.0 INTRODUCTION

This chapter describes modeling conducted in support of the Dallas-Fort Worth (DFW) Attainment Demonstration (AD) State Implementation Plan (SIP) Revision for the 2008 Eight-Hour Ozone Standard. The DFW ozone nonattainment area consists of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties. The 1990 Federal Clean Air Act (FCAA) Amendments require that attainment demonstrations (AD) be based on photochemical grid modeling or any other analytical methods determined by the United States Environmental Protection Agency (EPA) to be at least as effective. When development work on this DFW AD SIP revision commenced in 2012, the EPA's April 2007 *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2007) was the latest modeling guidance available. The EPA released an update to this guidance in December 2014 entitled *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2014). The April 2007 document will be referred to as the "former guidance" and the December 2014 one will be referred to as the "draft guidance."

Both guidance documents recommend air quality modeling procedures for demonstrating attainment of the eight-hour ozone National Ambient Air Quality Standard (NAAQS). They recommend several qualitative methods for preparing ADs that acknowledge the limitations and uncertainties of photochemical models when used to project ozone concentrations into future years. First, both modeling guidance documents recommend using model results in a relative sense and applying the model response to the observed ozone data. Second, both modeling guidance documents recommend using available air quality, meteorology, and emissions data to develop a conceptual model for eight-hour ozone formation and to use that analysis in episode selection. Third, both modeling guidance documents recommend using other analyses, i.e., weight of evidence (WoE), to supplement and corroborate the model results and support the adequacy of a proposed control strategy package.

The large majority of the modeling and technical analysis for this DFW AD SIP revision was done prior to release of the draft guidance, so the development work is consistent with the former guidance. However, most of these procedures are very similar between the former guidance and draft guidance. A notable difference is that the former guidance recommends that the attainment test be performed for all baseline episode days modeled above a specific threshold, while the draft guidance recommends performing the test for only the 10 days from the baseline with the highest modeled ozone values. Chapter 3: *Photochemical Modeling*, Section 3.7.2: *Future Baseline Modeling*, summarizes these attainment tests in more detail and provides the results for both approaches.

The remaining chapters and sections include an overview of the photochemical modeling, conceptual model, and WoE analyses. More detail on each of these components can be found in the following appendices to this DFW AD SIP revision:

- Appendix A: Meteorological Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard;
- Appendix B: Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard;
- Appendix C: Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard;

- Appendix D: Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard; and
- Appendix E: Modeling Protocol for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard.

The 1990 FCAA Amendments established five classifications for ozone nonattainment areas based on the magnitude of the regional one-hour ozone design value. Based on the monitored one-hour ozone design value at that time, four counties in the DFW area (Collin, Dallas, Denton, and Tarrant) were classified as a moderate nonattainment area. As published in the October 16, 2008 edition of the *Federal Register* (FR), the EPA determined the four-county DFW area to be in attainment of the one-hour ozone standard based on 2004 through 2006 monitored data (73 FR 61357).

With the change of the ozone NAAQS from a one-hour standard to an eight-hour standard in 2004, the EPA classified the DFW area as a moderate ozone nonattainment area with an attainment date of June 15, 2010. Five additional counties (Ellis, Johnson, Kaufman, Parker, and Rockwall) were added to the four original one-hour standard nonattainment counties to create the nonattainment area for the 1997 eight-hour standard. Ozone AD SIP revisions addressing the 1997 eight-hour ozone standard were required to be submitted to the EPA by June 15, 2007. In May 2007, photochemical modeling and other analyses conducted by the Texas Commission on Environmental Quality (TCEQ) were included in the AD SIP revision submitted to the EPA supporting the DFW area's attainment of the 1997 eight-hour ozone standard by June 15, 2010. The EPA published final conditional approval of the May 2007 DFW AD SIP Revision on January 14, 2009 (*74 FR 1903*).

In 2009, the monitored design value (complete ozone season prior to the attainment date) for the DFW area was 86 parts per billion (ppb), which is 2 ppb above the attainment level. The EPA published the final rule to determine the DFW area's failure to attain the 1997 eight-hour ozone standard and reclassify the DFW area as a serious nonattainment area on December 10, 2010 (*75 FR 79302*). The attainment date for the serious classification was June 15, 2013. The EPA prescribed that the attainment test be applied to the 2012 previous ozone season to determine compliance with the 2013 attainment date. Based on the fourth highest ozone readings per monitor from 2010, 2011, and 2012, 15 of the 17 regulatory monitors active within DFW during this time period had three-year ozone design values ranging from 69 to 83 ppb. However, two regulatory monitors had three-year ozone design values above the 84 ppb standard. The Keller monitor had a 2012 design value of 87 ppb, and the Grapevine Fairway monitor had a 2012 design value of 86 ppb. Both of these monitors are located in the northwest quadrant of the DFW nonattainment area where the highest ozone concentrations have historically been measured.

Ozone nonattainment designations under the revised 2008 eight-hour ozone standard became effective on July 20, 2012. Wise County was added to the nine nonattainment counties, which resulted in a 10-county DFW nonattainment area for the 2008 eight-hour ozone standard. The DFW area was classified as moderate nonattainment with a required attainment date of December 31, 2018. This DFW AD SIP revision uses photochemical modeling in combination with corroborative analyses to support a conclusion that the 10-county DFW nonattainment area will attain the 2008 eight-hour ozone standard of 75 ppb by December 31, 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. Also, the limited data collected in the DFW nonattainment area during Texas Air Quality Study 2006 (TexAQS II) is used to evaluate the model's performance and to improve understanding of the physical and chemical processes leading to ozone formation.

3.1 OVERVIEW OF THE OZONE PHOTOCHEMICAL MODELING PROCESS

The modeling system is composed of a meteorological model, several emissions processing models, and a photochemical air quality model. The meteorological and emission models provide the major inputs to the air quality model.

Ozone is a secondary pollutant; it is not generally emitted directly into the atmosphere. Ozone is created in the atmosphere by a complex set of chemical reactions between sunlight and several primary (directly emitted) pollutants. The reactions are photochemical and require ultraviolet energy from sunlight. The majority of primary pollutants directly involved in ozone formation fall into two groups, nitrogen oxides (NO_X) and volatile organic compounds (VOC). In addition, carbon monoxide (CO) is also an ozone precursor, but much less effective than either NO_X or VOC in forming ozone. As a result of NO_X and VOC reacting in the presence of sunlight, higher eight-hour concentrations of ozone are most common during the summer when daytime hours are extended, with concentrations peaking during the day and falling during the night and early morning hours.

Ozone chemistry is complex, involving hundreds of chemical compounds and chemical reactions. As a result, ozone cannot be evaluated using simple dilution and dispersion algorithms. Due to this chemical complexity, the modeling guidance strongly recommends using photochemical computer models to simulate ozone formation and to evaluate the effectiveness of future control strategies. Computer simulations are the most effective tools to address both the chemical complexity and the future case evaluation.

3.2 OZONE MODELING

Ozone modeling involves two major phases, the base case modeling phase and the future year modeling phase. The purpose of the base case modeling phase is to evaluate the model's ability to adequately replicate measured ozone and ozone precursor concentrations during recent periods with high ozone concentrations. The purpose of the future year modeling phase is to predict attainment year ozone design values at each monitor and to evaluate the effectiveness of controls in reaching attainment. The TCEQ developed a modeling protocol, which is attached as Appendix E describing the process to be followed to evaluate the ozone in the urban area as prescribed by the former guidance available at the time. This modeling protocol was submitted to the EPA in August 2013.

3.2.1 Base Case Modeling

Base case modeling involves several steps. First, ozone episodes are analyzed to determine what factors were associated with ozone formation in the area and whether those factors were consistent with the conceptual model and the EPA's episode selection criteria. Once an episode is selected, emissions and meteorological data are generated and quality assured. Then the meteorological and emissions (NO_X, VOC, and CO) data are input to the photochemical model and the ozone photochemistry is simulated, resulting in predicted ozone and ozone precursor concentrations.

Base case modeling results are evaluated by comparing them to the observed measurements of ozone and ozone precursors that were monitored during the base case period. Typically, this step is an iterative process incorporating feedback from successive evaluations to ensure that the model is adequately replicating observations throughout the modeling episode. The adequacy of the model in replicating observations is assessed statistically and graphically as recommended in the modeling guidance. Additional analyses using special study data are included when available. Satisfactory performance of the base case modeling provides a degree of reliability

that the model can be used to predict future year ozone concentrations (future year design values), as well as to evaluate the effectiveness of possible control measures.

3.2.2 Future Year Modeling

Future year modeling involves several steps. The procedure for predicting a future year ozone design value (attainment test) involves determining the ratio of the future year to the baseline year modeled ozone concentrations. This ratio is called the relative response factor (RRF). Whereas the emissions data for the base case modeling are episode-specific, the emissions data for the baseline year are based on typical ozone season emissions. Similarly, the emissions data for the future year are developed applying growth and control factors to the baseline year emissions. The growth and control factors are developed based on the projected growth in the demand for goods and services, along with the reduction in emissions expected from state, local, and federal control programs.

Both the baseline and future years are modeled using their respective ozone season emissions and the base case episode meteorological data as inputs. The same meteorological data are used for modeling both the baseline and future years. Thus, the ratio of future year modeled ozone concentrations to the baseline year concentrations provides a measure of the response of ozone concentrations to the change in emissions from projected growth and controls.

A future year ozone design value is calculated by multiplying the RRF by a baseline year ozone design value (DV_B). The DV_B is the average of the regulatory design values for the three consecutive years containing the baseline year, as show in Figure 3-1: *2006 Baseline Design Value Calculation*. A calculated future year ozone design value of less than or equal to 75 ppb signifies modeled attainment. The model can also be used to test the effectiveness of various control measures when evaluating control strategies.

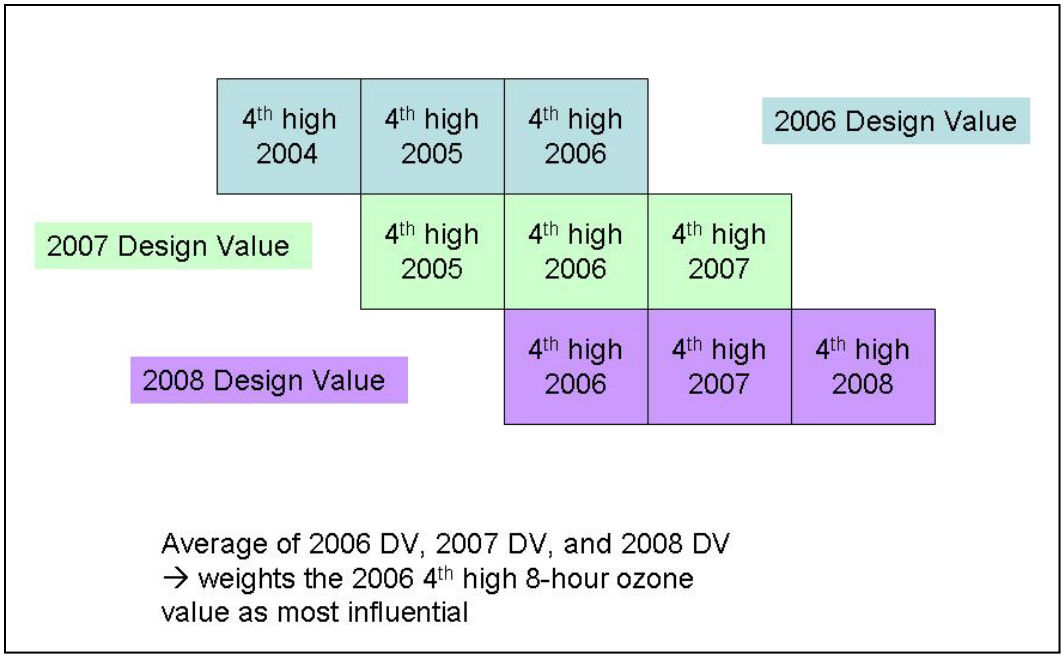


Figure 3-1: 2006 Baseline Design Value Calculation

3.3 EPISODE SELECTION

3.3.1 EPA Guidance for Episode Selection

When development work commenced for this DFW AD SIP revision in 2012, the EPA's former modeling guidance for the 1997 eight-hour ozone standard of 84 ppb was in effect. The episode selection work for this attainment analysis was done in accordance with this former guidance. The primary criteria for selecting ozone episodes for eight-hour ozone AD modeling are set forth in the former modeling guidance (as modified for the 2008 eight-hour ozone standard) and shown below.

- Select periods reflecting a variety of meteorological conditions that frequently correspond to observed eight-hour daily maximum ozone concentrations greater than 75 ppb at different monitoring sites.
- Select periods during which observed eight-hour ozone concentrations are close to the eight-hour ozone design values at monitors with a DV_B greater than or equal to 75 ppb.
- Select periods for which extensive air quality and/or meteorological data sets exist.
- Model a sufficient number of days so that the modeled attainment test can be applied at all of the ozone monitoring sites that are in violation of the eight-hour ozone NAAQS.

Based on these criteria, the TCEQ selected ozone episodes from June 2006 and August/September 2006 for use in this DFW AD SIP revision.

3.3.2 DFW Ozone Episode Selection Process

As shown in Figure 3-2: *DFW Eight-Hour Ozone Exceedance Days by Month from 1991 through 2012*, the highest ozone levels in DFW typically follow a bi-modal pattern with peaks in June and August-September. The 1997 eight-hour ozone DFW AD SIP revision from December 2011 relied on a 33-day June 2006 episode ranging from May 31 through July 2, 2006. A primary goal of the episode selection process for the current modeling work was to reflect this historical bi-modal pattern by including both June and August-September (August 13 through September 15, 2006) episodes.

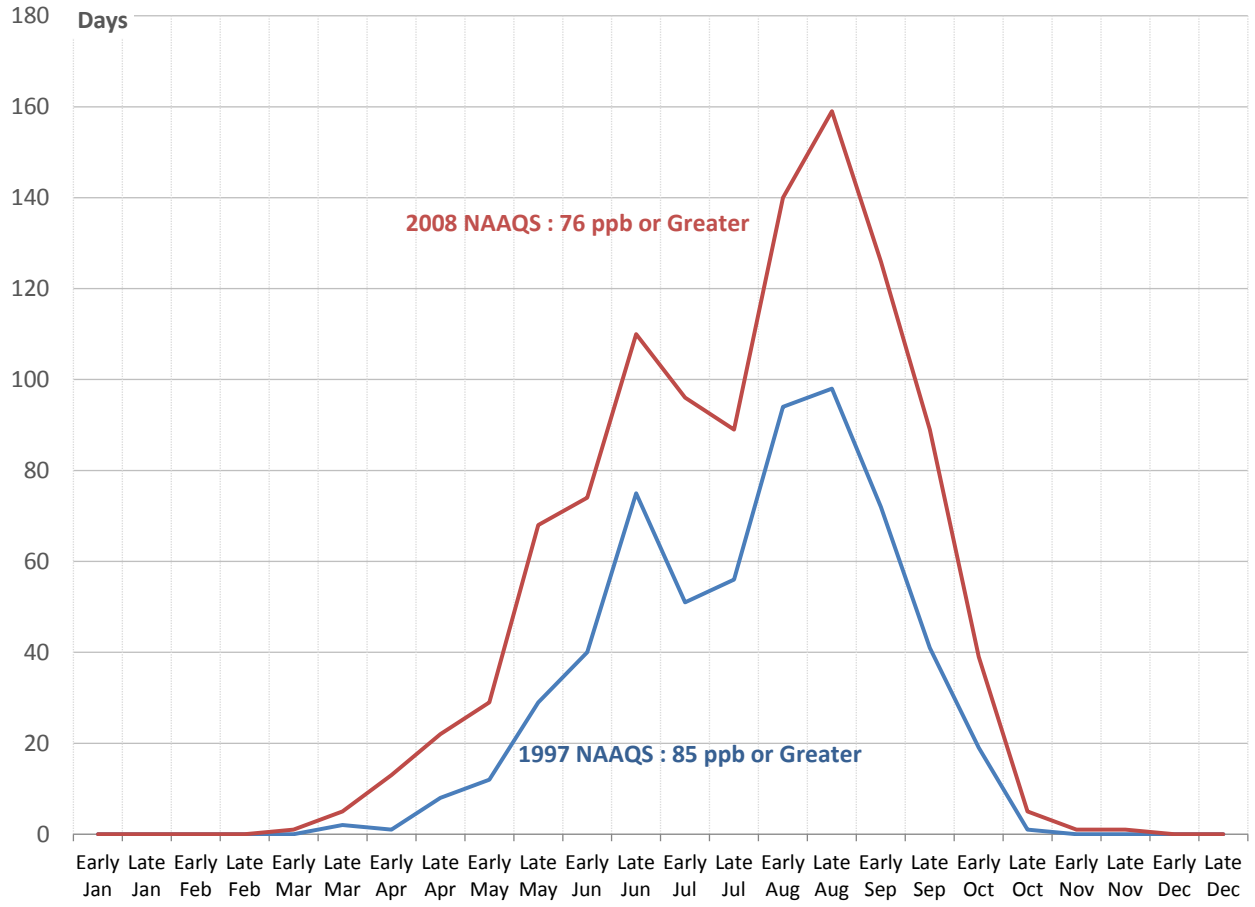


Figure 3-2: DFW Eight-Hour Ozone Exceedance Days by Month from 1991 through 2012

Table 3-1: *DFW 75 ppb Ozone Exceedance Days by Month from 2006 through 2012* shows that there were 50 total ozone exceedance days in 2006 with 18 occurring in June and 13 in August-September. Annual ozone exceedance days in subsequent years ranged from 18 in 2010 to 40 in 2011. An evaluation of these post-2006 years indicated that 2012 would be the best candidate for development of a new ozone episode. The nine exceedance days in June 2012 combined with the 12 in August-September correlate well with the historical bi-modal pattern shown in Figure 3-2. The 2011 calendar year was not representative of this historical norm because there were only four exceedance days in June and 26 in August-September, which is an unusual ozone season distribution for the DFW nonattainment area. Both 2007 and 2010 also had a relatively low number of exceedance days in June compared with August-September.

All three years of 2008, 2009, and 2012 had a June/August-September ozone exceedance day total of 21. While 2008 and 2009 could be considered as suitable candidates for seasonal ozone modeling, 2012 is a more recent option that would benefit from the use of more recently available emission inventory data sets, such as the 2011 National Emissions Inventory (NEI) submitted by states to the EPA. Also, the EPA has a 2011 national scale modeling platform that will provide useful data sets for a 2012 Texas ozone episode. Even though only the DFW nonattainment area ozone exceedances are shown here, the TCEQ has begun development of a 2012 seasonal episode because it is a suitable representation for DFW and other metropolitan

areas of the state such as Houston-Galveston-Brazoria (HGB). However, the 2012 ozone episode is not within the performance bounds required for AD SIP submissions, and therefore work on this new episode is still in progress.

Table 3-1: DFW 75 ppb Ozone Exceedance Days by Month from 2006 through 2012

Month	2006	2007	2008	2009	2010	2011	2012
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	1	0	0	0	0	0	2
April	2	3	1	1	0	2	0
May	3	1	3	5	4	0	4
June	18	2	6	8	3	4	9
July	9	3	5	7	0	6	5
August	8	11	7	8	9	15	11
September	5	5	8	5	2	11	1
October	4	2	0	0	0	2	0
November	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0
Annual Total	50	27	30	34	18	40	32
June Only	18	2	6	8	3	4	9
August-September Only	13	16	15	13	11	26	12
June/August-September Total	31	18	21	21	14	30	21

To ensure that both early and late summer ozone periods are represented in the current modeling, and that all necessary modeling work for this AD could be completed in a timely manner, the 34-day period from August 13 through September 15, 2006 was added to with the 33-day June 2006 episode for a total 67-day period representative of historical exceedance patterns in DFW. This August-September episode incorporates the extensive monitoring data collected during TexAQS II, including data from radar wind profilers and was used in the March 2010 HGB AD SIP revision. Throughout this discussion, the terms June episode and August-September episode will be used when the episodes need to be referenced separately. When analyses are performed on both, the term 67-day episode will be used to reflect the combination.

3.3.3 Summary of the Combined 67-Day 2006 Ozone Episode

Figure 3-3: *DFW Area Ozone Monitoring Locations* shows the spatial distribution of ozone monitors in the DFW nonattainment area. Monitors are located in the upwind areas to the east and south, within the urban core, and in the downwind locations to the north and west. Table 3-2: *Greater DFW Area Ozone Monitor Reference Table* provides the names, Continuous Ambient Monitoring Station (CAMS) code, alpha code, and activation/deactivation dates for 22 ozone monitors located within and surrounding the DFW nonattainment counties. 19 of these monitors had been active for a sufficient amount of time in 2006 that DV_B figures are available for the attainment test that utilizes RRF values. Table 3-3: *Monitor Specific Ozone Exceedances During 67-Day Combined Episode* shows that 12 of the DFW area ozone monitors exceeded the 75 ppb standard on at least 10 days of the 2006 episodes, which is the minimum preferred by the EPA modeling guidance. Use of the 67-day combined episode results in a range of 19 to 25

exceedance days at the five downwind northwestern monitors that have typically monitored the highest ozone levels in the DFW nonattainment area: Denton Airport South, Eagle Mountain Lake, Grapevine Fairway, Keller, and Fort Worth Northwest. Seven of the DFW nonattainment area monitors had fewer than 10 eight-hour ozone exceedance days during this period. However, these seven are all located along the upwind eastern and southern perimeters of DFW where the lowest regional ozone levels are typically monitored. Use of the secondary 70 ppb threshold suggested by the EPA modeling guidance results in all of the monitors above the preferred 10 days for RRF calculations.

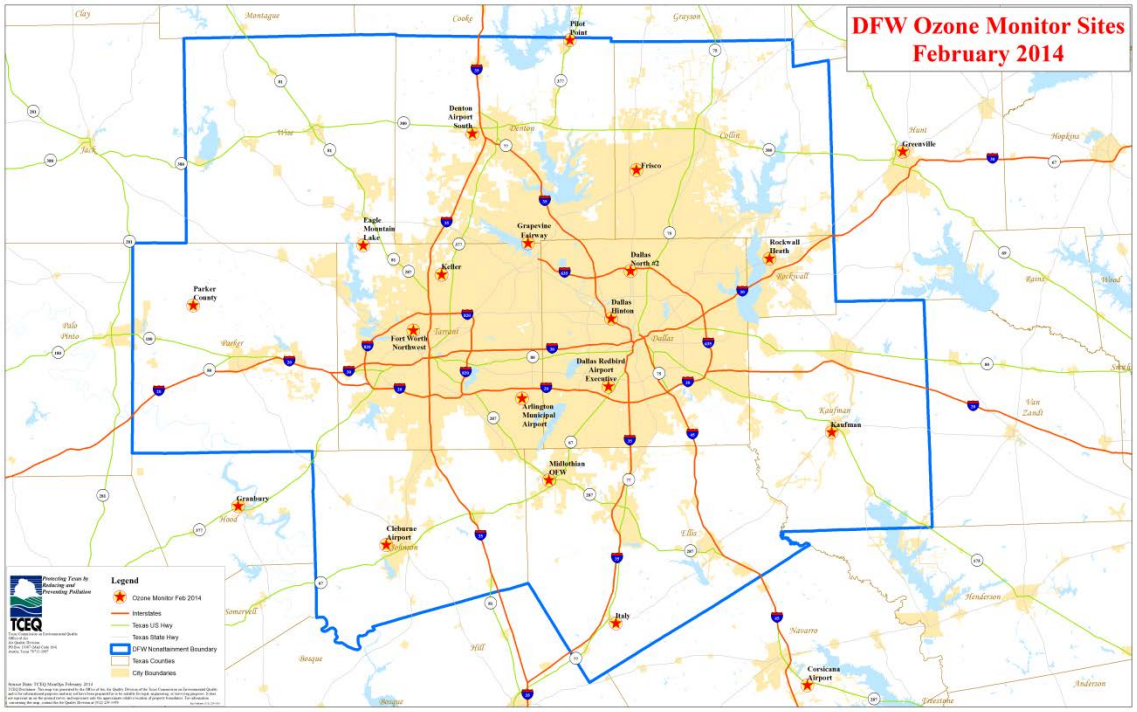


Figure 3-3: DFW Area Ozone Monitoring Locations

Table 3-2: Greater DFW Area Ozone Monitor Reference Table

DFW Area Ozone Monitor Name	CAMS Code	Alpha Code	County of Operation	Date Ozone Active	Date Ozone Deactivated
Frisco	C31	FRIC	Collin	07/29/1997	NA
Dallas Executive Airport	C402	REDB	Dallas	12/13/1999	NA
Dallas Hinton Street	C401	DHIC	Dallas	12/15/1999	NA
Dallas North #2	C63	DALN	Dallas	11/13/1998	NA
Denton Airport South	C56	DENT	Denton	03/22/1998	NA
Pilot Point	C1032	PIPT	Denton	05/03/2006	NA
Italy	C1044	ITLY	Ellis	09/09/2007	NA
Italy High School	C650	ITHS	Ellis	08/23/2005	11/05/2006
Midlothian OFW	C52	MDLO	Ellis	03/29/2006	NA
Midlothian Tower	C94	MDLT	Ellis	08/31/1997	08/22/2007
Cleburne Airport	C77	CLEB	Johnson	05/10/2000	NA
Kaufman	C71	KAUF	Kaufman	09/23/2000	NA
Parker County	C76	WTFD	Parker	08/03/2000	NA
Rockwall Heath	C69	RKWL	Rockwall	08/08/2000	NA
Arlington Municipal Airport	C61	ARLA	Tarrant	01/17/2002	NA
Eagle Mountain Lake	C75	EMTL	Tarrant	06/06/2000	NA
Fort Worth Northwest	C13	FWMC	Tarrant	08/14/1997	NA
Grapevine Fairway	C70	GRAP	Tarrant	08/23/2000	NA
Keller	C17	KELC	Tarrant	07/16/1997	NA
Granbury	C73	GRAN	Hood	05/10/2000	NA
Greenville	C1006	GRVL	Hunt	03/21/2003	NA
Corsicana Airport	C1051	CRSA	Navarro	06/17/2009	NA

Table 3-3: Monitor Specific Ozone Exceedances During 67-Day Combined Episode

DFW Area Monitor and CAMS Code	Maximum Eight-Hour Ozone (ppb)	Number of Days Above 70 ppb	Number of Days Above 75 ppb	Number of Days Above 85 ppb	Baseline Design Value (ppb)
Denton Airport South - C56	106	29	22	11	93.3
Eagle Mountain Lake - C75	107	27	22	9	93.3
Grapevine Fairway - C70	98	26	19	9	90.7
Keller - C17	103	33	25	11	91.0
Fort Worth Northwest - C13	101	27	21	9	89.3
Frisco - C31	101	25	20	9	87.7
Dallas North #2 - C63	90	19	14	3	85.0
Parker - County - C76	101	19	12	4	87.7
Dallas Executive Airport - C402	95	28	18	5	85.0
Cleburne Airport - C77	98	18	8	2	85.0
Arlington Municipal Airport - C61	91	18	14	3	83.3
Dallas Hinton Street - C401	96	22	13	2	81.7
Granbury - C73	92	16	8	3	83.0
Midlothian Tower - C94	98	17	8	1	NA
Pilot Point - C1032	101	23	17	9	NA
Rockwall Heath - C69	86	16	9	1	77.7
Midlothian OFW - C52	96	14	5	1	NA
Greenville - C1006	84	13	3	0	75
Kaufman - C71	86	11	5	1	74.7

Midlothian Tower, Pilot Point, and Midlothian OFW did not measure enough data from 2004 through 2008 for calculation of a 2006 baseline design value. Greenville and Granbury are not in the 2008 eight-hour ozone nonattainment area.

Appendix D describes the general meteorological conditions that are typically present on days when the eight-hour ozone concentration exceeds the 2008 eight-hour ozone NAAQS. High ozone is typically formed in the DFW nonattainment area on days with slower wind speeds out of the east and southeast. These prevailing winds also typically bring higher background ozone levels into the DFW nonattainment area. High background ozone concentrations are then amplified as an air mass moves over the urban core of Dallas and Tarrant Counties, both of which contain large amounts of NO_X emissions. Those emissions are then transported across the DFW nonattainment area to the northwest, where the highest eight-hour ozone concentrations are observed.

The conditions that typically lead to high ozone were present in the 33-day June 2006 episode. High pressure developed over the area from June 5 through June 10, which resulted in mostly sunny days with high temperatures above 90 degrees Fahrenheit. High pressure also caused winds that were calm or light out of the southeast. With light winds a gradual buildup of ozone and ozone precursors developed over the DFW nonattainment area, peaking in an eight-hour ozone concentration of 106 ppb at Eagle Mountain Lake and Denton Airport South on June 9, as

shown in Figure 3-4: *Maximum Eight-Hour Ozone by Monitor from May 31 through July 2, 2006*. High pressure began to erode away as a weak frontal boundary approached from the north. Wind speeds then increased over the area, causing ozone dilution and lowering the eight-hour ozone concentrations over the area. As winds switched directions and began blowing from the east-northeast on the backside of the frontal boundary, ozone concentrations again increased. Winds from the east-northeast have the potential for long range transport from the direction of the Ohio River Valley. Transport from the east-northeast likely contributed to an eight-hour ozone concentration of 107 ppb at Eagle Mountain Lake on June 14. Over the next few days, low pressure moved into the area from the Gulf of Mexico. This low pressure caused an increase in cloudiness and wind speed, which reduced the potential for ozone formation. High pressure returned to the area from June 27 through June 30. With the resultant high temperatures and low wind speeds, conditions were again favorable for ozone formation.

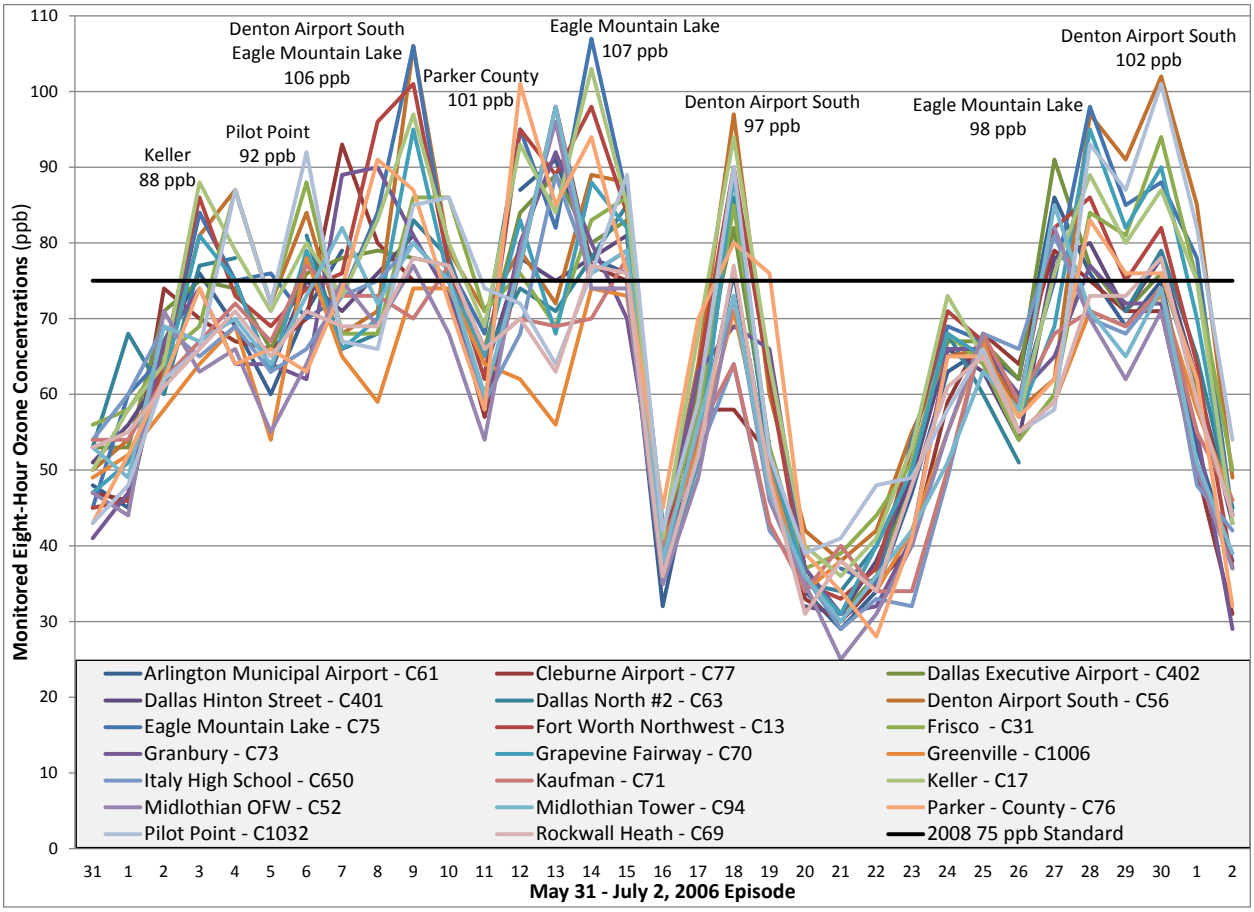


Figure 3-4: Maximum Eight-Hour Ozone by Monitor from May 31 through July 2, 2006

As shown in Figure 3-5: *Maximum Eight-Hour Ozone by Monitor from August 13 through September 15, 2006*, the 34-day August-September episode also had conditions favorable for elevated ozone concentrations. Strong southerly winds and a weak warm front kept ozone concentrations below 76 ppb from August 13 through August 17. High pressure settled in by August 18 with clear sunny skies and slow southerly winds allowing for the build-up of ozone concentrations, such as the 91 ppb peaks at Denton Airport South and Grapevine Fairway. Another weak front entered the area on August 22, causing winds to shift from the northeast, indicating possible transport of polluted air from the Ohio and Mississippi River valleys. The

weak front stalled just north of the DFW nonattainment area through August 24 keeping winds slow and allowing pollutants to accumulate. Stronger south winds returned by August 25, keeping ozone concentrations low through August 28. A stronger cold front moved through the DFW nonattainment area on August 29, bringing north winds and clouds. Clear skies with light north winds followed, which allowed for ozone concentrations to exceed the NAAQS through September 1, such as the 101 ppb peak at Frisco and 102 ppb peak at Denton Airport South. Another cold front brought cloudy skies and cooler temperatures, which limited ozone production. High pressure and ozone-conducive conditions returned from September 7 through 10 resulting in peak levels of 87 ppb at Frisco and Pilot Point. Northeast winds after a cold front may have again transported polluted air from areas east and north of DFW on September 14.

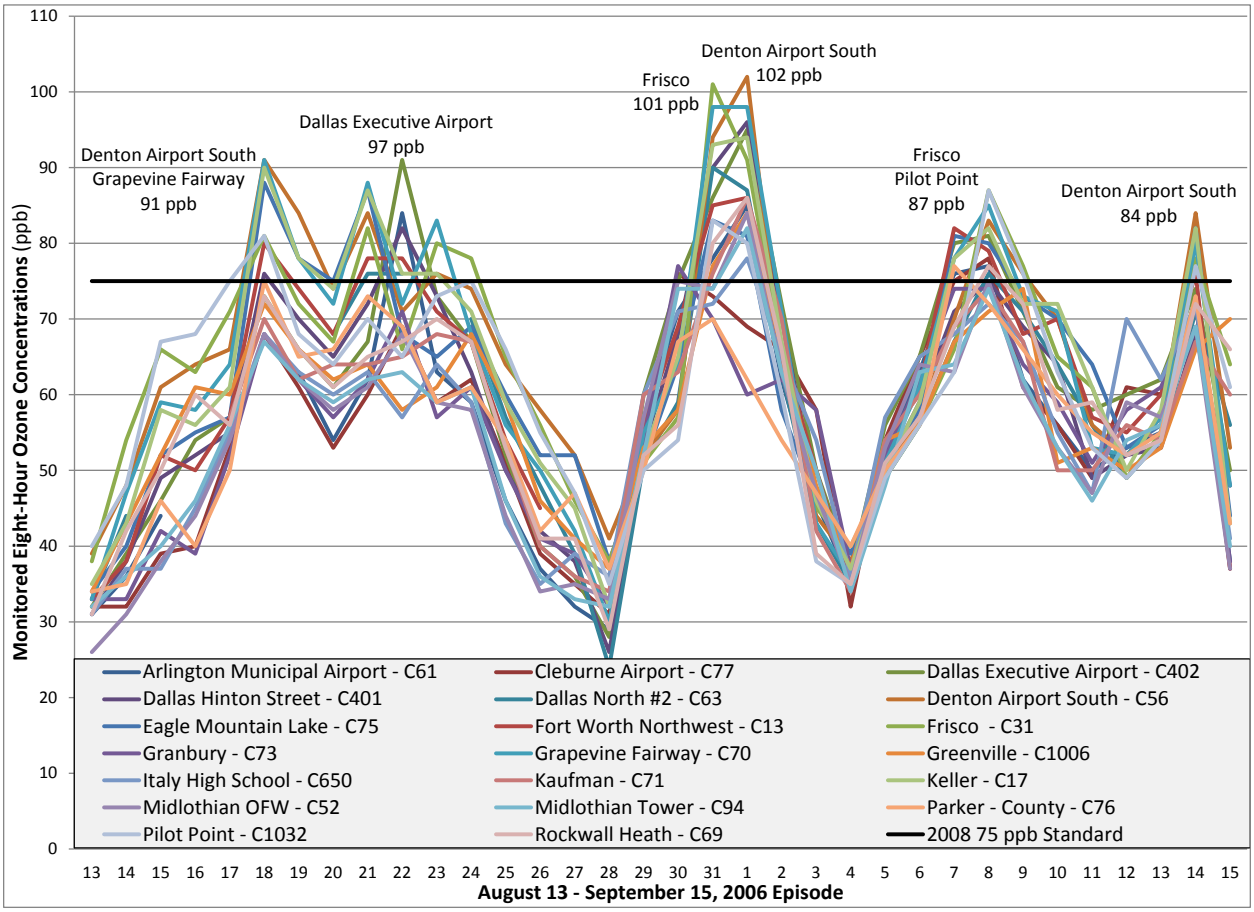


Figure 3-5: Maximum Eight-Hour Ozone by Monitor from August 13 through September 15, 2006

Back trajectories from the Eagle Mountain Lake monitor extending backwards in time for 48 hours and terminating at 500 meters above ground level (AGL) are shown for every day of the extended June 2006 episode in Figure 3-6: *Eagle Mountain Lake Monitor Back Trajectories for May 31 through July 2, 2006*. The left panel shows the May 31 through June 15, 2006, period while the right panel shows the June 16 through July 2, 2006, period. Similar 48-hour back trajectories for every day of the August-September episode are shown in Figure 3-7: *Denton Airport South Monitor Back Trajectories for August 13 through September 15, 2006*. The trajectories in both Figure 3-6 and Figure 3-7 depict air coming from north, east, and southerly directions. Westerly winds are not common during the summer months in the DFW nonattainment area, so there are no trajectories coming from the west to northwest. These

trajectories illustrate that the combined 67-day episode includes periods of synoptic flow from each of the directions commonly associated with elevated eight-hour ozone concentrations as more fully described in Appendix D.

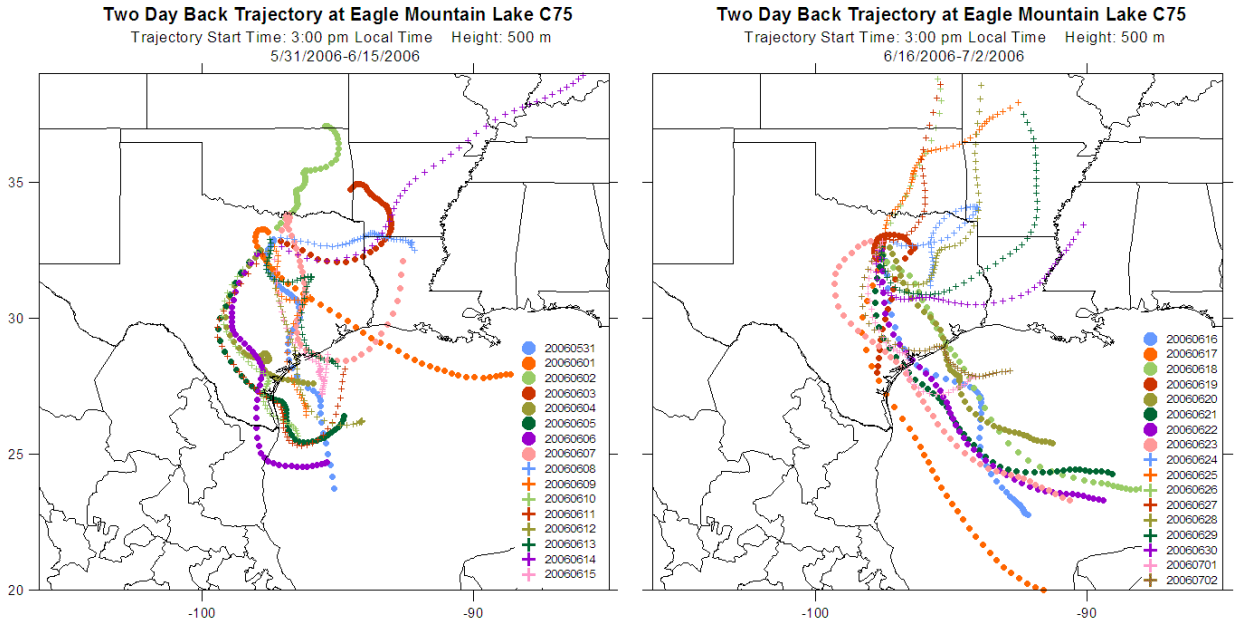


Figure 3-6: Eagle Mountain Lake Monitor Back Trajectories for May 31 through July 2, 2006

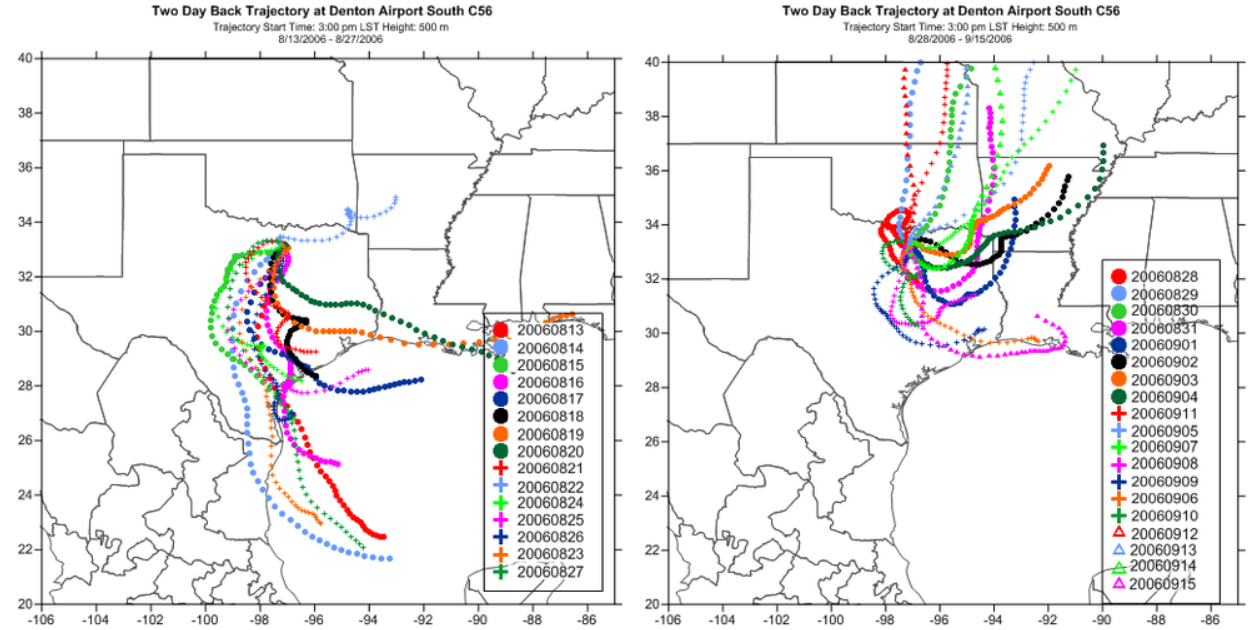


Figure 3-7: Denton Airport South Monitor Back Trajectories for August 13 through September 15, 2006

3.4 METEOROLOGICAL MODEL

The TCEQ is using the Weather Research and Forecasting Model (WRF), which has now largely replaced the Penn State University/National Center for Atmospheric Research (NCAR) Mesoscale Meteorological Model, Fifth Generation (MM5) for both forecasting and retrospective

modeling of historical episodes. The WRF model development was driven by a community effort to provide a modeling platform that supported the most recent research and allowed testing in forecast environments. WRF was designed to be completely mass conservative and built to allow better flux calculations, both of which are of central importance to the air quality community. The model was also designed with higher order numerical techniques than MM5 for many physical calculations. These model improvements over MM5 as well as a decision by NCAR to no longer support MM5 prompted the TCEQ as well as various Texas universities, the Central Regional Air Planning Association, and the EPA to adopt WRF for their respective meteorological modeling platforms.

3.4.1 Modeling Domains

As shown in Figure 3-8: *WRF Modeling Domains*, the meteorological modeling was configured with three nested grids at a resolution of 36 kilometers (km) for North America (na_36km), 12 km for Texas plus portions of surrounding states (sus_12km), and 4 km for the eastern portion of Texas (4 km). The extent of each of the WRF modeling domains was selected to accommodate the embedding of the commensurate air quality modeling domains. Table 3-4: *WRF Modeling Domain Definitions* provides the specific northing and easting parameters for these grid projections.

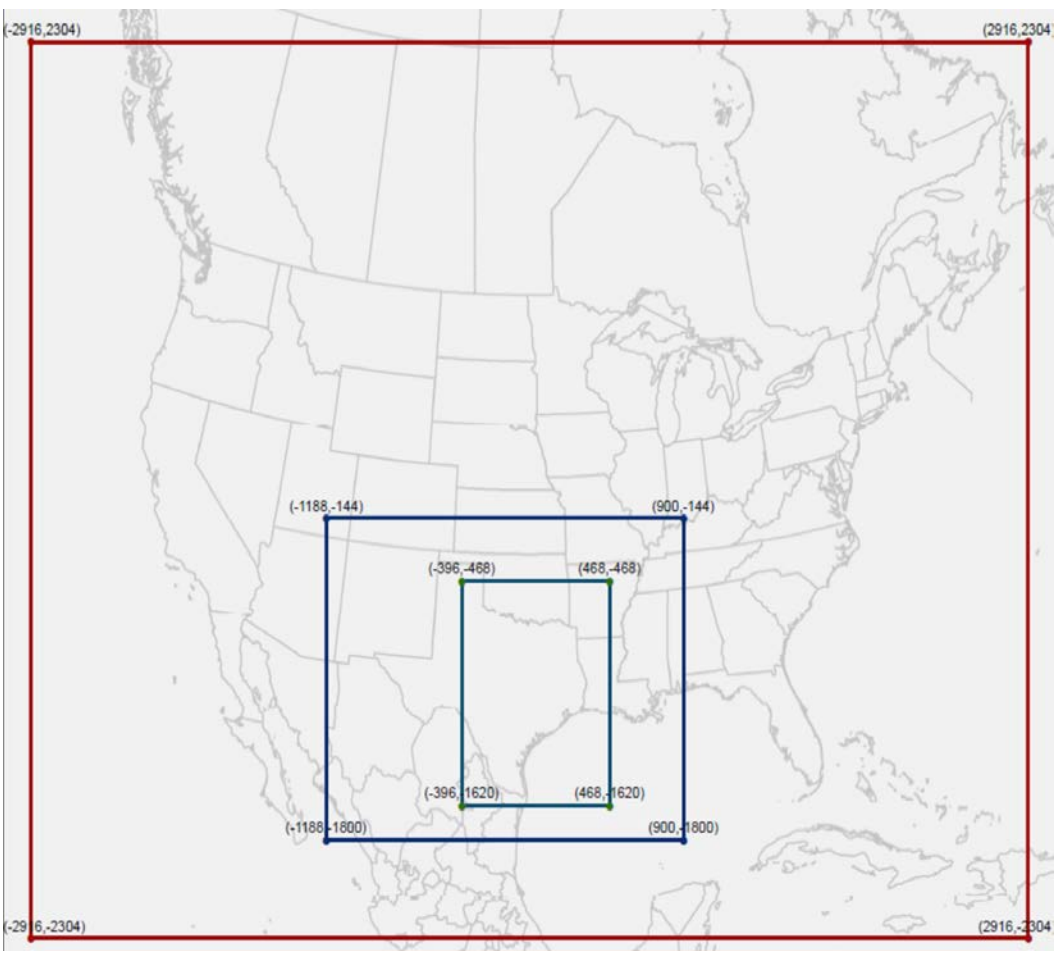


Figure 3-8: WRF Modeling Domains

Table 3-4: WRF Modeling Domain Definitions

Domain	Easting Range (km)	Northing Range (km)	East/West Grid Points	North/South Grid Points
na_36 km	(-2916,2916)	(-2304,2304)	163	129
sus_12km	(-1188,900)	(-1800,-144)	175	139
4 km	(-396,468)	(-1620,-468)	217	289

As shown in Figure 3-9: *WRF Vertical Layer Structure*, the vertical configuration of the WRF modeling domains consists of a varying 43-layer structure used with all of the horizontal domains. The first 21 vertical layers are identical to the same layers used with the Comprehensive Air Quality Model with Extensions (CAMx), while CAMx layers 22 through 28 each comprise multiple WRF layers.

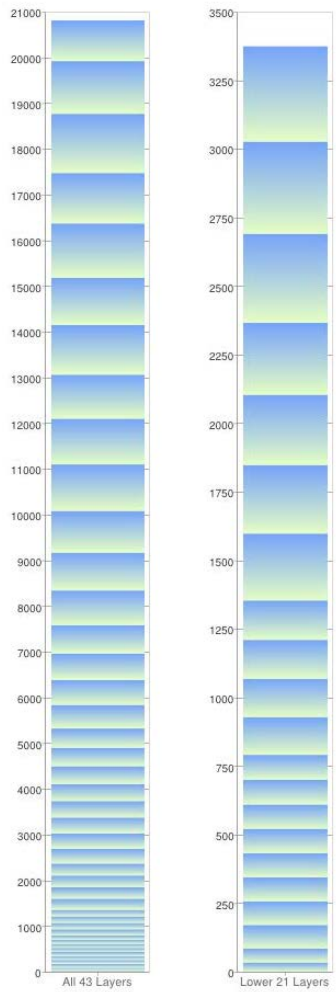


Figure 3-9: WRF Vertical Layer Structure

3.4.2 Meteorological Model Configuration

The selection of the final meteorological modeling configuration for the two episodes during 2006 resulted from numerous sensitivity tests and model performance evaluation. The preparation of WRF input files involves the execution of different models within the WRF Preprocessing System (WPS). Analysis nudging files are generated as part of WPS preparation of

WRF input and boundary condition files. Observational nudging files with radar profiler data were developed separately by the TCEQ.

For optimal photochemical model performance, low-level wind speed and direction are of greater importance than surface temperature. Additional meteorological features of critical importance for air quality modeling include cloud coverage and the strength and depth of the planetary boundary layer (PBL). Observational nudging using TexAQS II radar profiler data and one-hour surface analysis nudging improved wind performance. Switching from the NOAH (National Centers for Environmental Prediction, Oregon State, Air Force, and Hydrologic Research Laboratory) Land-Surface Model to the five-layer soil model also improved the representation of precipitation, temperature, and PBL depths.

The TCEQ continued to improve upon the performance of WRF for the June and August-September 2006 episodes through a series of sensitivities. The final WRF parameterization schemes and options selected are shown in Table 3-5: *WRF Model Configuration Parameters*. The selection of these schemes and options was based on extensive testing of model configurations that built upon experience with MM5 in previous SIP modeling. Among all the meteorological variables that can be validated, minimizing wind speed bias was the highest priority for model performance consideration. WRF output was post-processed using the WRFCAMx version 6.3 utility to convert the WRF meteorological fields to the appropriate CAMx grid and input format. The WRFCAMx now generates several alternative vertical diffusivity (Kv) files based upon multiple methodologies for estimating mixing given the same WRF meteorological fields. The Kv option to match the WRF Yonsei University (YSU) PBL scheme was used for the CAMx runs for the 2006 episodes. The vertical diffusivity coefficients were also modified on a land-use basis to maintain vertical mixing within the first 100 meters of the model overnight using the KVPATCH program (Environ, 2005).

Table 3-5: WRF Model Configuration Parameters

Domain	Nudging Type	PBL	Cumulus	Radiation	Land-Surface	Microphysics
36 km and 12 km	3-D, Surface Analysis, and Observations	YSU	Kain-Fritsch	RRTM / Dudhia *	5-layer soil model	WSM6 †
4 km	3-D, Surface Analysis, and Observations	YSU	Kain-Fritsch	RRTM / Dudhia *	5-layer soil model	WSM6 †

* RRTM = Rapid Radiative Transfer Model
† WSM6 = WRF Single-Moment 6-Class Microphysics Scheme

Appendix A provides additional detail on the meteorological modeling inputs presented here.

3.4.3 WRF Performance Evaluation

The WRF modeling was evaluated by comparing the hourly modeled and measured wind speed, wind direction, and temperature for all monitors in the DFW nonattainment area. Figure 3-10: *June 2006 WRF Modeling Performance* exhibits the percent of hours for which the average absolute difference between the modeled and measured wind speed and direction was within the specified accuracy benchmarks for specific DFW nonattainment area monitors, as well as a regional average. These benchmarks are less than 30 degrees for wind direction, less than 2 meters per second (m/s) for wind speed, and less than 2 degrees Fahrenheit for temperature.

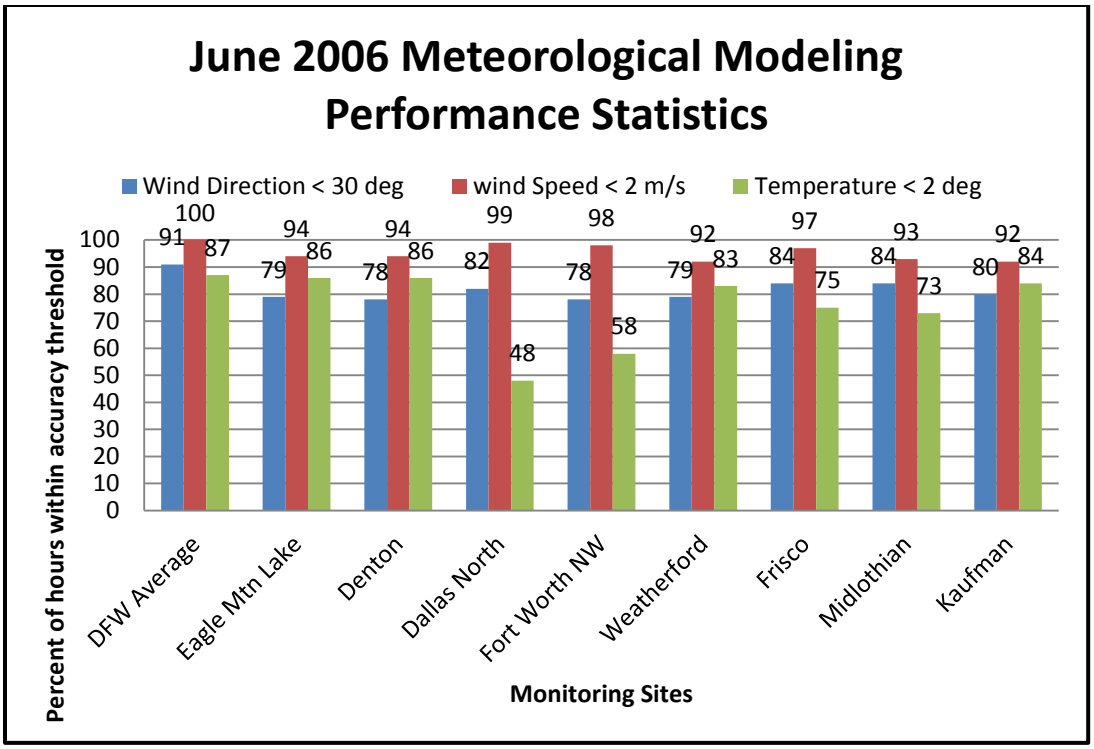


Figure 3-10: June 2006 WRF Modeling Performance

As Figure 3-10 shows, WRF performed well for wind speed and wind direction, and reasonably well for temperature. As noted above, the WRF configuration was selected for optimal performance on low-level wind speed since this meteorological variable strongly impacts CAMx performance. Wind speed performance was excellent at the individual monitors, but observed wind direction is less accurate when wind speeds are low, a condition often observed during ozone exceedances. Table 3-6: *WRF Meteorological Modeling Percent Accuracy for June 2006* provides an additional evaluation of WRF predictions to stricter benchmarks (Emery et al., 2001). The model's ability to replicate wind direction and speed within 20 degrees and 1 m/s on average enhances the confidence in this modeling setup. Appendix A includes more detail on the June, August, and September 2006 WRF modeling performance.

Table 3-6: WRF Meteorological Modeling Percent Accuracy for June 2006

DFW Area Monitor	Wind Direction (°) Error ≤ 30 / 20 / 10	Wind Speed (m/s) Error ≤ 2 / 1 / 0.5	Temperature (°C) Error ≤ 2 / 1 / 0.5
DFW Area Average	91 / 83 / 65	100 / 89 / 64	87 / 39 / 14
Eagle Mountain Lake	79 / 69 / 48	94 / 68 / 40	86 / 44 / 18
Denton	78 / 64 / 35	94 / 64 / 32	86 / 66 / 45
Dallas North	82 / 71 / 42	99 / 83 / 51	48 / 23 / 08
Fort Worth NW	78 / 68 / 42	98 / 83 / 54	58 / 20 / 08
Weatherford	79 / 67 / 42	92 / 66 / 37	83 / 44 / 20
Frisco	84 / 73 / 47	97 / 74 / 42	75 / 35 / 16
Midlothian Tower	84 / 72 / 45	93 / 70 / 41	73 / 41 / 24
Kaufman	80 / 68 / 43	92 / 67 / 34	84 / 46 / 25

3.5 MODELING EMISSIONS

For the stationary emission source types, which consist of point and area sources, routine emission inventories provided the major inputs for the emissions modeling processing. Emissions from mobile and biogenic sources were derived from relevant emission models. Specifically, link-based on-road mobile source emissions were derived from travel demand model (TDM) activity output coupled with the EPA Motor Vehicle Emissions Simulator (MOVES) emission factor model. The MOVES2010b model was used to develop on-road emission estimates for the DFW AD SIP revision proposal, but the MOVES2014 version became available and was used to develop on-road emission estimates for this DFW AD SIP revision. Non-road mobile source emissions were derived from the Texas NONROAD (TexN) model and the EPA's National Mobile Inventory Model (NMIM). Version 1.6 of TexN was used to develop non-road emission estimates for the DFW AD SIP revision proposal, but version 1.6.1 of TexN was used to develop non-road emission estimates for this DFW AD SIP revision. The point, area, on-road, non-road, and off-road emission estimates were processed to air quality model-ready format using version three of the Emissions Processing System (EPS3; Environ, 2007). Biogenic emissions were derived from version 2.1 of the Model of Emissions of Gases and Aerosols from Nature (MEGAN 2.1), which outputs air quality model-ready emissions (Guenther, et al., 2012).

An overview is provided here of the emission inputs used for the 2006 base case, 2006 baseline, and 2018 future case. Appendix B contains more detail on the development and processing of the emissions using the various EPS3 modules. Table 3-7: *Emissions Processing Modules* summarizes many of the steps taken to prepare chemically speciated, temporally allocated, and spatially distributed emission files needed for the air quality model. Model-ready emissions were developed for the combined 67-day episode. The following sections give a brief description of the development of each emissions source category.

Table 3-7: Emissions Processing Modules

EPS3 Module	Description
PREAM	Prepare area and non-link based area and mobile sources emissions for further processing
LBASE	Spatially allocate link-based mobile source emissions among grid cells
PREPNT	Group point source emissions into elevated and low-level categories for further processing
CNTLEM	Apply controls to model strategies, apply adjustments, make projections, etc.
TMPRL	Apply temporal profiles to allocate emissions by day type and hour
SPCEMS	Chemically speciate emissions into nitrogen oxide, nitrogen dioxide (NO_2), and various Carbon Bond 6 (CB6) VOC species
GRDEM	Spatially distribute emissions by grid cell using source category surrogates
MRGUAM	Merge and adjust multiple gridded files for model-ready input
PIGEMS	Assigns Plume-in-Grid (PiG) emissions and merges elevated point source files

3.5.1 Biogenic Emissions

The TCEQ used MEGAN 2.1 to develop the biogenic emission inputs for CAMx. The MEGAN model requires inputs by model grid cell area of:

- emission factors for nineteen chemical compounds or compound groups;
- plant functional types (PFT);
- leaf area index (LAI) and fractional vegetated leaf area index (LAIv); and

- meteorological information including air and soil temperatures, photosynthetically active radiation (PAR), barometric pressure, wind speed, water vapor mixing ratio, and accumulated precipitation.

The TCEQ used the default emission factors and PFTs that are provided with MEGAN. To process the emission factors and PFTs to the TCEQ air modeling domain structures, gridded layers of each emission factor file were created in ArcMap version 9.3. The TCEQ created 2006-specific LAIv data using the level-4 Moderate-Resolution Imaging Spectroradiometer (MODIS) global LAI MCD15A2 product. For each eight-day period, the satellite tiles covering North America in a Sinusoidal grid were mosaicked together using the MODIS Reprojection Tool. Urban LAI cells, which MODIS excludes, were filled according to a function that follows the North American average for four urban land cover types. The MODIS quality control flags were applied to use only the high quality data from the main retrieval algorithm. The resultant LAI was divided by the percentage of vegetated PFT per grid cell to yield the final LAIv.

The WRF model provided the meteorological data needed for MEGAN input, except for PAR. The episode-specific satellite-based PAR inputs were obtained from the historical data center operated by the Global Energy and Water Cycle Experiment (GEWEX) Continental International Project (GCIP) and GEWEX Americas Prediction Project at the University of Maryland. The PAR data were derived from hourly Geostationary Operational Environmental Satellite (GOES) imagery of cloud cover, which were processed with a solar irradiation model.

The MEGAN model was run for each 2006 episode day. Since biogenic emissions are dependent upon the meteorological conditions on a given day, the same episode-specific emissions for the 2006 baseline were used in the 2018 future case modeling scenarios. The summaries of biogenic emissions for each day of the 67-day combined episode are provided in Appendix B. Figure 3-11: *Sample Biogenic VOC Emissions for June 12, 2006 Episode Day* provides a graphical plot of biogenic VOC emissions distribution at a resolution of 4 km throughout eastern Texas.

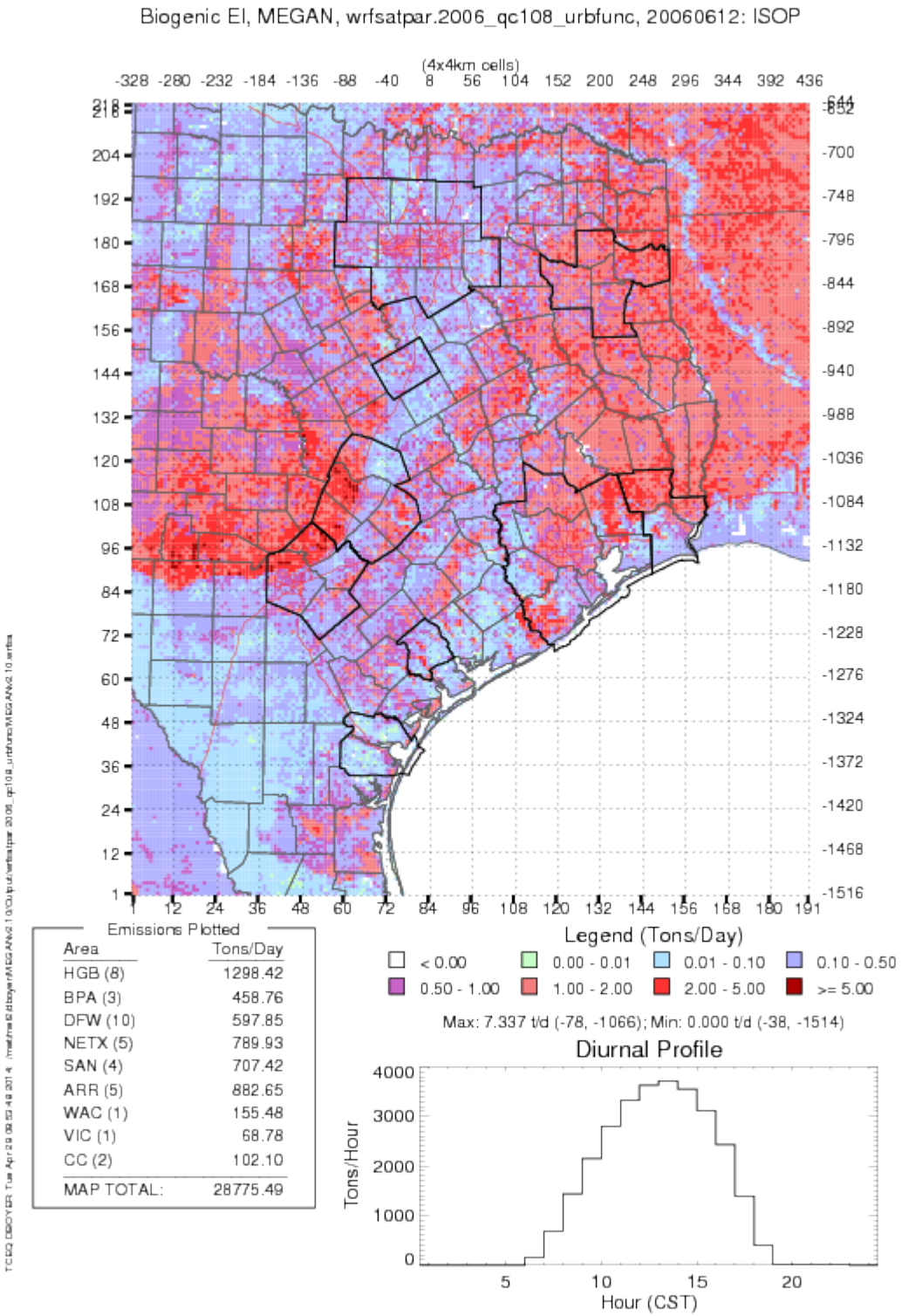


Figure 3-11: Sample Biogenic VOC Emissions for June 12, 2006 Episode Day

3.5.2 2006 Base Case

3.5.2.1 Point Sources

Point source modeling emissions were developed from regional inventories such as the EPA's NEI, the EPA's Acid Rain Database (ARD), state inventories including the State of Texas Air Reporting System (STARS), and local inventories. Data were processed with EPS3 to generate model-ready emissions, and similar procedures were used to develop the 67-day base case episode.

Outside Texas

Point source emissions data for the regions of the modeling domains outside of Texas were obtained from a number of different sources. Emissions from point sources in the Gulf of Mexico (e.g., oil and gas production platforms) were obtained from the 2005 Gulf-Wide Emissions Inventory (GWEI) provided by the United States (U.S.) Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the Minerals Management Service, as monthly totals. Canadian emissions were obtained from the 2006 National Pollutant Release Inventory (NPRI) from Environment Canada, while 1999 Mexican emissions data were obtained from Phase III of the Mexican NEI. The Gulf of Mexico and 1999 Mexican inventories were not grown to 2006 due to the lack of historical operations data, applied controls, and/or a projection methodology. For the non-Texas U.S. portion of the modeling domain, hourly NO_X emissions for major electric generating units (EGU) were obtained from the ARD for each hour of each base case episode day. Emissions for non-ARD sources in states beyond Texas were obtained from the EPA's 2008 NEI-based modeling platform.

Within Texas

Hourly NO_X emissions from EGUs within Texas were obtained from the ARD for each base case episode day. Emissions from non-ARD sources were obtained from a STARS database emissions extract for the year 2006. In addition, agricultural and forest fire emissions for 2006 were obtained from the Fire INventory of NCAR (FINN) database, courtesy of Environ's work for the East Texas Council of Governments (Environ, 2008). Fires are treated as point sources.

Table 3-8: *2006 Sample Base Case Point Source Emissions for 10-County DFW* provides a summary of the DFW nonattainment area point source emissions for the Wednesday June 14, 2006 episode day. The EGU emissions are different for each day and hour of the episode based on real-time continuous emissions monitoring data that are reported to the EPA's ARD. Emission estimates for the remaining non-ARD point source categories of cement kilns, oil and gas facilities, and "other" do not vary by specific episode day, but are averaged over the entire period of June 1 through August 31, 2006.

Table 3-8: 2006 Sample Base Case Point Source Emissions for 10-County DFW

DFW Point Source Category	NO_X tons per day (tpd)	VOC (tpd)	CO (tpd)
Point - EGUs on June 14, 2006	8.42	1.02	3.85
Point - Cement Kilns	22.08	1.94	17.45
Point - Oil and Gas	11.53	21.82	8.74
Point – Other	14.31	25.65	17.26
DFW Nonattainment Area Total	56.34	50.43	47.30

On-Road Mobile Sources

The 2006 on-road mobile source emission inputs were developed using the 2014 version of the MOVES model (MOVES2014). The vehicle miles traveled (VMT) activity data sets that were used for these efforts are:

- the TDM managed by the North Central Texas Council of Governments (NCTCOG) for the DFW nonattainment area;
- Highway Performance Monitoring System (HPMS) data collected by the Texas Department of Transportation (TxDOT) for the non-DFW portions of Texas contained within the modeling domain; and
- the EPA default information included with the MOVES2014 database for the non-Texas U.S. portions of the modeling domain.

The output from these emission modeling applications were processed through EPS3 to generate the on-road speciated and gridded inputs for photochemical modeling applications.

DFW Nonattainment Area

For the 10-county DFW nonattainment area, link-based on-road emissions were developed by NCTCOG using 2006 TDM output and MOVES2014 emission rates to generate average school and summer season on-road emissions for four day types of Monday-Thursday average weekday, Friday, Saturday, and Sunday. For the June 2006 base case episode, the summer season day-type emissions were used. For the August-September 2006 period, the school season day-type emissions were used.

Non-DFW Portions of Texas

For the Texas counties outside of the DFW nonattainment area, on-road emissions were developed by the Texas Transportation Institute (TTI) using MOVES2014 emission rates and 2006 HPMS VMT estimates for each county. Average school and summer season emissions by vehicle type and roadway type were estimated for the four day types of Monday-Thursday average weekday, Friday, Saturday, and Sunday.

Outside of Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used MOVES2014 in default mode to generate 2006 average summer weekday emission estimates for every non-Texas U.S. county. Temporal profiles based on the Texas on-road inventories from TTI and NCTCOG were developed to adjust these summer weekday emissions to the remaining day and season type combinations referenced above.

Table 3-9: *Summary of On-Road Mobile Source Emissions Development* contains additional detail about the on-road mobile inventory development in different regions of the modeling domain.

Table 3-9: Summary of On-Road Mobile Source Emissions Development

On-Road Inventory Development Parameter	DFW	Non-DFW Texas	Non-Texas States/Counties
VMT Source and Resolution	TDM Roadway Links	HPMS Data Sets 19 Roadway Types	MOVES2014 12 Roadway Types
Season Types	School and Summer Seasons	School and Summer Seasons	Summer Season Adjusted to School

On-Road Inventory Development Parameter	DFW	Non-DFW Texas	Non-Texas States/Counties
Day Types	Weekday, Friday, Saturday, and Sunday	Weekday, Friday, Saturday, and Sunday	Weekday Adjusted to Friday, Saturday, and Sunday
Roadway Speed Distribution	Varies by Hour and Link	Varies by Hour and Roadway Type	MOVES2014 Default
MOVES Fuel and Source Use Types	Gasoline and Diesel 13 Source Use Types	Gasoline and Diesel 13 Source Use Types	Gasoline and Diesel 13 Source Use Types

Table 3-10: *2006 Base Case On-Road Modeling Emissions for 10-County DFW* summarizes the on-road mobile source emission estimates for the 2006 base case episode for the 10-county DFW nonattainment area for all combinations of season and day type. The on-road emission estimates in Table 3-10 were developed with MOVES2014, while the on-road emission estimates for the DFW AD SIP revision proposal were developed with MOVES2010b.

Table 3-10: 2006 Base Case On-Road Modeling Emissions for 10-County DFW

Season and Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	284.27	116.50	1,315.46
Summer Friday	294.54	120.41	1,430.74
Summer Saturday	208.95	107.91	1,228.21
Summer Sunday	188.15	101.29	1,066.20
School Weekday	284.90	116.80	1,320.26
School Friday	292.87	120.07	1,424.23
School Saturday	206.38	107.40	1,216.60
School Sunday	185.99	100.89	1,057.09

3.5.2.2 Non-Road and Off-Road Mobile Sources

Non-road mobile sources include vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes. Off-road mobile sources include aircraft, locomotives, and commercial marine vessels. Non-road and off-road mobile source modeling emissions were developed using TexN for non-road emissions within Texas, NMIM for non-road emissions outside of Texas, the EPA's NEI databases, and data sets from the TCEQ Texas Air Emissions Repository (TexAER). The output from these emission modeling applications and databases were processed through EPS3 to generate the air quality model-ready emission files for non-road and off-road sources.

Outside Texas

For the non-Texas U.S. portion of the modeling domains, the TCEQ used the EPA's NMIM to generate average summer weekday non-road mobile source emissions by county and ran it specifically for 2006. For the off-road categories of aircraft, locomotive, and commercial marine, the TCEQ used the EPA's 2008 NEI to create 2006 average summer weekday off-road emissions for the non-Texas U.S. portions of the modeling domain. Summer weekend day emissions for the non-road and off-road mobile source categories were developed as part of the EPS3 processing using temporal profiles specific to each source category.

Within Texas

The TCEQ used the TexN model to generate average summer weekday non-road mobile source category emissions by county for 2006. Airport ground support equipment (GSE) and oil and gas drilling rig emissions were estimated separately as detailed below. During EPS3 processing, temporal adjustments were made to create Saturday and Sunday non-road emission estimates. Table 3-11: *2006 Base Case Non-Road Modeling Emissions for 10-County DFW* summarizes these non-road inputs by day type. The non-road emission estimates in Table 3-11 were developed with version 1.6.1 of TexN, while the non-road emission estimates for the DFW AD SIP revision proposal were developed with the 1.6 version of TexN.

Table 3-11: 2006 Base Case Non-Road Modeling Emissions for 10-County DFW

2006 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	98.06	64.69	806.01
Saturday	68.72	94.19	977.67
Sunday	50.08	82.22	823.17

Airport emission inventories were developed with the Federal Aviation Administration's Emissions Dispersion Modeling System (EDMS). EDMS outputs emission estimates for aircraft engines, auxiliary power units, and GSE. Table 3-12: *2006 Base Case Airport Modeling Emissions for 10-County DFW* summarizes these estimates for DFW International Airport, Love Field, and the remaining 59 smaller regional airports within DFW. Love Field contracted with Leigh-Fisher to develop emission estimates for 2006 using EDMS. The remaining airport specific emission estimates are based on an NCTCOG study done under contract to the TCEQ.

Table 3-12: 2006 Base Case Airport Modeling Emissions for 10-County DFW

DFW Nonattainment Area Airport or Airport Group	NO_X (tpd)	VOC (tpd)	CO (tpd)
DFW International	9.84	2.37	16.69
Love Field	1.22	0.57	3.39
59 Regional Airports	1.72	1.52	28.01
DFW Area Total for 61 Airports	12.78	4.46	48.09

2006 locomotive emission estimates were developed by backcasting 2011 data from TexAER using emission rate and activity adjustment factors. Emissions were estimated separately for Class I line-haul locomotives, Class II and III line-haul locomotives, and rail yard switcher locomotives. Table 3-13: *2006 Base Case Locomotive Modeling Emissions for 10-County DFW* summarizes the estimates for all locomotive activity in DFW.

Table 3-13: 2006 Base Case Locomotive Modeling Emissions for 10-County DFW

Locomotive Source Classification Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
Line-Haul Locomotives – Class I	21.42	1.19	3.22
Line-Haul Locomotives – Classes II and III	0.60	0.02	0.06
Rail Yard Switcher Locomotives	7.95	0.51	0.84
DFW Nonattainment Area Total	29.97	1.72	4.12

3.5.2.3 Area Sources

Area source modeling emissions were developed using the EPA NEI and the TCEQ's TexAER database. The emissions information in these databases was processed through EPS3 to generate the air quality model-ready area source emission files.

Outside Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used the EPA's 2008 NEI to create 2006 daily area source emissions.

Within Texas

The TCEQ obtained emissions data from the 2008 TexAER database (TCEQ, 2011) and backcast these estimates to 2006 using Texas-specific economic growth factors for 2008 to 2006. Temporal profiles were applied with EPS3 to obtain the figures presented in Table 3-14: *2006 Base Case Area Source Emissions for 10-County DFW*.

Table 3-14: 2006 Base Case Area Source Emissions for 10-County DFW

2006 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	29.02	290.46	85.59
Saturday	22.21	136.92	75.57
Sunday	15.41	88.36	65.69

The 2006 county-level drilling rig emissions were based on work done under contract by Eastern Research Group, Inc. (ERG, 2011) using activity data from the Railroad Commission of Texas (RRC), and are summarized in Table 3-15: *2006 Oil and Gas Drilling Rig Emissions for 10-County DFW Area*.

Table 3-15: 2006 Oil and Gas Drilling Rig Emissions for 10-County DFW Area

Equipment Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Drilling Rigs	18.23	1.16	3.57

For oil and gas production sources, county-specific 2006 oil and gas emissions were calculated based on a TCEQ-contracted research project (ERG, 2010). The emissions were estimated according to 2006 county-specific oil and gas production information from the RRC and emission factors compiled in the 2010 ERG study. Emission estimates by equipment type are summarized in Table 3-16: *2006 Oil and Gas Production Emissions for 10-County DFW Area*.

Table 3-16: 2006 Oil and Gas Production Emissions for 10-County DFW Area

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Natural Gas 4-Cycle Rich Burn Compressors - 50 To 499 HP	56.19	0.10	2.54
Natural Gas Well Heaters	2.11	0.12	1.77
Natural Gas 2-Cycle Lean Burn Compressors - 50 To 499 HP	1.45	0.14	0.21
Natural Gas 4-Cycle Rich Burn Compressors - 500+ HP w/NSCR	0.84	0.16	7.25
Natural Gas 4-Cycle Lean Burn Compressors - 500+ HP	0.71	1.43	6.77
Oil Production - Artificial Lift	0.32	0.00	0.50
Oil Production - Heater Treater	0.14	0.01	0.11
Natural Gas Well Dehydrators	0.08	1.65	0.23
Oil Production - All Processes	0.00	0.01	0.01
Natural Gas 4-Cycle Rich Burn Compressors - 50 To 499 HP w/NSCR	0.00	0.01	0.61
Natural Gas Condensate - Storage Tanks	0.00	18.06	0.00
Natural Gas Well Pneumatic Devices	0.00	7.07	0.00
Natural Gas Exploration - Well Completion, All Processes	0.00	3.34	0.00
Oil and Gas Production - Produced Water	0.00	2.30	0.00
Natural Gas Fugitives – Other	0.00	2.04	0.00
Natural Gas Fugitives – Valves	0.00	1.73	0.00
Natural Gas Well Venting	0.00	1.19	0.00
Crude Oil Storage Tanks	0.00	1.18	0.00
Natural Gas Condensate - Tank Truck/Railcar Loading	0.00	0.57	0.00
Oil Production – Wellhead	0.00	0.55	0.00
Oil Well Pneumatic Devices	0.00	0.46	0.00
Natural Gas Fugitives – Flanges	0.00	0.28	0.00
Natural Gas Fugitives – Connectors	0.00	0.27	0.00
Oil Well Completion - All Processes	0.00	0.23	0.00
Natural Gas Fugitives - Open Ended Lines	0.00	0.21	0.00
Oil Production Fugitives – Other	0.00	0.15	0.00
Crude Oil Truck/Railcar Loading	0.00	0.11	0.00
Natural Gas Fugitives – Pumps	0.00	0.11	0.00
Oil Production Fugitives – Valves	0.00	0.10	0.00
Oil Production Fugitives – Pumps	0.00	0.05	0.00
Natural Gas Production - Compressor Engines	0.00	0.04	0.06
Oil Production Fugitives – Connectors	0.00	0.04	0.00
Oil Production Fugitives - Open Ended Lines	0.00	0.01	0.00
Natural Gas 2-Cycle Lean Burn Compressors < 50 HP	0.00	0.00	0.01
Oil Production Fugitives – Flanges	0.00	0.00	0.00
Natural Gas 4-Cycle Rich Burn Compressors - <50 HP	0.00	0.00	0.01
Oil and Gas Production Total	61.84	43.72	20.09

Some facilities associated with oil and gas production are required to report to the TCEQ as point sources. Emissions for 2006 from these facilities are not included above within Table 3-16, but are summarized by standard industrial classification (SIC) in Table 3-17: *2006 Point Source Oil and Gas Emissions for 10-County DFW Area*. Table 3-17 provides detail for the "Point - Oil and Gas" category from Table 3-8.

Table 3-17: 2006 Point Source Oil and Gas Emissions for 10-County DFW Area

SIC Description	SIC Code	NO_X (tpd)	VOC (tpd)	CO (tpd)
Crude Petroleum and Natural Gas	1311	4.78	15.67	4.88
Natural Gas Liquids	1321	5.43	2.70	2.58
Natural Gas Transmission	4922	1.03	0.81	0.96
Petroleum Bulk Stations and Terminals	5171	0.08	1.89	0.12
Mixed, Manufactured, LPG Production	4925	0.21	0.00	0.19
Refined Petroleum Pipelines	4613	0.01	0.74	0.02
DFW Nonattainment Area Total	NA	11.53	21.82	8.74

3.5.2.4 Base Case Summary

Table 3-18: *2006 Sample Base Case Anthropogenic Emissions for 10-County DFW* summarizes the typical weekday emissions in the 10-county DFW nonattainment area by source type for the base case episode. The EGU emissions presented are specific to the June 14, 2006 episode day, and are different for each of the remaining 66 days in the combined 67-day episode. Table 3-18 is for an average weekday during the June episode, which uses the summer season on-road inventories. For the August-September base case emissions, the school season on-road inventories presented above in Table 3-10 were used. Compared to a similar summary from the DFW AD SIP revision proposal, these figures include on-road and non-road emission updates from the newer MOVES2014 and TexN 1.6.1 models, respectively.

Table 3-18: 2006 Sample Base Case Anthropogenic Emissions for 10-County DFW

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	284.27	116.50	1,315.46
Non-Road	98.06	64.69	806.01
Area Sources	29.02	290.46	85.59
Off-Road – Locomotives	29.97	1.72	4.12
Off-Road – Airports	12.78	4.46	48.09
Oil and Gas – Production	61.84	43.72	20.09
Oil and Gas – Drill Rigs	18.23	1.16	3.57
Point – Oil and Gas	11.53	21.82	8.74
Point – EGUs on June 14, 2006	8.42	1.02	3.85
Point – Cement Kilns	22.08	1.94	17.45
Point – Other	14.31	25.65	17.26
Total	590.51	573.14	2,330.23

3.5.3 2006 Baseline

The baseline modeling emissions are based on typical ozone season emissions, whereas the base case modeling emissions are episode day-specific. The biogenic emissions, dependent on the day-specific meteorology, are an exception in that the same episode day-specific emissions are used in both the 2006 base case and baseline. In addition, the 2006 baseline emissions for on-road, non-road, off-road, oil and gas, and area sources are the same as used for the 2006 base case episode, since they are based on typical ozone season emissions. Unlike the base case, fire emissions were not included in the 2006 baseline as they are not typical ozone season day emissions.

For the non-ARD point sources, the 2006 baseline emissions are the same as the modeling emissions used for the 67-day episode base case with a couple of exceptions. The 2006 baseline ARD EGU emissions were estimated using the average of the 2006 third quarter hourly ARD emissions to more accurately reflect EGU emissions during the peak ozone season. The highly reactive VOC (HRVOC) emissions reconciliation in the HGB area developed for the 2006 base case was used for the 2006 baseline. For the Gulf of Mexico, Canada, and Mexico, the 2006 baseline used the same emissions as the base case.

Table 3-19: *2006 Summer Baseline Anthropogenic Emissions for 10-County DFW* provides the baseline emissions for an average summer weekday. The non-ARD emissions are the same as the base case, since they are ozone season day averages. The averaged baseline ARD emissions are not the same as any specific day in the base case, but typical of the entire episode. The only difference between Table 3-18 and Table 3-19 is that the former has episode day specific EGU emissions of 8.42 NO_X tpd for June 14, 2006 while the latter has a peak ozone season average of 9.63 NO_X tpd. The 2006 August-September baseline has the same emission estimates with the exception of including school season on-road emissions instead of those for summer. Compared to a similar summary from the DFW AD SIP revision proposal, these figures include on-road and non-road emission updates from the newer MOVES2014 and TexN 1.6.1 models, respectively.

Table 3-19: 2006 Summer Baseline Anthropogenic Emissions for 10-County DFW

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	284.27	116.50	1,315.46
Non-Road	98.06	64.69	806.01
Area Sources	29.02	290.46	85.59
Off-Road – Locomotives	29.97	1.72	4.12
Off-Road – Airports	12.78	4.46	48.09
Oil and Gas – Production	61.84	43.72	20.09
Oil and Gas – Drill Rigs	18.23	1.16	3.57
Point – Oil and Gas	11.53	21.82	8.74
Point – EGUs (Ozone Season Average)	9.63	1.03	4.77
Point – Cement Kilns	22.08	1.94	17.45
Point – Other	14.31	25.65	17.26
Total	591.72	573.15	2,331.15

Table 3-20: *2006 DFW Point Source Baseline Emission Estimates by Industry Type* provides a summary by SIC of the 17 major industrial categories within the DFW nonattainment area that

each emitted more than 0.25 NO_X tpd in 2006, with the remaining 73 industry types emitting a total of 3.26 NO_X tpd. As of 2006, there were 394 point source facilities throughout the DFW nonattainment area with three in the cement kiln category (SIC of 3241), twelve in electric services (SIC of 4911), and 379 that comprise the remaining 88 SIC types. Based on submissions to the TCEQ STARS database, these 379 non-cement kiln non-EGU facilities were estimated to emit 25.84 NO_X tpd in 2006.

Table 3-20: 2006 DFW Point Source Baseline Emission Estimates by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	22.08	1.94	17.45
4911	Electric Services	9.63	1.03	4.77
1321	Natural Gas Liquids	5.43	2.70	2.58
1311	Crude Petroleum and Natural Gas	4.78	15.67	4.88
3274	Lime	3.83	0.02	0.46
3296	Mineral Wool	2.20	0.73	1.69
3312	Blast Furnaces and Steel Mills	1.37	1.00	4.74
4922	Natural Gas Transmission	1.03	0.81	0.96
3221	Glass Containers	0.88	0.04	0.04
2099	Food Preparations	0.57	0.03	0.25
2952	Asphalt Felts and Coatings	0.46	0.60	0.63
4581	Airports, Flying Fields, and Services	0.43	0.24	0.20
3511	Turbines and Turbine Generator Sets	0.40	0.08	0.07
2013	Sausages and Other Prepared Meat Products	0.33	0.01	0.16
3674	Semiconductors and Related Devices	0.32	0.79	0.23
4953	Refuse Systems	0.30	0.47	1.20
3251	Brick and Structural Clay Tile	0.26	0.43	0.99
	Remaining 73 SICs Below 0.25 NO_X tpd	3.26	23.86	6.92
	DFW Area Total for 90 SIC Codes	57.55	50.44	48.21
	Non-EGU Non-Cement Kiln Total	25.84	47.47	26.00

3.5.4 2018 Future Case Emissions

The biogenic emissions used for the 2018 future case modeling are the same episode day-specific emissions used in the base case. In addition, similar to the 2006 baseline, no fire emissions were included in the 2018 future case modeling.

3.5.4.1 Point Sources

Outside Texas

The non-ARD point source emissions data in the regions outside Texas were derived from the EPA's 2018 emissions modeling platform, which is projected from the 2011 NEI. For non-Texas EGUs, TCEQ applied Clean Air Interstate Rule (CAIR) Phase II caps at the state level. For the Canada and Mexico portions of the modeling domain, the 2018 point source emissions were the

same as the emissions used in the 2006 baseline. The Gulf of Mexico emissions for 2018 were based on 2011 estimates, and held constant at 2011 levels for the 2018 future year.

Within Texas

2018 future case EGU emission estimates within Texas were based on the CAIR Phase II program that specifies an annual statewide limit starting in 2015 of 150,845 tons per year of NO_X emissions, which corresponds to a daily average of 413 NO_X tpd. Since electricity generation is higher during the ozone season than other times of year, historical operational profiles were used to allocate higher estimates for ozone season modeling purposes. To assign future operational NO_X caps to each existing EGU, their operational histories were evaluated for compliance with CAIR Phase I caps that have been in effect from 2009 through 2013. State law assigns 90.5% of the CAIR budgets to existing EGUs, with the remaining 9.5% set aside for newly permitted EGUs. Assignment of ozone season NO_X emissions to each existing EGU resulted in a total less than the 90.5% level, so the remainder was spread proportionally among all existing EGUs. Newly permitted EGUs were assigned their maximum permit allowable emissions.

The three cement kilns operating within the DFW nonattainment area were assigned the maximum ozone season caps that are specified in 30 Texas Administrative Code (TAC) §117.3123. Emissions for the remaining non-EGU facilities within the DFW nonattainment area were projected from the 2012 levels reported to STARS by each point source facility. An ERG study (ERG, 2010) entitled *Projection Factors for Point and Area Sources* was used as the basis for providing adjustments to the reported 2012 levels based on a combination of the type of industry and county of operation for each facility. Table 3-21: *2012 DFW Area Point Source Emission Estimates by Industry Type* provides a summary by SIC of the 17 major industries within the DFW nonattainment area that emitted more than 0.1 NO_X tpd in 2012, with the remaining 77 industry types emitting a total of 1.57 NO_X tpd. As of 2012 there were 412 point source facilities throughout the DFW nonattainment area: three in the cement kiln category, 12 in electric services, and 397 that comprise the remaining 92 SIC types. Based on submissions to the TCEQ STARS database, these 397 non-cement kiln non-EGU facilities were estimated to emit 23.54 NO_X tpd in 2012.

Table 3-21: 2012 DFW Area Point Source Emission Estimates by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	9.03	0.86	9.20
4911	Electric Services	8.25	3.16	13.86
1311	Crude Petroleum and Natural Gas	11.00	16.49	9.00
1321	Natural Gas Liquids	4.59	4.94	3.88
3274	Lime	1.43	0.01	0.34
4922	Natural Gas Transmission	1.09	2.26	0.77
3312	Blast Furnaces and Steel Mills	0.88	0.89	4.10
3296	Mineral Wool	0.57	0.56	1.27
4953	Refuse Systems	0.55	0.67	2.16
2952	Asphalt Felts and Coatings	0.46	0.49	0.59
4581	Airports, Flying Fields, and Services	0.33	0.17	0.05

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3711	Motor Vehicles and Car Bodies	0.23	3.78	0.16
3253	Ceramic Wall and Floor Tile	0.20	0.16	0.82
3511	Turbines and Turbine Generator Sets	0.19	0.05	0.05
2631	Paperboard Mills	0.16	0.06	0.17
3341	Secondary Nonferrous Metals	0.16	0.16	1.88
4952	Sewerage Systems	0.15	0.03	0.12
	Remaining 77 SICs Below 0.1 NO_X tpd	1.57	15.16	3.53
	DFW Area Total for 94 SIC Codes	40.82	49.88	51.95
	Non-Cement Kiln Non-EGU Total (92 SICs)	23.54	45.87	28.89

Table 3-22: *2018 DFW Area Point Source Emission Projections by Industry Type* provides a summary of the 2018 point source emission projections by SIC. For the cement kiln and electric utility sources, the required emission caps are modeled in the future year even if historical operational levels have only been roughly 50% of these caps. For example, the cement kilns operated at an average ozone season day level of 9.03 NO_X tpd in 2012, but the 2018 future year is still modeled at the 17.64 NO_X tpd cap. In a similar fashion, the EGUs emitted an average of 8.25 NO_X tpd in 2012, but the 2018 future year is modeled at the CAIR Phase II caps of 16.91 NO_X tpd. This conservative approach of modeling the maximum allowable emission levels ensures that future estimates are not underestimated for these large NO_X sources on high ozone days. Specific caps do not apply to the non-cement kiln non-EGU facilities, which are projected to emit 22.99 NO_X tpd in 2018 after application of the ERG projection factors discussed previously.

Table 3-22: 2018 DFW Area Point Source Emission Projections by Industry Type

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
3241	Cement, Hydraulic	17.64	0.78	11.45
4911	Electric Services	16.91	4.44	20.61
1311	Crude Petroleum and Natural Gas	10.74	16.70	8.44
1321	Natural Gas Liquids	4.48	5.01	3.24
3274	Lime	1.40	0.01	0.39
4922	Natural Gas Transmission	1.06	2.29	0.79
3312	Blast Furnaces and Steel Mills	0.86	0.90	4.97
3296	Mineral Wool	0.56	0.57	1.66
4953	Refuse Systems	0.53	0.67	2.30
2952	Asphalt Felts and Coatings	0.44	0.50	0.56
4581	Airports, Flying Fields, and Services	0.33	0.17	0.07
3711	Motor Vehicles and Car Bodies	0.22	3.82	0.15
3253	Ceramic Wall and Floor Tile	0.20	0.16	0.86
3511	Turbines and Turbine Generator Sets	0.19	0.05	0.06

SIC Code	SIC Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
2631	Paperboard Mills	0.16	0.06	0.22
3341	Secondary Nonferrous Metals	0.15	0.16	2.07
4952	Sewerage Systems	0.14	0.03	0.14
	Remaining 77 SICs Below 0.1 NO_X tpd	1.53	15.36	3.97
	DFW Area Total for 94 SIC Codes	57.54	51.67	61.95
	Non-Cement Kiln Non-EGU Total (92 SICs)	22.99	46.46	29.89

A similar approach was taken for projecting non-EGU emission levels from 2012 to 2018 in the non-DFW areas of Texas. Within the eight-county HGB area, point source NO_X emissions are limited by the Mass Emissions Cap and Trade Program (MECT), while HRVOC emissions are limited by the HRVOC Emissions Cap and Trade Program (HECT). These MECT and HECT limits were taken into account while projecting 2018 point source levels for both EGUs and non-EGUs operating in the HGB area.

3.5.4.2 On-Road Mobile Sources

2018 on-road mobile source inputs were developed using MOVES2014 in combination with the following vehicle activity data sets:

- the TDM managed by NCTCOG for the DFW nonattainment area;
- HPMS data collected by TxDOT for the non-DFW portions of Texas contained within the modeling domain; and
- the EPA default information included with the MOVES2014 database for the non-Texas U.S. portions of the modeling domain.

The output from these emission modeling applications were processed through EPS3 to generate the on-road speciated and gridded inputs for photochemical modeling applications.

DFW and Non-DFW Areas of Texas

For all 254 Texas counties, HPMS-based on-road emissions were developed by TTI for 2018 using MOVES2014. Similar to the approach taken for 2006, 2018 on-road emissions were estimated for the four day types of weekday, Friday, Saturday, and Sunday for both the school and summer seasons. For the 10-county DFW nonattainment area, 2018 link-based on-road emissions were estimated using MOVES2014 and TDM output from NCTCOG.

Outside of Texas

For the non-Texas U.S. portions of the modeling domain, the TCEQ used MOVES2014 in default mode to generate 2018 average summer weekday emissions for every non-Texas county. Temporal profiles based on the Texas on-road inventories from TTI and NCTCOG were developed to adjust these summer weekday emissions to the remaining day and season type combinations referenced above.

Table 3-23: *2018 Future Case On-Road Modeling Emissions for 10-County DFW* summarizes the on-road mobile source emissions for the 2018 future case for the 10-county DFW nonattainment area for all combinations of season and day type. The on-road emission estimates in Table 3-23 were developed with MOVES2014, while the on-road emission estimates for the DFW AD SIP revision proposal were developed with MOVES2010b. A technical

supplement to the proposal for this DFW AD SIP revision was provided to the public for comment in January 2015 with preliminary MOVES2014 on-road emission inventories that reported 10-county DFW estimates of 131.97 NO_X tpd, 63.79 VOC tpd, and 980.84 CO tpd for the 2018 summer weekday scenario. These preliminary inventory data sets were incorrectly modeled with 30 parts per million (ppm) sulfur gasoline instead of the 10 ppm level that will be required starting in January 2017. This error was corrected, and the updated 2018 summer weekday figures are shown in Table 3-23 along with those for the other season and day type combinations.

Table 3-23: 2018 Future Case On-Road Modeling Emissions for 10-County DFW

Season and Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	119.69	62.20	989.88
Summer Friday	122.67	63.80	1,083.31
Summer Saturday	90.42	58.74	924.25
Summer Sunday	84.54	56.58	806.43
School Weekday	119.97	62.32	993.96
School Friday	122.27	63.73	1,081.33
School Saturday	89.72	58.60	918.48
School Sunday	83.55	56.37	797.80

For the 10-county DFW nonattainment area, the on-road mobile source NO_X emissions are reduced roughly 58% from the 2006 baseline (284.27 tpd) to the 2018 future case (119.69 tpd). VOC emissions are reduced roughly 47% from the 2006 baseline (116.50 tpd) to the 2018 future case (62.20 tpd). Due to the ongoing fleet turnover effect where older high-emitting vehicles are replaced with newer low-emitting ones, these substantial on-road reductions are projected to occur even with projected growth in VMT between the years of 2006 and 2018.

3.5.4.3 Non- and Off-Road Mobile Sources

Outside Texas

For the non-Texas U.S. portion of the modeling domains, the TCEQ used the EPA's NMIM specifically for 2018 to generate average summer weekday non-road mobile source emission projections by county. For the off-road categories of aircraft, locomotive, and commercial marine, the TCEQ used the EPA's 2011 NEI to create 2018 average summer weekday off-road emissions for the non-Texas U.S. portions of the modeling domain. Summer weekend day emissions for the non-road and off-road mobile source categories were developed as part of the EPS3 processing using temporal profiles specific to each source category.

Within Texas

The TCEQ used the TexN model to generate average summer weekday non-road mobile source category emissions by county for 2018. Airport GSE and oil and gas drilling rig emissions were estimated separately as detailed below. During EPS3 processing, temporal adjustments were made to create Saturday and Sunday non-road emission estimates. Table 3-24: *2018 Future Case Non-Road Modeling Emissions for 10-County DFW* summarizes these non-road inputs by day type. The non-road emission estimates in Table 3-24 were developed with version 1.6.1 of TexN, while the non-road emission estimates for the DFW AD SIP revision proposal were developed with the 1.6 version of TexN.

For the 10-county DFW nonattainment area, non-road NO_X emissions are reduced by roughly 57% from the 2006 baseline (98.06 tpd) to the 2018 future case (42.13 tpd). VOC emissions are decreased roughly 49% from the 2006 baseline (64.69 tpd) to the 2018 future case (33.02 tpd). Due to the ongoing fleet turnover effect where older high-emitting equipment is replaced with newer low-emitting equipment, these substantial non-road reductions are projected to occur even with expected growth in overall non-road equipment population and activity between the years of 2006 and 2018.

Table 3-244: 2018 Future Case Non-Road Modeling Emissions for 10-County DFW

2018 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	42.13	33.02	578.12
Saturday	30.91	47.05	742.31
Sunday	23.59	42.00	644.62

Airport emission inventories were developed with the FAA EDMS tool, which outputs emission estimates for aircraft engines, APUs, and GSE. Table 3-25: *2018 Future Case Airport Modeling Emissions for 10-County DFW* summarizes these estimates for DFW International Airport, Love Field, and the remaining 59 smaller regional airports within DFW. Love Field contracted with Leigh-Fisher to develop emission estimates for 2018 using EDMS. The remaining airport specific emission estimates are based on an NCTCOG study done under contract to the TCEQ.

Table 3-25: 2018 Future Case Airport Modeling Emissions for 10-County DFW

DFW Nonattainment Area Airport or Airport Group	NO_X (tpd)	VOC (tpd)	CO (tpd)
DFW International	10.50	2.02	10.65
Love Field	1.70	0.43	2.43
59 Regional Airports	0.86	1.10	20.99
DFW Area Total for 61 Airports	13.06	3.55	34.07

2018 locomotive emission estimates were developed by projecting 2011 figures from TexAER using emission rate adjustment factors while holding activity constant at 2011 levels. Emissions were estimated separately for Class I line-haul locomotives, Class II and III line-haul locomotives, and rail yard switcher locomotives. Table 3-26: *2018 Future Case Locomotive Emissions for 10-County DFW* summarizes these estimates for all locomotive activity in DFW.

For the 10-county DFW nonattainment area, the locomotive NO_X emissions are reduced by about 40% from the 2006 baseline (29.97 tpd) to the 2018 future case (17.86 tpd), and the VOC emissions are decreased about 48% from the 2006 baseline (1.72 tpd) to the 2018 future case (0.89 tpd). These substantial locomotive emissions reductions are projected to occur due to the ongoing fleet turnover effect where older high-emitting locomotive diesel engines are replaced with newer low-emitting ones.

Table 3-26: 2018 Future Case Locomotive Emissions for 10-County DFW

Locomotive Source Classification Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
Line-Haul Locomotives – Class I	11.55	0.50	3.02
Line-Haul Locomotives – Classes II and III	0.53	0.02	0.06

Locomotive Source Classification Description	NO_X (tpd)	VOC (tpd)	CO (tpd)
Rail Yard Switcher Locomotives	5.78	0.37	0.79
DFW Nonattainment Area Total	17.86	0.89	3.87

3.5.4.4 Area Sources

Outside Texas

For the non-Texas U.S. within the modeling domains, the TCEQ used the EPA's 2011 NEI with to create 2018 daily area source emissions.

Within Texas

The TCEQ used data from the 2011 TexAER database (TCEQ, 2011), and projected these estimates to 2018 using the Texas-specific economic growth factors for 2011 to 2018. Temporal profiles were applied with EPS3 to obtain the figures presented in Table 3-27: *2018 Future Case Area Source Emissions for 10-County DFW*.

Table 3-27: 2018 Future Case Area Source Emissions for 10-County DFW

2018 Day Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Monday – Friday Average Weekday	30.76	284.94	78.09
Saturday	23.61	137.45	67.38
Sunday	16.46	88.12	56.79

The 2018 county-level drilling rig emission estimates were based on the latest available drilling activity data obtained from the RRC, which are summarized in Table 3-28: *2013 Oil and Gas Drilling Activity for the 10-County DFW Area*. A 2018 drilling rig emission rate for each of the three categories referenced in Table 3-28 was multiplied by the corresponding number of feet drilled. These emission rates for 1999 through 2040 are documented in Chapter 4 of an ERG report entitled *Development of Texas Statewide Drilling Rigs Emission Inventories for the Years 1990, 1993, 1996, and 1999 through 2040* (ERG, 2011). The results are summarized in Table 3-29: *2018 Oil and Gas Drilling Rig Emissions for 10-County DFW Area*.

Table 3-28: 2013 Oil and Gas Drilling Activity for the 10-County DFW Area

Type and Depth of 2013 Drilling Levels	2013 Feet Drilled
Vertical/Horizontal Drilling	5,556,499
Vertical Drilling less than 7,000 Feet	17,608
Vertical Drilling greater than 7,000 Feet	16,073

Table 3-29: 2018 Oil and Gas Drilling Rig Emissions for 10-County DFW Area

Equipment Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
Drilling Rigs	2.82	0.21	0.45

2018 future year emission estimates for oil and gas production were projected using 2013 RRC data, which is the latest full year for which such activity information is available. The 2013-to-2018 projection factors were obtained from an ERG study entitled *Forecasting Oil and Gas Activities* (ERG, 2012) (http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1212-20120831-erg-forecasting_oild_gas_activities.pdf) where several methodologies were evaluated for the purposes of projecting oil and gas production levels. The recommended approach is based on the Hubbert peak theory that relies on a bell-shaped curve to predict the rate of fossil fuel extraction over time from a specific region. Table 3-30: *Barnett Shale Emission Projection Factors from 2013 to 2018* summarizes these projection factors from the ERG study for natural gas, crude oil, and condensate.

Table 3-30: Barnett Shale Emission Projection Factors from 2013 to 2018

Fossil Fuel Type	Barnett Shale Projection Factor from 2013 to 2018
Natural Gas	47.69%
Crude Oil	52.13%
Condensate	13.67%

The 2013 emission estimates based directly on historical RRC data were then multiplied by the projection factors in Table 3-30 to obtain the 2018 emissions estimates by equipment type presented in Table 3-31: *2018 Oil and Gas Production Emissions for 10-County DFW Area*. Improvements to these 2018 oil and gas production emission estimates occurred between AD SIP proposal and adoption. Updated RRC activity data become available that increased the estimate of compressor engine emissions. A study was completed in 2014 (ERG, 2014) that updated methodologies for estimating emissions from hydraulic pump engines, mud degassing activities, and impacts of the New Source Performance Standards (NSPS) Subpart OOOO for completions of new wells. The 2018 oil and gas production emission estimates in Table 3-31 incorporates the results of all of these updates.

Table 3-31: 2018 Oil and Gas Production Emissions for 10-County DFW Area

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Natural Gas 4-Cycle Rich Burn Compressors 50 To 499 HP	4.68	0.05	1.81
Natural Gas 4-Cycle Rich Burn Compressors 50 To 499 HP w/NSCR	1.13	0.05	2.15
Natural Gas 4-Cycle Rich Burn Compressors <50 HP	0.69	0.00	0.07
Natural Gas 4-Cycle Rich Burn Compressors 500+ HP w/NSCR	0.53	0.02	0.85
Oil Production - Artificial Lift	0.15	0.00	0.23
Natural Gas 4-Cycle Rich Burn Compressors 500+ HP	0.07	0.00	0.06
Natural Gas 4-Cycle Lean Burn Compressors 50 To 499 HP	0.06	0.03	0.14
Natural Gas 4-Cycle Lean Burn Compressors <50 HP	0.04	0.00	0.01
Natural Gas 2-Cycle Lean Burn Compressors 50 To 499 HP	0.02	0.04	0.07
Natural Gas 2-Cycle Lean Burn Compressors 500+ HP	0.02	0.00	0.00
Natural Gas Well Dehydrators	0.01	1.62	0.16
Natural Gas Well Heaters	0.01	0.00	0.01
Natural Gas 4-Cycle Lean Burn Compressors 500+ HP	0.00	0.00	0.02
Natural Gas Production - Compressor Engines	0.00	0.01	0.01
Oil Production - All Processes	0.00	0.01	0.01
Oil Production - Heater Treater	0.00	0.00	0.00
Oil and Gas Production - Hydraulic Fracturing Pumps	0.88	0.06	0.19
Natural Gas Well Pneumatic Devices	0.00	5.81	0.00
Natural Gas Exploration - Well Pneumatic Pumps	0.00	5.57	0.00
Natural Gas Condensate - Storage Tanks	0.00	2.87	0.00
Natural Gas Fugitives – Other	0.00	2.04	0.00
Natural Gas Well Venting	0.00	1.19	0.00
Natural Gas Fugitives – Valves	0.00	1.09	0.00
Oil and Gas Production - Produced Water	0.00	0.87	0.00
Crude Oil Storage Tanks	0.00	0.51	0.00
Natural Gas Exploration - Well Completion, All Processes	0.00	0.02	0.00
Natural Gas Fugitives – Flanges	0.00	0.28	0.00
Natural Gas Fugitives – Connectors	0.00	0.27	0.00
Oil Production – Wellhead	0.00	0.26	0.00
Natural Gas Fugitives - Open Ended Lines	0.00	0.21	0.00
Oil Well Pneumatic Devices	0.00	0.20	0.00
Natural Gas Fugitives – Pumps	0.00	0.11	0.00
Natural Gas Condensate - Tank Truck/Railcar Loading	0.00	0.09	0.00
Oil Production Fugitives – Other	0.00	0.07	0.00
Oil Well Completion - All Processes	0.00	0.06	0.00
Oil Exploration - Mud Degassing	0.00	0.02	0.00
Oil Well Pneumatic Pumps	0.00	0.06	0.00
Crude Oil Truck/Railcar Loading	0.00	0.05	0.00
Oil Production Fugitives – Valves	0.00	0.05	0.00

Oil and Gas Production Equipment	NO_X (tpd)	VOC (tpd)	CO (tpd)
Oil Production Fugitives – Pumps	0.00	0.03	0.00
Oil Production Fugitives – Connectors	0.00	0.02	0.00
Natural Gas Exploration - Mud Degassing	0.00	0.60	0.00
Oil Production Fugitives - Open Ended Lines	0.00	<0.01	0.00
Oil Production Fugitives – Flanges	0.00	<0.01	0.00
Oil and Gas Production Total	8.31	24.24	5.80

Comparison of the 2006 oil and gas production emission estimates in Table 3-16 with the 2018 projections in Table 3-31 shows that compressor engine emissions are the primary source of NO_X from oil and gas activity in the Barnett Shale, but that the 2018 levels are lower than 2006. This is primarily due to the introduction of TCEQ Chapter 117 rules for compressor engines rated above 50 horsepower, which took effect starting in 2007. Without these rules, the average natural gas compressor engine emission rate would be 6.94 NO_X grams/horsepower-hour (gm/hp-hr). Introduction of this rule lowered this emission rate by roughly 91% to 0.61 NO_X gm/hp-hr.

Some facilities associated with oil and gas production are required to report to the TCEQ as point sources. 2018 emission projections for these facilities are not included within Table 3-31, but are summarized by SIC in Table 3-32: *2018 Point Source Oil and Gas Emissions for 10-County DFW Area*. The emissions in Table 3-32 are part of the total 2018 emissions detailed in Table 3-22.

Table 3-32: 2018 Point Source Oil and Gas Emissions for 10-County DFW Area

SIC Description	SIC Code	NO_X (tpd)	VOC (tpd)	CO (tpd)
Crude Petroleum and Natural Gas	1311	10.74	16.70	8.44
Natural Gas Liquids	1321	4.48	5.01	3.24
Natural Gas Transmission	4922	1.06	2.29	0.79
Petroleum Bulk Stations and Terminals	5171	0.06	1.66	0.15
Mixed, Manufactured, LPG Production	4925	0.02	0.00	0.11
Refined Petroleum Pipelines	4613	0.01	0.37	0.02
DFW Nonattainment Area Total	NA	16.37	26.02	12.75

Figure 3-12: *Barnett Shale Drilling and Natural Gas Production from 1993-2014* summarizes Barnett Shale drilling and production levels from 1993 through the present based on regularly updated information available on the RRC Barnett Shale Information Web page (http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/barnett-shale-information/). The blue line in Figure 3-12 is the daily average natural gas production rate from 1993 through April 2014. As shown, Barnett Shale natural gas production has followed a bell-shaped curve with production levels peaking in 2012 when the daily average extraction rate was 5,743 million cubic feet (MMcf) per day. From this 2012 peak, the 2013 daily average was 5,355 MMcf/day (7% lower) and the 2014 daily average was 4,877 MMcf/day (15% lower).
The black line in Figure 3-12 is the Henry Hub natural gas spot price, which hovered in the $7-9 range during the Barnett Shale drilling boom years of 2005-2008, and then dropped to the $3-4 range where it has remained since. The red line in Figure 3-12 shows how the number of drilling permits issued reached a peak of roughly 4,000 in 2008, declined steeply through 2009 as

natural gas prices fell, and since 2012 have been in the range of roughly 1,000 per year, similar to the pre-drilling boom years of 2001-2004. A University of Texas at Austin study entitled *Barnett Study Determines Full-Field Reserves, Production Forecast* (UT-Austin, 2013) (http://www.beg.utexas.edu/info/docs/OGJ_SFSGAS_pt2.pdf) evaluated historical production data per well to determine that the natural gas extraction rate is highest in the first year and then begins to decline exponentially. For an average production span of 25 years per well, roughly 50% of the natural gas is extracted in the first five years, with the remaining 50% extracted within the subsequent twenty years. The decline in natural gas production since 2012 is expected because wells that began producing during the drilling boom years of 2005 through 2008 are now past this five-year mark, and drilling levels from 2009 onwards have not been sufficient to keep production either at or near the 2012 peak. The TCEQ will continue to monitor the monthly updates provided by the RRC to determine if any changes occur in these recent drilling and production trends.

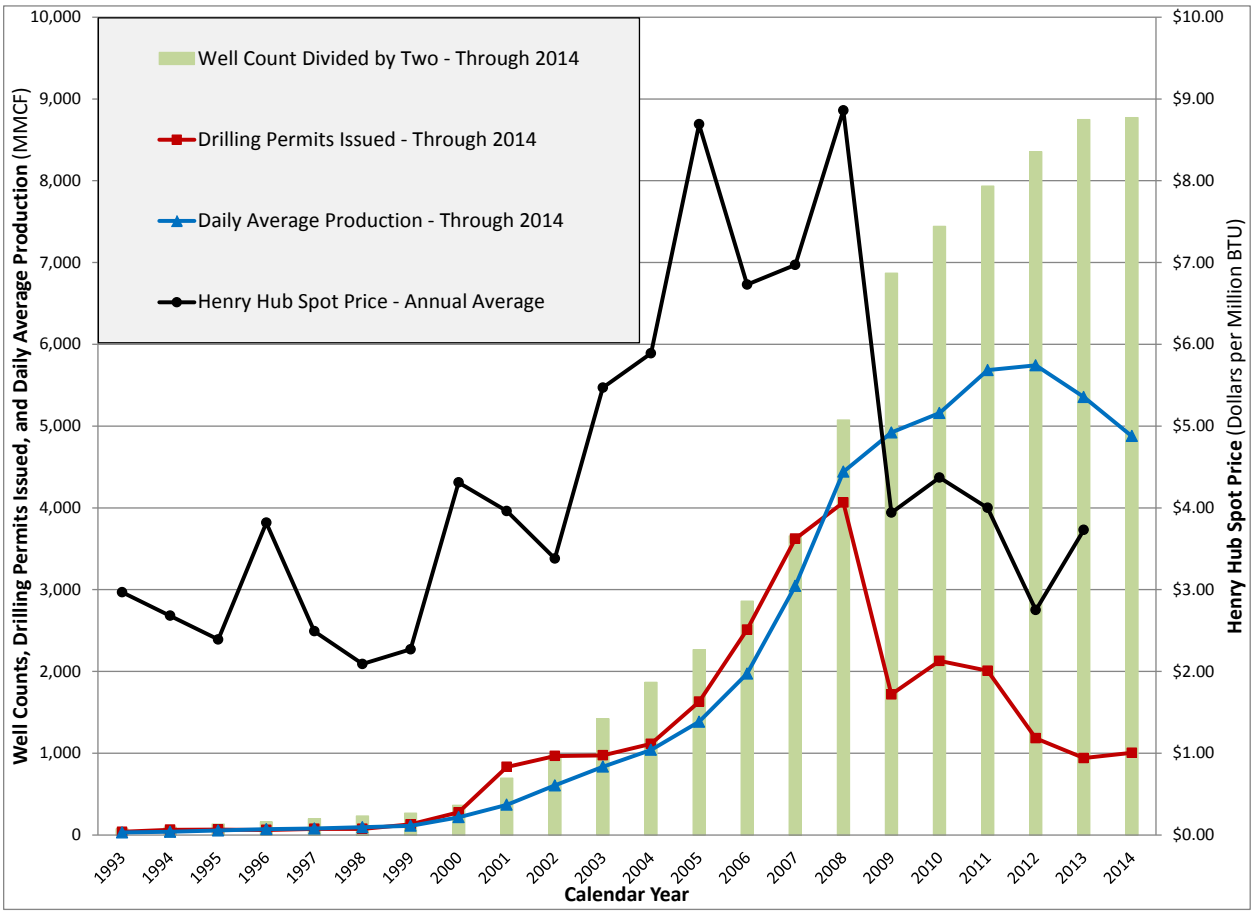


Figure 3-12: Barnett Shale Drilling and Natural Gas Production from 1993-2014

3.5.4.5 Future Base Summary

Table 3-33: *2018 Future Case Anthropogenic Emissions for 10-County DFW* summarizes the typical summer weekday emissions in the 10-county DFW nonattainment area by source type for the 2018 future case modeling. Compared to a similar summary from the DFW AD SIP revision proposal, these figures include on-road and non-road emission updates from the newer MOVES2014 and TexN 1.6.1 models, respectively. Table 3-33 also includes updates to the 2018 oil and gas production emission estimates discussed in Section 3.5.4.4: *Area Sources*.

Table 3-33: 2018 Future Case Anthropogenic Emissions for 10-County DFW

DFW Nonattainment Area Source Type	NO_X (tpd)	VOC (tpd)	CO (tpd)
On-Road	119.69	62.20	989.88
Non-Road	42.13	33.02	578.12
Area Sources	30.76	284.94	78.09
Off-Road – Locomotives	17.86	0.89	3.87
Off-Road – Airports	13.06	3.55	34.07
Oil and Gas – Production	8.31	24.24	5.80
Oil and Gas – Drill Rigs	2.82	0.21	0.45
Point – Oil and Gas	16.37	26.02	12.75
Point – EGUs (Peak Ozone Season Average)	16.91	4.44	20.61
Point – Cement Kilns	17.64	0.78	11.45
Point – Other	6.62	20.43	17.14
Total	292.17	460.72	1,752.23

3.5.5 2006 and 2018 Modeling Emissions Summary for DFW

Table 3-34: *2006 Baseline and 2018 Future Modeling Emissions for DFW Area* provides side-by-side comparisons of the NO_X and VOC emissions by major source category from Table 3-19 and Table 3-33 for an average summer weekday. The total 10-county DFW nonattainment area anthropogenic NO_X emissions are projected to be reduced by roughly 51% from 2006 (591.72 tpd) to 2018 (292.17 tpd). The total 10-county DFW nonattainment area anthropogenic VOC emissions are projected to be reduced by 20% from 2006 (573.15 tpd) to 2018 (460.72 tpd).

Table 3-34: 2006 Baseline and 2018 Future Modeling Emissions for DFW Area

DFW Nonattainment Area Source Type	2006 NO_X (tpd)	2018 NO_X (tpd)	2006 VOC (tpd)	2018 VOC (tpd)
On-Road	284.27	119.69	116.50	62.20
Non-Road	98.06	42.13	64.69	33.02
Area Sources	29.02	30.76	290.46	284.94
Off-Road – Locomotives	29.97	17.86	1.72	0.89
Off-Road – Airports	12.78	13.06	4.46	3.55
Oil and Gas – Production	61.84	8.31	43.72	24.24
Oil and Gas – Drill Rigs	18.23	2.82	1.16	0.21
Point – Oil and Gas	11.53	16.37	21.82	26.02
Point – EGUs (Ozone Season Average)	9.63	16.91	1.03	4.44
Point – Cement Kilns	22.08	17.64	1.94	0.78
Point – Other	14.31	6.62	25.65	20.43
Total	591.72	292.17	573.15	460.72

Figure 3-13: *2006 Baseline and 2018 Future Modeling Emissions for DFW Area* graphically compares the anthropogenic NO_X and VOC emission estimates presented in Table 3-34.

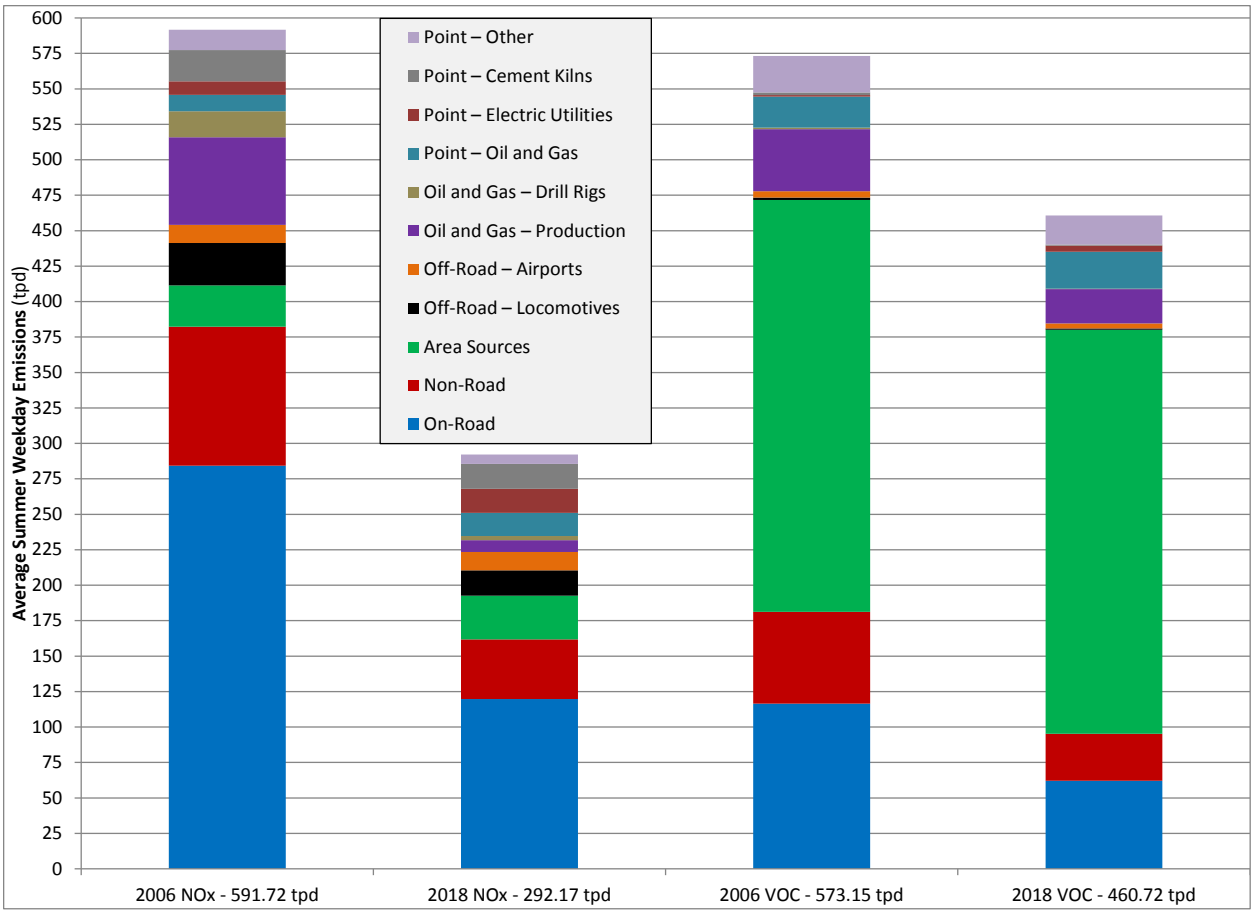


Figure 3-13: 2006 Baseline and 2018 Future Modeling Emissions for DFW Area

3.6 PHOTOCHEMICAL MODELING

To ensure that a modeling study can be successfully used as technical support for an AD SIP revision, the air quality model must be scientifically sound and appropriate for the intended application and freely accessible to all stakeholders. In a regulatory environment, it is crucial that oversight groups (e.g., the EPA), the regulated community, and the public have access to and have reasonable assurance of the suitability of the model. The following three prerequisites were identified for selecting the air quality model to be used in the DFW AD. The model must:

- have a reasonably current, peer-reviewed, scientific formulation;
- be available at no or low cost to stakeholders; and
- be consistent with air quality models being used for Texas SIP development.

The only model to meet all three of these criteria is CAMx. The model is based on well-established treatments of advection, diffusion, deposition, and chemistry. Another important feature is that NO_X emissions from large point sources can be treated with the PiG submodel, which helps avoid the artificial diffusion that occurs when large, hot, point source emissions are introduced into a grid volume. The model software, including the PiG submodel, and the CAMx user's guide are publicly available (Environ, 2014). In addition, the TCEQ has many years of experience with CAMx as it was used for the modeling conducted in the HGB ozone nonattainment area, the Beaumont-Port Arthur ozone maintenance area, previous DFW ADs, and modeling being conducted in other areas of Texas (e.g., Austin and San Antonio).

3.6.1 Modeling Domains and Horizontal Grid Cell Size

Figure 3-14: *CAMx Modeling Domains* and Table 3-35: *CAMx Modeling Domain Definitions* depict and define the fine resolution 4 km domain covering eastern Texas, a medium resolution 12 km domain covering all of Texas plus some or all of surrounding states, and a coarse resolution 36 km domain covering the continental U.S. plus southern Canada and northern Mexico. The 4 km domain is nested within the 12 km domain, which in turn is nested within the 36 km domain. All three domains were projected in a Lambert Conformal Conic (LCC) projection with the origin at 97 degrees west and 40 degrees north.

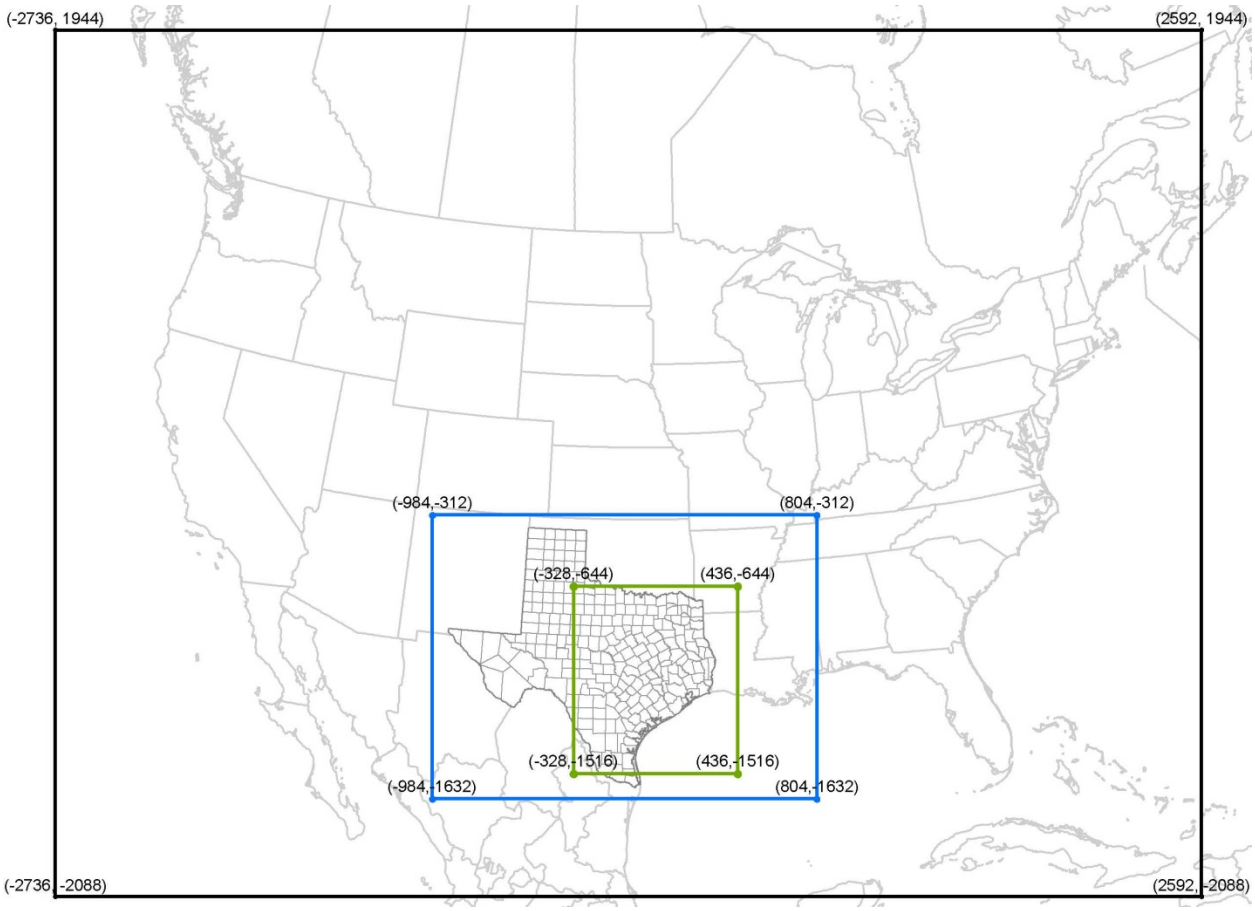


Figure 3-14: CAMx Modeling Domains

Table 3-35: CAMx Modeling Domain Definitions

Domain Code	Domain Cell Size	Dimensions (grid cells)	Lower left-hand corner	Upper right-hand corner
36 km	36 x 36 km	148 x 112	(-2736,-2088)	(2592,1944)
12 km	12 x 12 km	149 x 110	(-984,-1632)	(804,-312)
4 km	4 x 4 km	191 x 218	(-328,-1516)	(436,-644)

3.6.2 Vertical Layer Structure

The vertical configuration of the CAMx modeling domains consists of 28 layers of varying depths in units of meters (m) AGL as shown in Table 3-36: *CAMx Vertical Layer Structure*.

Table 3-36: CAMx Vertical Layer Structure

CAMx Layer	WRF Layer	Top (m AGL)	Center (m AGL)	Thickness (m)
28	38	15,179.1	13,637.9	3,082.5
27	36	12,096.6	10,631.6	2,930.0
26	32	9,166.6	8,063.8	2,205.7
25	29	6,960.9	6,398.4	1,125.0
24	27	5,835.9	5,367.0	937.9
23	25	4,898.0	4,502.2	791.6
22	23	4,106.4	3,739.9	733.0
21	21	3,373.5	3,199.9	347.2
20	20	3,026.3	2,858.3	335.9
19	19	2,690.4	2,528.3	324.3
18	18	2,366.1	2,234.7	262.8
17	17	2,103.3	1,975.2	256.2
16	16	1,847.2	1,722.2	249.9
15	15	1,597.3	1,475.3	243.9
14	14	1,353.4	1,281.6	143.6
13	13	1,209.8	1,139.0	141.6
12	12	1,068.2	998.3	139.7
11	11	928.5	859.5	137.8
10	10	790.6	745.2	90.9
9	9	699.7	654.7	90.1
8	8	609.7	565.0	89.3
7	7	520.3	476.1	88.5
6	6	431.8	387.9	87.8
5	5	344.0	300.5	87.1
4	4	256.9	213.8	86.3
3	3	170.6	127.8	85.6
2	2	85.0	59.4	51.0
1	1	33.9	17.0	33.9

3.6.3 Model Configuration

The TCEQ used CAMx version 6.11, which includes a number of upgrades and features from previous versions. The following CAMx 6.11 options were employed:

- revised gridded file formats for meteorology inputs, initial/boundary conditions, emission inputs, output concentration values, and deposition fields;
- photolysis rate updates based on inputs for surface albedo, height above ground, terrain height, solar zenith, clouds, temperature, and barometric pressure; and
- new gas-phase chemistry mechanisms for CB6 speciation and CB6 "revision 2" (CB6r2), which revises isoprene and aromatics extensively, and has additional NO_X recycling from organic nitrates.

In addition to the CAMx inputs developed from the meteorological and emissions modeling, inputs are needed for initial and boundary conditions, spatially resolved surface characteristic parameters, spatially resolved albedo/haze/ozone (i.e., opacity) and photolysis rates, and a chemistry parameters file. The TCEQ contracted with Environ (Environ, 2012) to derive episode-specific boundary conditions from the Goddard Earth Observing Station global atmospheric model with Chemistry (GEOS-Chem) model runs for 2006 and 2018. Boundary conditions were developed for each grid cell along all four edges of the outer 36 km modeling domain at each of the 28 vertical layers for each episode hour. This work also produced initial conditions for each of the 67 days within both episodes. The TCEQ used these episode-specific initial and lateral boundary conditions for this modeling study.

Surface characteristic parameters, including topographic elevation, LAI, vegetative distribution, and water/land boundaries are input to CAMx via a land-use file. The land-use file provides the fractional contribution (0 to 1) of twenty-six land-use categories, as defined by Zhang et al (2003). For the 36 km domain, the TCEQ developed the land-use file using version 3 of the Biogenic Emissions Landuse Database (BELD3) for areas outside the U.S. and the 2006 National Land Cover Dataset (NLCD) for the U.S. For the 4 km and 12 km domains, the TCEQ used updated land-use files developed by Texas A&M University (Popescu et al., 2012), which were derived from more highly resolved data collected by the Texas Parks and Wildlife Department, Landscape Fire and Resource Management Planning Tools Project (LANDFIRE), LandSat, National Institute of Statistics and Geography (INEGI), and the NLCD. Monthly averaged LAI was created from the eight-day 1 km resolution MODIS MCD15A2 product.

Spatially-resolved opacity and photolysis rates are input to CAMx via a photolysis rates file and an opacity file. These rates, which are specific to the chemistry parameters file for the CB6 mechanism, are also input to CAMx. The TCEQ used episode-specific satellite data from the Total Ozone Mapping Spectrometer to prepare the clear-sky photolysis rates and opacity files. Photolysis rates are internally adjusted by CAMx according to cloud and aerosol properties using the inline Troposheric Ultraviolet Visible model.

3.6.4 Model Performance Evaluation

The CAMx model configuration was applied to the 2006 base case using the episode-specific meteorological parameters, biogenic emission inputs, and anthropogenic emission inputs. The CAMx modeling results were compared to the measured ozone and ozone precursor concentrations at all regulatory monitoring sites, which resulted in a number of modeling iterations to implement improvements to the meteorological modeling, emissions modeling, and subsequent CAMx modeling. A detailed performance evaluation for the 2006 base case modeling episode is included in Appendix C. In addition, all performance evaluation products are available on the TCEQ modeling files File Transfer Protocol (FTP) site (ftp://amdaftp.tceq.texas.gov/pub/TX/).

3.6.4.1 Performance Evaluations Overview

The performance evaluation of the base case modeling demonstrates the adequacy of the model to correctly replicate the relationship between meteorological conditions, emissions of NO_X and VOC precursors, and the levels of ozone formed. The model's ability to suitably replicate this relationship is necessary to have confidence in the model's prediction of the future year ozone and the response to various control measures. As recommended in the EPA modeling guidance (EPA, 2007), the TCEQ has incorporated the recommended eight-hour performance measures into its evaluations but also focuses on one-hour performance analyses, especially in the DFW nonattainment area. The localized small-scale (i.e., high resolution) meteorological and emissions features characteristic of the DFW nonattainment area require model evaluations to

be performed at the highest resolution possible to determine whether or not the model is getting the right answer for the right reasons.

3.6.4.2 Operational Evaluations

Statistical measures including the Unpaired Peak Accuracy (UPA), the Mean Normalized Bias (MNB), and the Mean Normalized Gross Error (MNGE) were calculated by comparing monitored (measured) and four-cell bi-linearly interpolated modeled ozone concentrations for all episode days and monitors. For one-hour ozone comparisons, the EPA recommends ranges of ±20% for UPA and ±15% for MNB, and a 30% level for MNGE, which is always positive because it is an absolute value. There are no recommended eight-hour ozone criteria for UPA, MNB, and MNGE. Graphical measures including time series and scatter plots of hourly measured and bi-linearly interpolated modeled ozone were developed. For monitoring locations where specific measurements were available, similar graphical plots were developed for ozone precursors such as NO, NO_2, ethylene, and isoprene. In addition, plots of modeled daily maximum eight-hour ozone concentrations were developed and overlaid with the measured daily maximum eight-hour ozone concentrations. Detailed operational evaluations for the 2006 base case modeling episode are included in Appendix C.

Statistical Evaluations

Figure 3-15: *Observed versus Modeled Peak Eight-Hour Ozone for June Episode* compares the observed and modeled daily maximum eight-hour ozone concentrations for each of the 33 days in the June episode. Although there are no recommended criteria for the eight-hour UPA, error bars of ±20% are shown. In general, ozone concentrations are over-estimated on most days, but the majority of modeled maximum values fall within the ±20% range. Nine of the 33 episode days are out of this ±20% range, but seven of these nine days had monitored peak ozone values between 40-70 ppb, which is well below the 75 ppb exceedance level. Figure 3-16: *Observed versus Modeled Peak Eight-Hour Ozone for August-September Episode* compares the observed and modeled daily maximum eight-hour ozone concentrations for each of the 34 days in the August-September episode. Compared with the June model performance, there is greater over-estimation of peak eight-hour ozone levels in the August-September episode. Twenty-one of the 34 days fall outside of the ±20% range, but 14 of these 21 days had peak eight-hour ozone levels below 75 ppb.

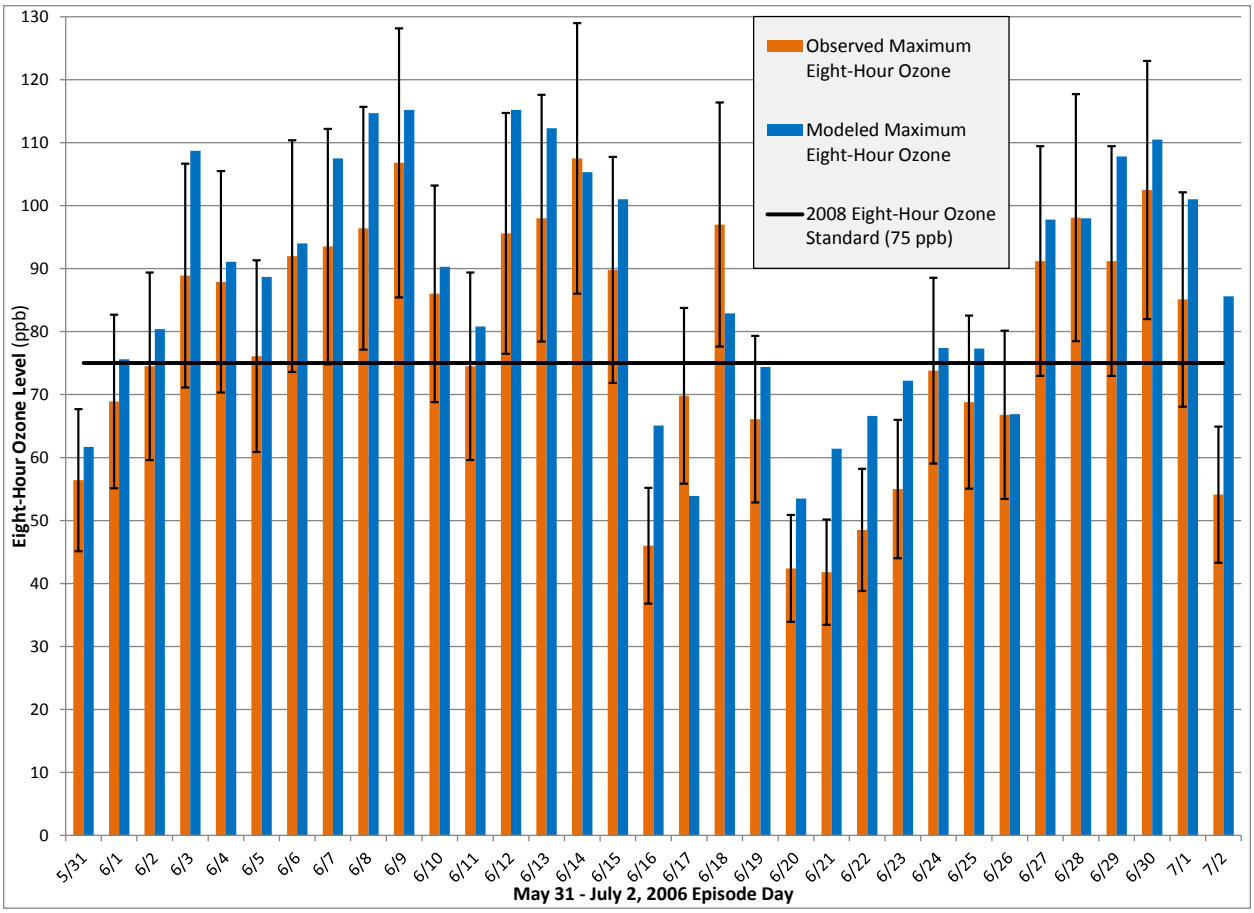


Figure 3-15: Observed versus Modeled Peak Eight-Hour Ozone for June Episode

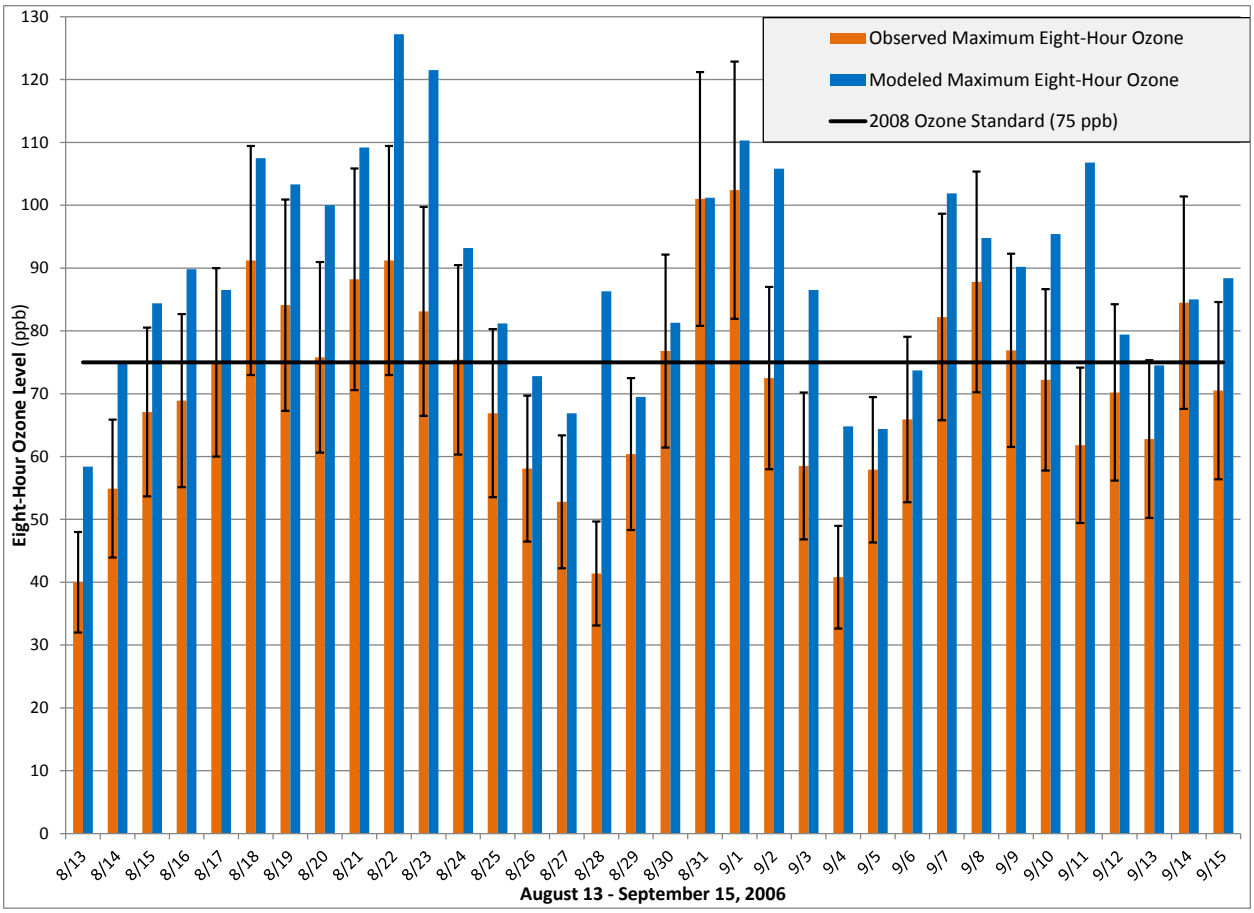


Figure 3-16: Observed versus Modeled Peak Eight-Hour Ozone for August-September Episode

Figure 3-17: *MNB and MNGE Hourly Ozone Statistics for June Episode Days* presents the hourly MNB and MNGE results from May 31 through July 2, 2006. The EPA recommended criteria of ±15% for MNB and 30% for MNGE are shown as the black and red bars, respectively. Three of the 33 days in this episode are out of the recommended MNB range, while two exceed the recommended MNGE level. June 17 is one of the three days exceeding the MNB range, but its peak eight-hour ozone level was below 75 ppb. The remaining two days out of the MNB range are June 18 and July 1. June 18 experienced a slow-moving frontal passage, which was difficult for the meteorological model to replicate. July 1 was a cloudy day, which limited ozone production, but the meteorological model predicted fewer clouds and thus more ozone.

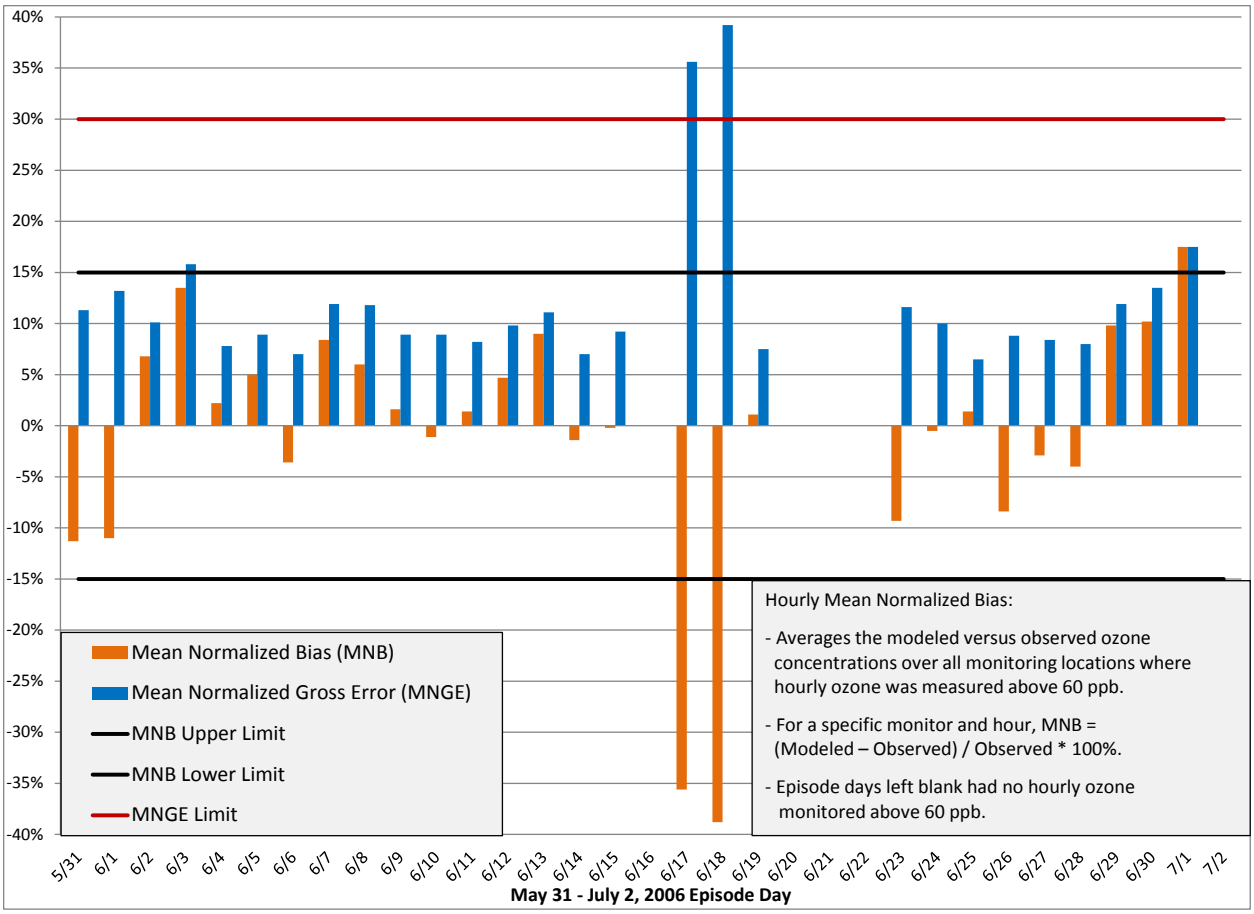


Figure 3-17: MNB and MNGE Hourly Ozone Statistics for June Episode Days

Figure 3-17: *MNB and MNGE Hourly Ozone Statistics for June Episode Days* presents the hourly MNB and MNGE results for August 13 through September 15, 2006. Similar to Figure 3-16, Figure 3-18 demonstrates the consistent over-prediction of modeled ozone during this episode, particularly for days when peak eight-hour ozone was monitored below 75 ppb. Twelve of the 34 episode days are out of the recommended MNB range, while three exceed the recommended MNGE level. Eight of the 12 episode days out of the MNB range are when peak eight-hour ozone was monitored below 75 ppb.

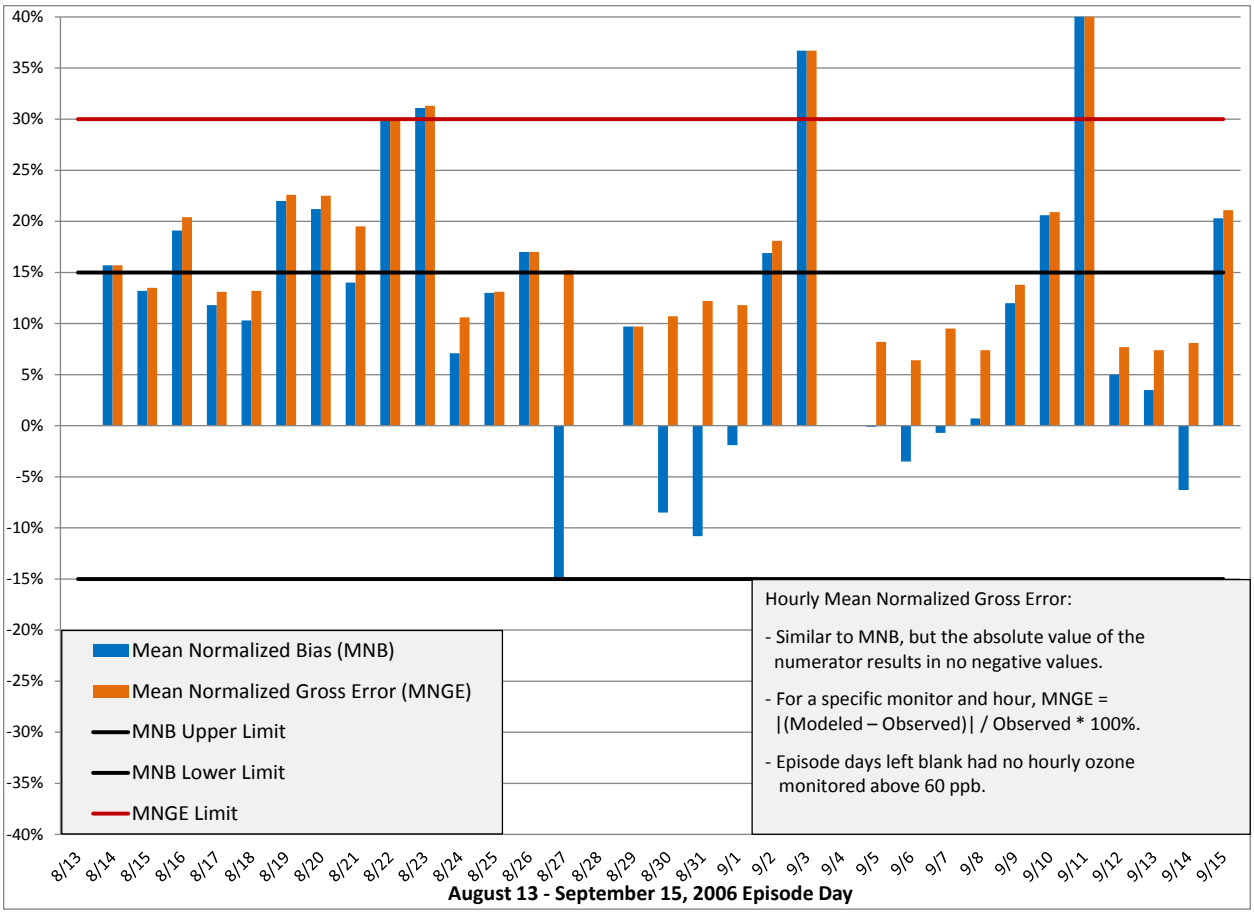


Figure 3-18: MNB and MNGE Hourly Ozone Statistics for August-September Days

In general, the modeling over-predicts monitored ozone for both the June and August-September episodes, but the effect tends to be more pronounced on low ozone days. For the June episode, 15 of the 33 days (45%) had peak eight-hour monitored levels below 75 ppb, while the August-September episode had 19 of 34 days (56%) with peak eight-hour monitored levels below 75 ppb. Compared with the June episode, the August-September episode also had more frontal passages and varying cloud conditions to simulate, both of which are challenging for meteorological modeling.

Combining the 67 days from both episodes, there are 34 days with peak eight-hour ozone levels below 75 ppb and 33 days above. Of these 33 exceedance days from the combined episode, 9 are out of the ±20% UPA range and 6 are out the ±15% MNB range. Those days that exceed the MNGE level of 30% are included within the 6 out of the MNB range. Considering that the majority of eight-hour exceedance days from the combined episodes meet the recommended performance criteria, the model suitably simulates the frequency and magnitude of daily maximum eight-hour ozone concentrations at area monitors.

Graphical Evaluations

A selection of graphical evaluations of modeling results is presented here, but more detail is contained in Appendix C where five representative monitoring locations were chosen for detailed evaluation. Time series and scatterplots are ideal for examining model performance at specific monitoring locations. Time series plots offer the opportunity to follow ozone formation

through the course of a day, while scatter plots provide a visual means to see how the model performs across the range of observed ozone and precursor concentrations.

As shown in Figure 3-3, the Kaufman monitor is located in the far southeastern corner of the DFW nonattainment area. Since it is primarily upwind during most of the ozone season, Kaufman is usually one of the monitors recording the lowest ozone levels in DFW. Figure 3-19: *Kaufman June Episode Time Series and Scatter Plots* presents time series of hourly ozone and NO_X concentrations from May 31 through July 2, 2006. Observed concentrations are shown as red dots and the blue lines are modeled concentrations. In general, the model well replicates the diurnal pattern of higher ozone during the day and decreasing at night. On average the model over-predicts ozone concentrations, particularly when monitored concentrations are quite low, such as the 20-40 ppb range that often occurs during the night and early morning hours. This is also evident in the ozone scatter plot, which shows improved correlation of modeled versus observed ozone at higher levels versus lower ones. Figure 3-20: *Kaufman August-September Episode Time Series and Scatter Plots* presents similar information at the Kaufman monitor for August 13 through September 15, 2006. The same pattern is shown here where the overall diurnal pattern and ozone peaks are relatively well modeled, but that lower levels of ozone during the night and early morning hours are over-predicted.

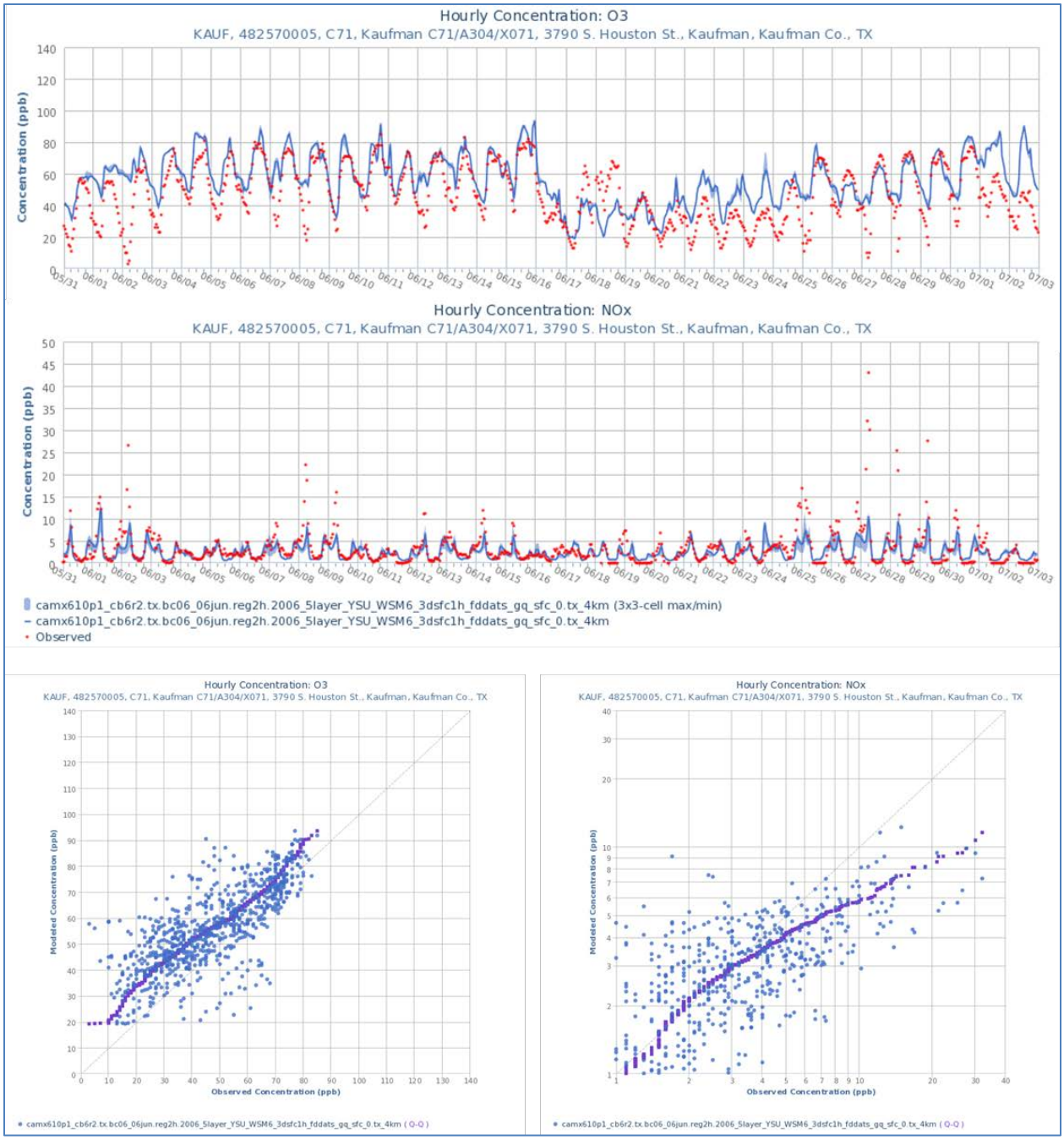


Figure 3-19: Kaufman June Episode Time Series and Scatter Plots

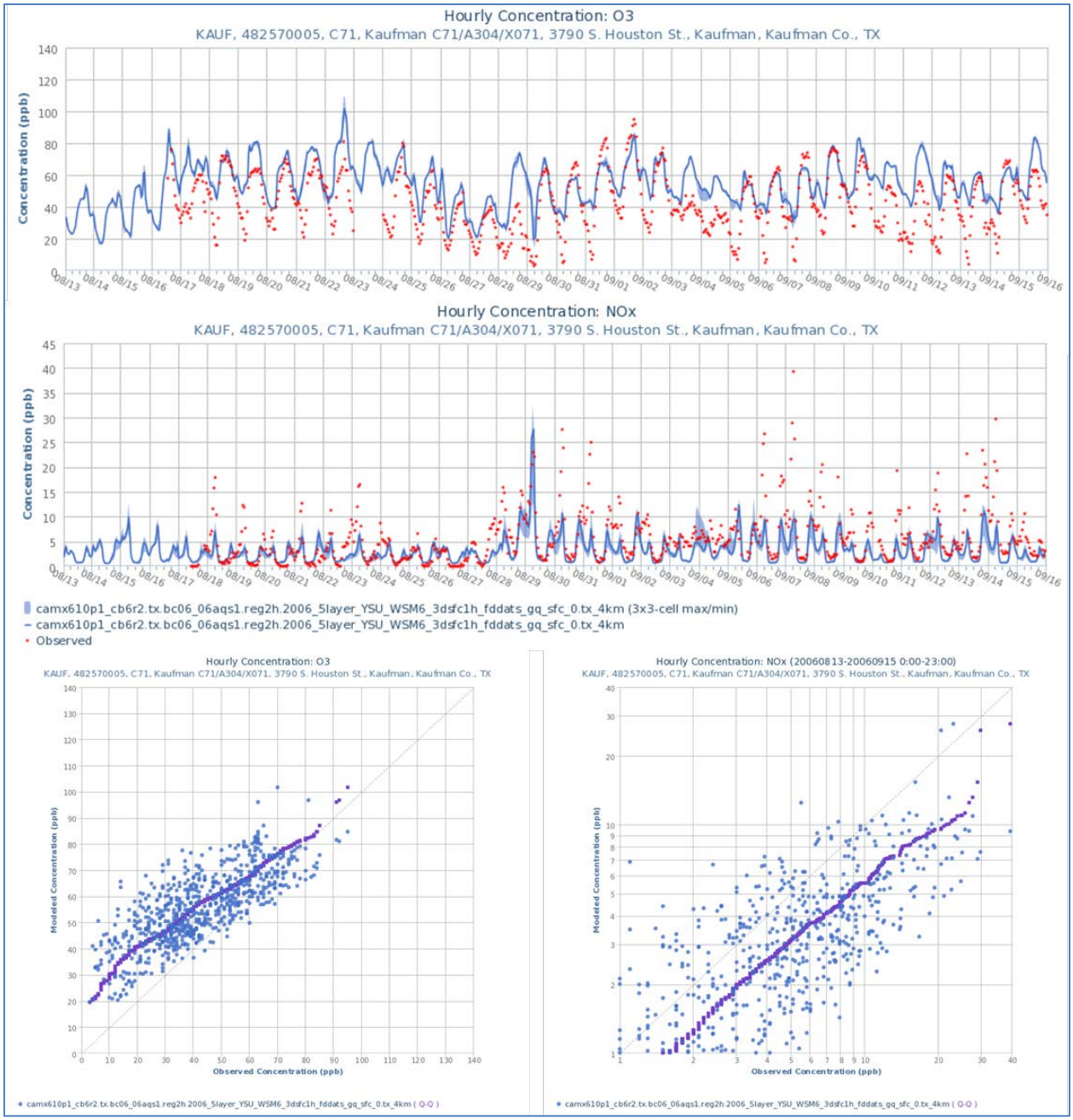


Figure 3-20: Kaufman August-September Episode Time Series and Scatter Plots

As shown in Figure 3-3, the Denton Airport South monitor is located in the far northwestern corner of the DFW nonattainment area. Since it is primarily downwind of the urban core during most of the ozone season, Denton Airport South is usually one of the monitors recording the highest ozone levels in DFW. Comparisons of hourly modeled versus observed ozone are presented in Figure 3-21: *Denton June Episode Time Series and Scatter Plots* and Figure 3-22: *Denton August-September Episode Time Series and Scatter Plots*. As with the Kaufman performance presented in Figure 3-19 and Figure 3-20, the model does a reasonable job at Denton Airport South of replicating the diurnal peaks during both episodes with some over-prediction apparent, particularly at low ozone levels during the night and early morning hours. The model significantly under-predicted only one monitored eight-hour ozone exceedance on

June 18 due to the previously mentioned difficulty that the meteorological model encountered in replicating a slow moving frontal passage.

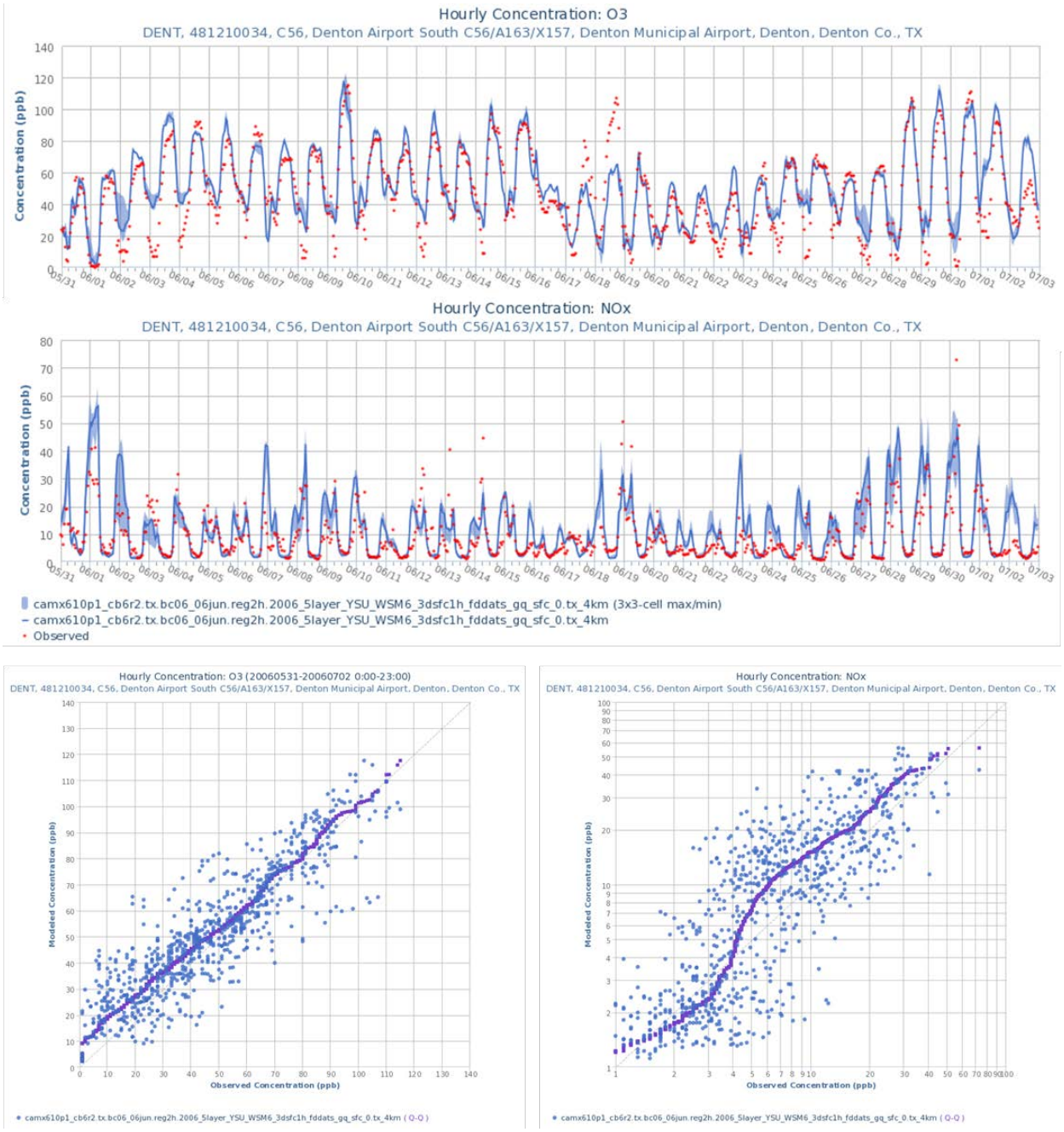


Figure 3-21: Denton June Episode Time Series and Scatter Plots

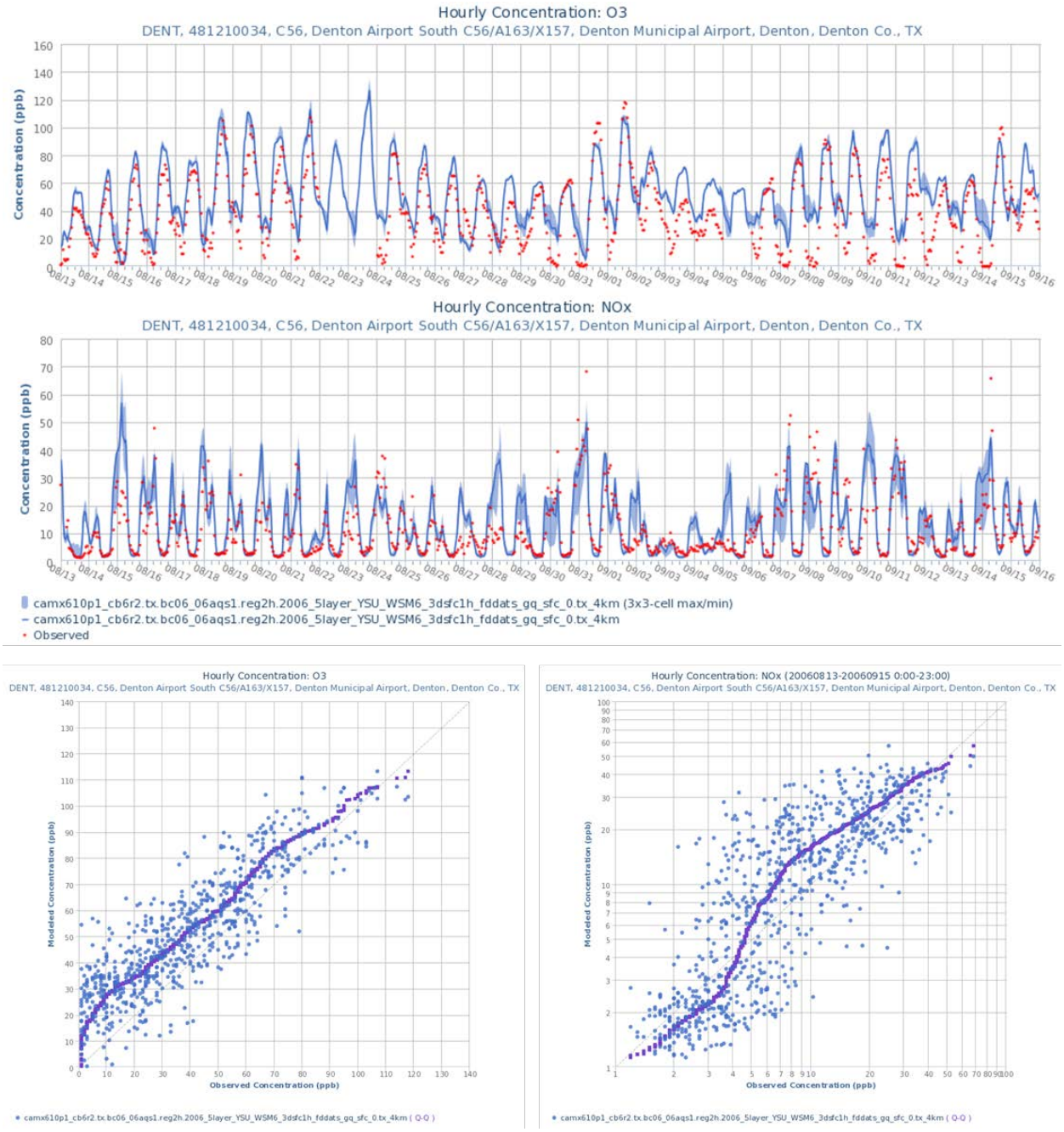


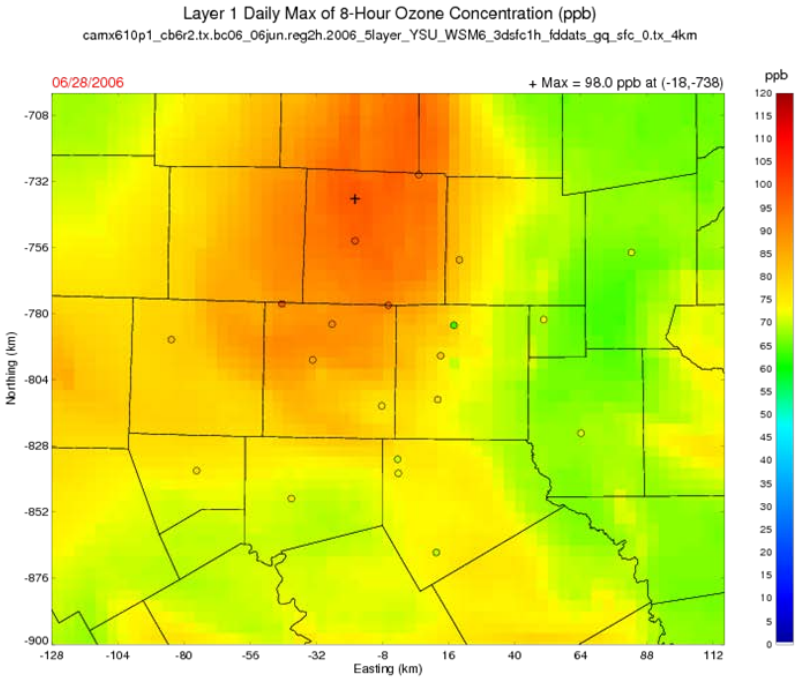
Figure 3-22: Denton August-September Episode Time Series and Scatter Plots

The Kaufman and Denton Airport South monitors were chosen as examples for discussing model performance because they represent the farthest upwind and downwind locations during ozone season, which roughly corresponds to the lowest and highest monitoring locations, respectively. Appendix C provides more detail with time series and scatter plots for the additional monitoring locations of Dallas Hinton Street, Eagle Mountain Lake, and Fort Worth Northwest. Comparison of modeled versus observed concentrations of VOC are presented for the Dallas Hinton Street and Fort Worth Northwest monitors because these locations are equipped with auto-GC instrumentation. In general, estimation of isoprene concentrations is quite good at Dallas Hinton Street, but weaker at Fort Worth Northwest. Conversely, estimation

of concentrations for alkanes, ethylene, and olefins is better at Fort Worth Northwest than at Dallas Hinton Street.

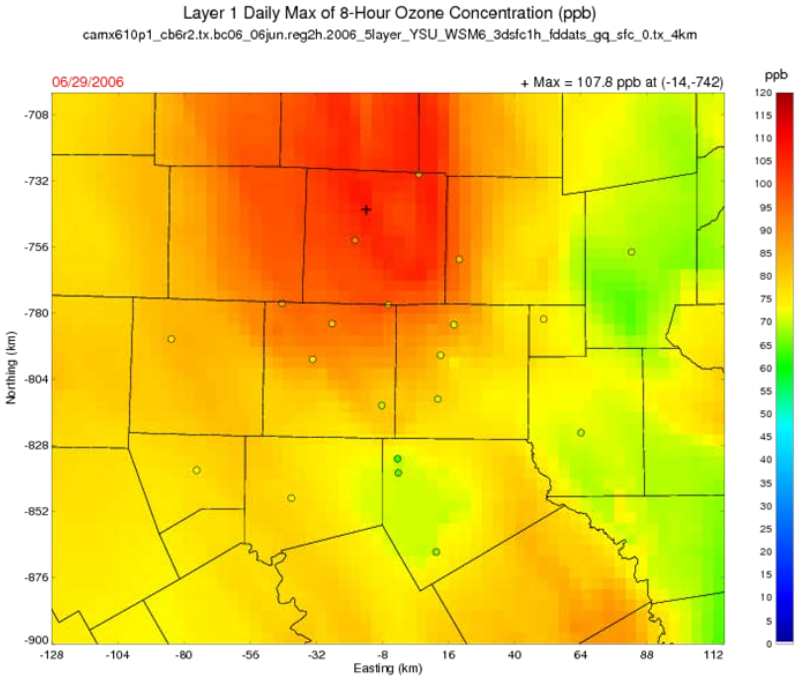
When evaluating model performance, the TCEQ also employs graphical plots showing the daily peak ozone across the modeling domain. This plot is akin to the contour plots often used to display terrain elevations, and is a good tool for visually comparing the modeled peak ozone across the domain with observations. The plots are not snapshots in time, but instead show the maximum eight-hour ozone value for each grid cell regardless of when it occurred during the day. Areas downwind of the urban core will generally have ozone peaks that occur later in the day than upwind areas.

Appendix C contains these graphical plots for each episode day where observed maximum daily average eight-hour ozone was above 75 ppb. These days are June 3 through 10, June 12 through 14, June 18, June 27 through July 1, August 17 through 24, August 30through September 1, September 7 through 9, and September 14. Example plots for four of these episode days are presented here in Figure 3-23: *Modeled versus Observed Maximum Ozone on June 28 and 29* and Figure 3-24: *Modeled versus Observed Maximum Ozone on August 30 and 31*. Observed maximum daily average eight-hour ozone concentrations are represented by small circles at the monitor locations. When the color of the dot matches closely the surrounding colors, the model is predicting the observed maximum values well. In general, the model performed very well during the June 2006 episode with a few days exhibiting weaker performance. The August-September 2006 episode is characterized by more over-prediction, particularly in August and early September. However, a few days in this latter episode do show good performance. In both episodes, the model locates the plumes of highest ozone concentration very well with a few exceptions.



June 28, 2006

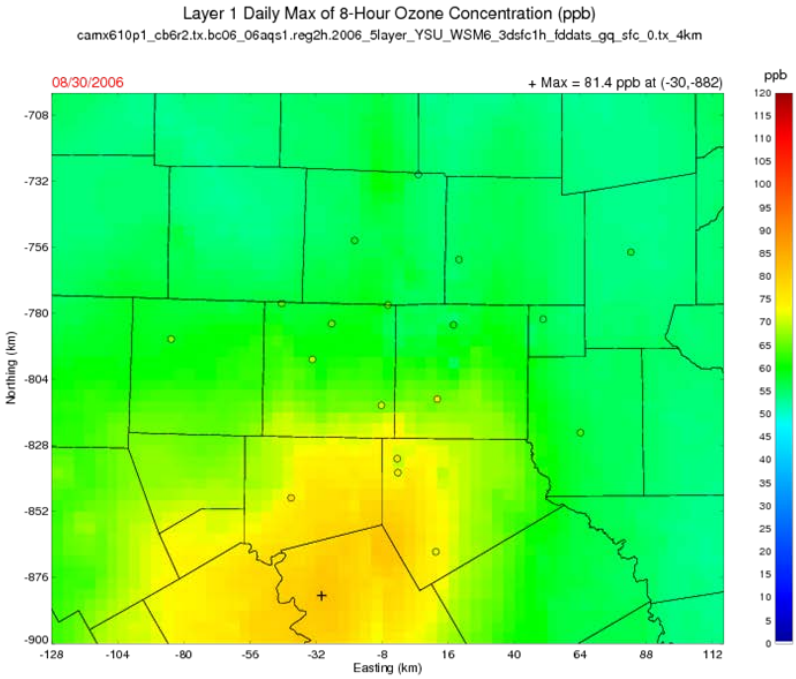
MDA8 Ozone
Obs: 98.1 ppb (EMTL)
Mod: 98.0 ppb



June 29, 2006

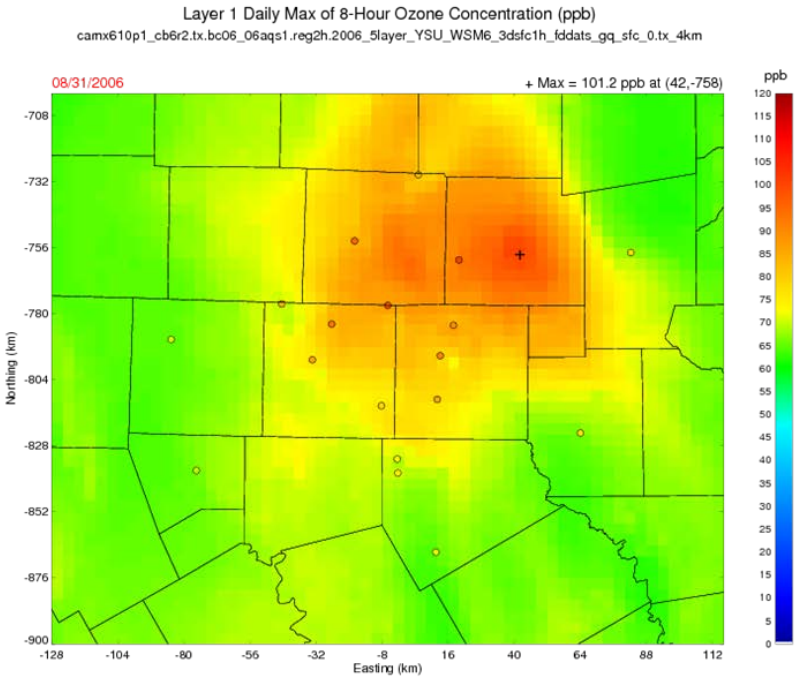
MDA8 Ozone
Obs: 91.2 ppb (DENT)
Mod: 107.8 ppb

Figure 3-23: Modeled versus Observed Maximum Ozone on June 28 and 29



August 30, 2006

MDA8 Ozone
Obs: 76.8 ppb (CLEB)
Mod: 81.3 ppb



August 31, 2006

MDA8 Ozone
Obs: 101.0 ppb (FRIC)
Mod: 101.2 ppb

Figure 3-24: Modeled versus Observed Maximum Ozone on August 30 and 31

Evaluations Based on TexAQS II Rural Monitoring Network Data

The TCEQ also evaluated how well the model predicted ozone and precursor concentrations at rural sites located upwind of the DFW nonattainment area during the episodes. A brief discussion is presented here, but more detail and references are provided in Appendix C. Figure 3-25: *Rural Monitoring Sites Used for Performance Evaluation* shows the locations of these sites as red dots. They are Italy High School (ITHS, C60) about 30 miles south of Dallas, Palestine (PLTN, C647) about 80 miles southeast of Dallas, Clarksville (CLVL, C648) about 100

miles northeast of Dallas, and San Augustine (SAGA, C646) about 160 miles from Dallas near the Louisiana border.

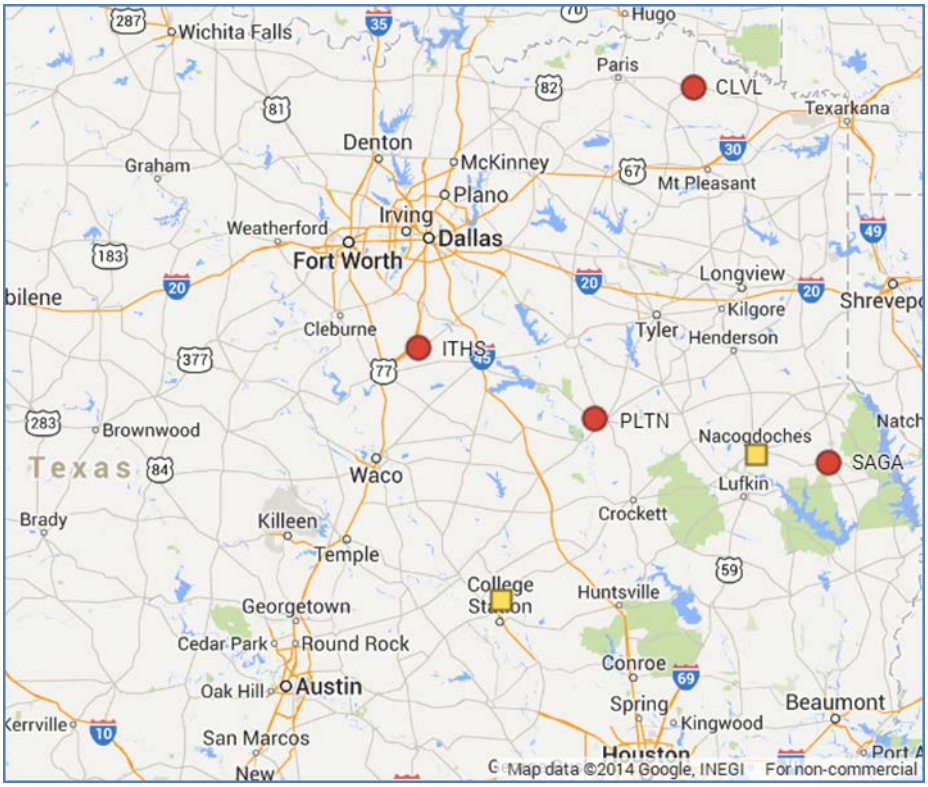


Figure 3-25: Rural Monitoring Sites Used for Performance Evaluation

In general, peak ozone during the June episode was well predicted at Italy High School and Clarksville, with moderate over-prediction at Palestine and San Augustine. During the August-September episode, Italy High School model performance was good, with over-prediction at the remaining three monitors, although the model predicted the peaks on some days quite well. Similar to the ozone monitors within or near the urban core, the model generally over-predicted overnight and early morning ozone concentrations during both episodes.

The yellow squares in Figure 3-25 show locations near College Station and Nacogdoches where instrumented balloons to measure ozone (ozonesondes) were launched during the June 2006 episode as part of the Tropospheric Ozone Pollution Project, which was conducted as part of the TexAQS II study (Morris, 2006). The ozonesonde data provided a unique and valuable means for assessing the model's performance. Besides simply allowing modeled concentrations to be compared with measurements aloft, the detailed profiles provided insight into how well the model characterizes vertical mixing compared to the real atmosphere. The most striking difference between observed and modeled vertical ozone profiles is the wide variability in ozone concentrations with altitude observed on most days. The model tends to vary much more slowly, which is not unexpected since it tends to organize wind flow and vertical motion, and also because the model's vertical resolution becomes coarser with increasing elevation.

Another aspect of the TexAQS II study included aircraft measurements of ozone and precursors within the DFW nonattainment area on September 13, 2006 (Gulf of Mexico Atmospheric Composition and Climate Study, National Oceanic & Atmospheric Administration [NOAA], 2006). The instrumented aircraft flew at an elevation of around 500 meters from 1:30-4:00 PM

on this day. Analysis of the aircraft measurements indicates that the model predicted the observed ozone quite well except for a small over-prediction as the aircraft passed through the urban plume downwind of the DFW metropolitan area. The modeled winds are more southerly than the observations, and showed little variability through the sampling period. Appendix C contains more detail than presented here on the evaluation of rural monitors, ozonesonde data, and aircraft flight measurements.

3.6.4.3 Diagnostic Evaluations

While most model performance evaluation (MPE) focuses on how well the model reproduces observations in the base case, a second and perhaps more important aspect of model performance is how well the model predicts changes as a result of modifications to its inputs (Smith, 2010). The former type of MPE is static in the sense that it is based on a fixed set of observations that never change, while evaluating the model's response to perturbations in its inputs is dynamic in the sense that the change in the model's output is evaluated. Dynamic MPE is performed much less often than static MPE, simply because there is often little observational data available that can be directly related to quantifiable changes in model inputs. Since the AD is based on modeling the future by changing the model's inputs due to growth and controls, it is beneficial to pursue dynamic MPE. The EPA's modeling guidance recommends assessing the model's response to emission changes. Two such dynamic MPEs are described below: prospective modeling analysis and weekday/weekend analysis.

Prospective Modeling – Revised 2012 Future Case Analysis

The purpose of this diagnostic analysis is to test the model in a forecast mode where the answer is known in advance. For the DFW AD SIP revision in December 2011, a retrospective analysis was performed where 1999 ozone concentrations were estimated with 1999 anthropogenic emission inputs run with the June 2006 base case meteorological and biogenic inputs. These 1999 anthropogenic emission inputs were already available from the DFW AD SIP revision adopted in May 2007. These 1999 anthropogenic inputs cannot be used with the current 2006 modeling configuration because of incompatibility with the new modeling domains described in Table 3-35.

The TCEQ has started developing a 2012 base case episode on the newer domains shown in Figure 3-14, but has not yet obtained satisfactory model performance with it. However, the latest available 2012 anthropogenic emission inputs from these efforts were available to perform a prospective future case analysis with the 2006 base case meteorology and biogenic inputs. Ozone season emission inputs for the 2012 future year were needed for the DFW AD SIP revision adopted in December 2011. At the time that work was performed, the latest available scientific tools and inputs were used for modeling attainment in the 2012 future year. Table 3-37: *Summary of Ozone Modeling Platform Changes* summarizes these older tools and inputs, and compares them to the latest ones currently being used.

Table 3-37: Summary of Ozone Modeling Platform Changes

Modeling Platform Category	December 2011 AD SIP Revision	Proposed 2015 AD SIP Revision
4 km Fine Grid Modeling Domain	DFW nonattainment area and adjacent counties	All of eastern Texas plus some non-Texas counties
12 km Medium Grid Modeling Domain	Eastern Texas plus some adjacent states	All of Texas plus some adjacent states
36 km Coarse Grid Modeling Domain	Eastern half of continental U.S.	All of continental U.S. plus southern Canada and northern Mexico

Modeling Platform Category	December 2011 AD SIP Revision	Proposed 2015 AD SIP Revision
Meteorological Model	MM5 3.7.3	WRF 3.2
CAMx Version	CAMx 5.20.1	CAMx 6.11
Chemical Mechanism	Carbon Bond 05 (CB05)	Carbon Bond 6 (CB6)
Boundary Conditions	Model for Ozone and Related Chemical Tracers (MOZART) Model	GEOS-Chem Model
Biogenics Model	Global Biosphere Emissions and Interactions System (GloBEIS)	MEGAN 2.10

A prospective 2012 future case analysis was run with the June 2006 episode, but relied on all of the newer tools and inputs referenced in the far right column of Table 3-37. Table 3-38: *2012 Future Case with June 2006 Episode on Old and New Platforms* summarizes these results. For reference purposes, the 2012 future design value (DV_F) results from the December 2011 AD SIP are included and truncated in accordance with EPA modeling guidance. In Table 3-38, comparing the older 2012 DV_F figures (second column) with the DV_F figures from the new modeling platform (third column) indicates that the current projected eight-hour ozone design values are 4-8 ppb higher with the results varying by individual monitor. These results can only be presented for monitors that were operational during 2006. The 2012 DV_B and regulatory design value (DV_R) values cannot be provided for the Midlothian Tower monitor, which is no longer operational.

Table 3-38 also includes the 2012 DV_R (fourth column) and 2012 DV_B (last column) for each monitor. The 2012 DV_R is obtained by truncating the average of the fourth-highest eight-hour observation for each year over the full three years of 2010, 2011, and 2012. The DV_R is used to determine if the area is either in nonattainment or has reached attainment of the NAAQS. As was shown in Figure 3-1, a DV_B is an average of three years of DV_R values. These 2012 DV_B figures were obtained by averaging the 2012 DV_R, 2013 DV_R, and 2014 DV_R per monitor. The 2012 DV_B figures reported in the DFW AD SIP revision proposal did not incorporate the 2014 DV_R for each monitor. Since this 2014 DV_R information is now available, the complete 2012 DV_B values are included in Table 3-38. The attainment test of multiplying an RRF by a DV_B essentially predicts a future year DV_B, even though the DV_R in the future year is the final metric for determining attainment of the NAAQS.

Table 3-38: 2012 Future Case with June 2006 Episode on Old and New Platforms

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Denton Airport South - C56	77	84	83	83.67
Eagle Mountain Lake - C75	78	82	82	80.67
Grapevine Fairway - C70	76	82	86	84.00
Keller - C17	76	81	87	83.00
Fort Worth Northwest - C13	75	80	79	80.00
Frisco - C31	74	79	83	81.67

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Dallas North #2 - C63	71	77	81	80.33
Parker County - C76	72	78	78	77.00
Dallas Executive Airport - C402	70	77	81	78.00
Cleburne Airport - C77	70	76	79	78.00
Arlington Municipal Airport - C61	70	75	83	79.33
Dallas Hinton Street - C401	67	74	82	81.33
Granbury - C73	69	74	77	76.67
Midlothian Tower - C94	66	73	Not Operating	Not Operating
Pilot Point - C1032	67	73	82	81.67
Rockwall Heath - C69	63	70	77	75.67
Midlothian OFW - C52	62	68	76	74.67
Greenville - C1006	59	67	72	71.67
Kaufman - C71	60	67	70	71.33

Note: DV_F and DV_R figures are typically truncated, while DV_B figures are reported to two decimal places.

Table 3-39: *2012 Future Case with 67-Day Episode on Old and New Platforms* presents similar information as Table 3-38, but for the entire 67-day episode from both June 2006 and August-September 2006. Similar to the results shown in Table 3-38, the 2012 DV_F figures for the current modeling platform are 4-8 ppb higher than the older one with results varying by monitor. As described above for Table 3-38, the 2012 DV_B figures in Table 3-39 incorporate complete 2014 DV_R data. The results in both Table 3-38 and Table 3-39 demonstrate that the current modeling platform with a 2006 base case does a satisfactory job of forecasting ozone design values with anthropogenic emission inputs for alternate years. More detail on this analysis is included in Appendix C.

Table 3-39: 2012 Future Case with 67-Day Episode on Old and New Platforms

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Denton Airport South - C56	77	83	83	83.67
Eagle Mountain Lake - C75	78	82	82	80.67
Grapevine Fairway - C70	76	81	86	84.00
Keller - C17	76	81	87	83.00
Fort Worth Northwest - C13	75	79	79	80.00
Frisco - C31	74	79	83	81.67
Dallas North #2 - C63	71	77	81	80.33
Parker County - C76	72	77	78	77.00
Dallas Executive Airport - C402	70	76	81	78.00
Cleburne Airport - C77	70	75	79	78.00

2006 DFW Area Monitor and CAMS Code	2011 AD DV_F for 2012 (ppb)	Current DV_F for 2012 (ppb)	2012 DV_R (ppb)	2012 DV_B (ppb)
Arlington Municipal Airport - C61	70	74	83	79.33
Dallas Hinton Street - C401	67	73	82	81.33
Granbury - C73	69	73	77	76.67
Midlothian Tower - C94	66	72	Not Operating	Not Operating
Pilot Point - C1032	67	72	82	81.67
Rockwall Heath - C69	63	70	77	75.67
Midlothian OFW - C52	62	67	76	74.67
Greenville - C1006	59	67	72	71.67
Kaufman - C71	60	66	70	71.33

Note: DV_F and DV_R figures are typically truncated, while DV_B figures are reported to two decimal places.

Observational Modeling – Weekday/Weekend

Weekend emissions of NO_X and VOC in urban areas tend to be lower than weekday emissions because of fewer vehicle miles driven. The effect is most pronounced on weekend mornings, especially Sundays, since there is significantly reduced commuting for work purposes. Figure 3-26: *2006 DFW Area 6 AM Anthropogenic Emissions by Day of Week* shows a comparison of modeled 6 AM NO_X and VOC emissions for Wednesdays, Saturdays, and Sundays. The on-road mobile sources are the largest contributor to differences in emissions for weekdays and weekends. 6 AM was chosen because a more stable comparison of emission estimates and monitored concentrations can be made prior to the commencement of photochemical processes in the presence of sunlight.

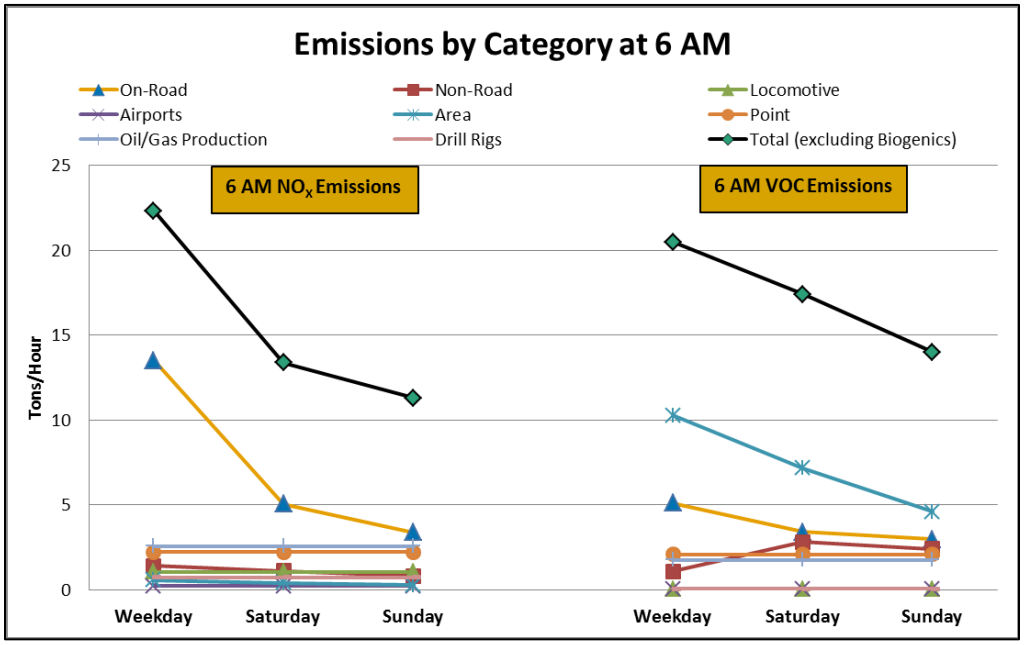


Figure 3-26: 2006 DFW Area 6 AM Anthropogenic Emissions by Day of Week

Early morning emissions tend to be especially important in determining peak eight-hour ozone levels (MacDonald, 2010), so the weekday/weekend differences should manifest themselves

noticeably in the relative levels of weekday and weekend ozone concentrations. Since there are relatively few Saturdays, Sundays, and Wednesdays (chosen to represent typical weekdays) in the episode, the TCEQ employed a novel approach by applying Saturday, Sunday, and Wednesday emissions inputs to the meteorological inputs for each day of the episode, which resulted in a total of 67 episode days modeled for the 2006 baseline with anthropogenic emission estimates for each of these three day types. This approach is possible since meteorology is independent of the day of week. By replacing the emissions of any episode day with those for just a Wednesday, just a Saturday, and just a Sunday, a representation of the day of week effects can be obtained.

For comparison with the modeled emissions from each of these 67-day scenarios by inventory day type, median monitored 6:00 AM NO_X concentrations were calculated for every Wednesday, Saturday, and Sunday from May 15 through October 15 for the years 2004 through 2008. Within each year, a total of 79 to 133 observations were observed for this timeframe at 11 NO_X monitoring sites in DFW. Figure 3-27: *Mean 6 AM NO_X Concentrations by Monitor Relative to Wednesday* presents these results and compares them to the change in modeled concentrations from the Wednesday, Saturday, and Sunday day type modeling scenarios. All sites show observed NO_X concentrations declining from Wednesday to Saturday, and then from Saturday to Sunday. The modeled values show greater variability than their observed counterparts, with all sites having modeled decreases between 37% and 67% from Wednesday to Sunday. The observed decreases at all sites were in the range of 40% and 70%.

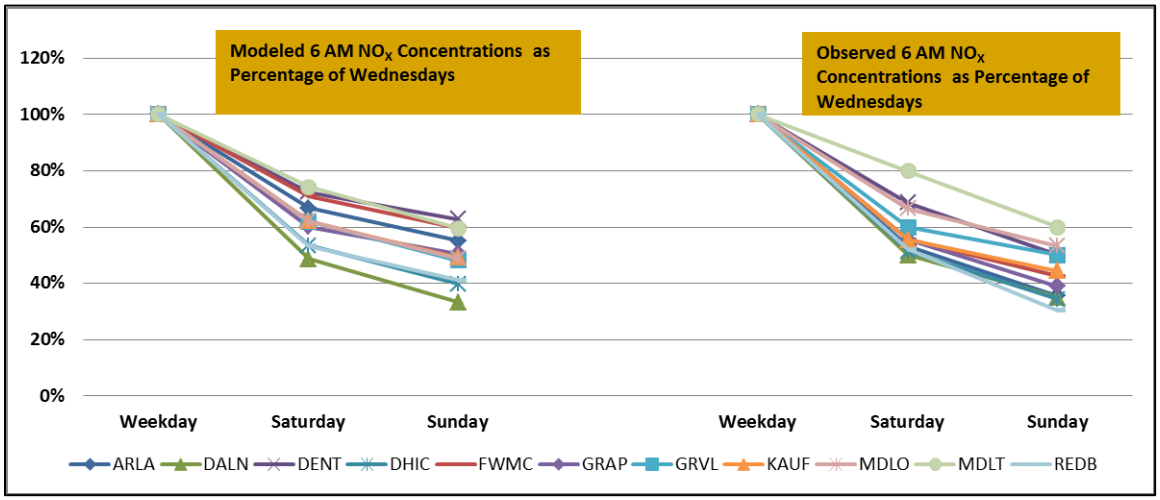


Figure 3-27: Mean 6 AM NO_X Concentrations by Monitor Relative to Wednesday

Figure 3-28: *Observed and Modeled 95th Percentile Peak Ozone by Day Type* compares the median observed concentrations for high ozone days with the modeled concentrations by day of week for 19 DFW area monitors. The observed 95th percentile concentrations range between a 1% increase to a 10% decrease on Saturday compared with Wednesday, while all sites showed a Sunday decrease between 6% and 16% compared with Wednesday. The modeled values consistently decreased between 2% and 6% on Saturday compared with Wednesday, and between 2% and 11% on Sunday compared with Wednesday. The model is satisfactorily replicating the observed weekday-weekend NO_X and ozone differences, especially for the higher ozone days. More detail on this analysis is included in Appendix C.

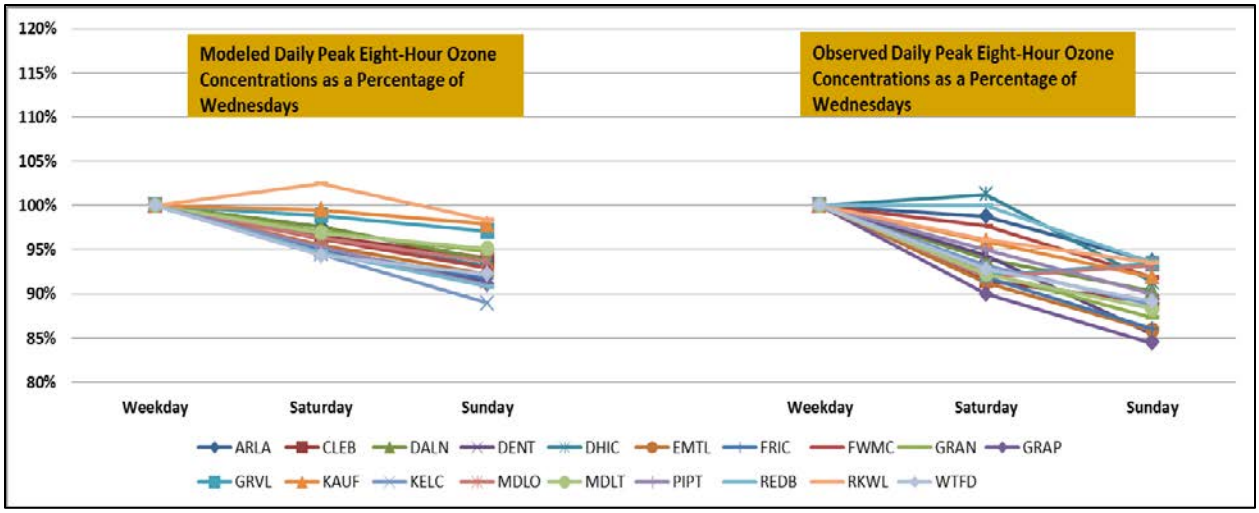


Figure 3-28: Observed and Modeled 95th Percentile Peak Ozone by Day Type

3.7 2006 BASELINE AND 2012 FUTURE CASE MODELING

3.7.1 2006 Baseline Modeling

The TCEQ selected 2006 as the baseline year for conducting the attainment modeling. The 2006 baseline emissions discussed in Section 3.5.3: *2006 Baseline* were used as model inputs. All 2006 baseline episode days with modeled eight-hour maximum concentrations above 75 ppb were used for the modeled attainment test. Since there were more than 10 days for each monitor modeled above 75 ppb in the 2006 baseline, there was no need to fall back on a lower threshold, such as the 70 ppb level suggested in the EPA's former modeling guidance (EPA, 2007). Figure 3-29: *Location of DFW Ozone Monitors with 4 km Grid Cell Array* shows the proximity of each monitor to adjacent ones within the 4 km fine grid domain. The EPA's default recommendation for a 4 km domain in the former guidance is to use an array of seven-by-seven cells for application of the attainment test. This process is suitable for areas where ozone monitors are separated by several kilometers, but would lead to a significant blending of the results among monitors in the more dense DFW area network. The maximum concentrations from an array of three-by-three grid cells surrounding each monitor was chosen for the DFW area attainment test so that better resolution could be obtained in the results for individual monitors.

For each DFW area ozone monitor operational in 2006, Table 3-40: *2006 Baseline Design Value Summary for the Attainment Test* details the DV_B, the modeled average of episode days above 75 ppb, and the total number of days from the 67-day episode when eight-hour ozone concentrations were modeled above 75 ppb. Compared to the DFW AD SIP revision proposal, Table 3-40 reports slight differences in both the modeled average of days above 75 ppb and the number of days modeled above 75 ppb. These differences are due to the incorporation of updated on-road and non-road emission inputs for 2006 discussed above in Section 3.5: *Modeling Emissions*.

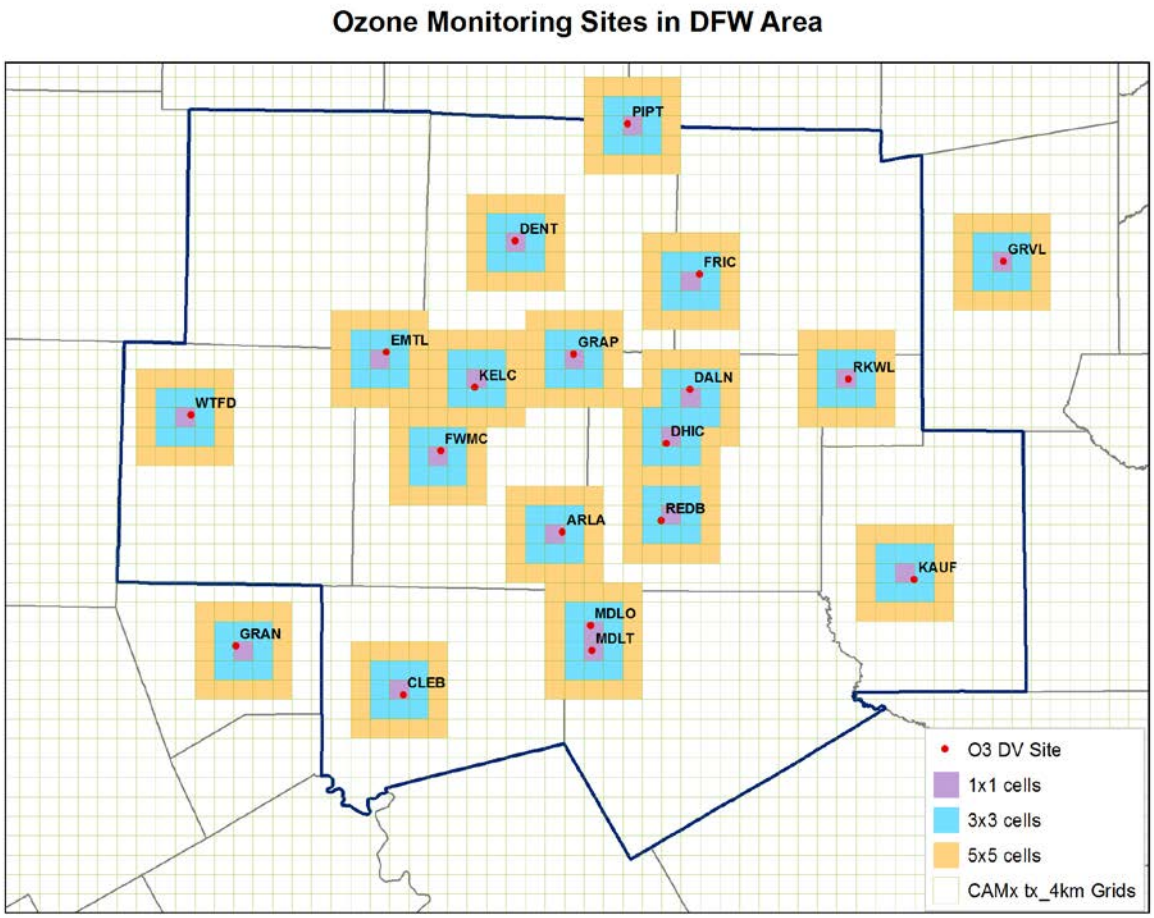


Figure 3-29: Location of DFW Ozone Monitors with 4 km Grid Cell Array

Table 3-40: 2006 Baseline Design Value Summary for the Attainment Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	Modeled Average of Days >75 ppb	Number of Modeled Days > 75ppb
Denton Airport South - C56	DENT	93.33	88.97	36
Eagle Mountain Lake - C75	EMTL	93.33	89.20	28
Grapevine Fairway - C70	GRAP	90.67	92.15	33
Keller - C17	KELC	91.00	90.49	32
Fort Worth Northwest - C13	FWMC	89.33	89.69	29
Frisco - C31	FRIC	87.67	87.58	35
Dallas North #2 - C63	DALN	85.00	87.00	31
Parker County - C76	WTFD	87.67	86.07	20
Dallas Executive Airport - C402	REDB	85.00	84.94	28
Cleburne Airport - C77	CLEB	85.00	83.27	18
Arlington Municipal Airport - C61	ARLA	83.33	85.82	31
Dallas Hinton Street - C401	DHIC	81.67	87.22	31

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	Modeled Average of Days >75 ppb	Number of Modeled Days > 75ppb
Granbury - C73*	GRAN	83.00	83.24	19
Midlothian Tower - C94†	MDLT	80.50	83.41	22
Pilot Point - C1032†	PIPT	81.00	87.67	33
Rockwall Heath - C69	RKWL	77.67	82.69	26
Midlothian OFW - C52†	MDLO	75.00	84.31	23
Greenville - C1006*	GRVL	75.00	79.16	17
Kaufman - C71	KAUF	74.67	79.49	18

* Granbury and Greenville are located outside of the 10-County DFW nonattainment area.
† Midlothian OFW, Midlothian Tower, and Pilot Point did not measure enough data from 2004 through 2008 to calculate a complete DV_B. The DV_B shown uses all available data.

3.7.2 Future Baseline Modeling

Similar to the 2006 baseline modeling, 2018 future case modeling was conducted for each of the 67 episode days using the anthropogenic emission inputs discussed in Section 3.5.4: *2018 Future Case Emissions*. Using the same days from the 2006 baseline where eight-hour ozone concentrations were modeled above 75 ppb, the RRF for each monitor was calculated by dividing the 2018 modeled peak eight-hour ozone average by the 2006 peak eight-hour modeled ozone average. For example, there were a total of 36 days in the 67-day episode where the Denton Airport South monitor was modeled above 75 ppb in the 2006 baseline. Table 3-40 shows that the 2006 baseline average of the maximum eight-hour modeled ozone for these 37 days is 88.97 ppb. The 2018 future case average for the same 36 days is 73.14 ppb. The Denton Airport South RRF is obtained by dividing the 73.14 ppb future year average by the 88.97 ppb baseline average to obtain 0.8221. A summary for all monitors is provided in Table 3-41: *RRF Calculations from the 2006 Baseline and 2018 Future Case*.

Table 3-41: RRF Calculations from the 2006 Baseline and 2018 Future Case

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of Days >75 ppb	2018 Average of Days >75 ppb	Relative Response Factor (RRF)
Denton Airport South - C56	DENT	88.97	73.14	0.8221
Eagle Mountain Lake - C75	EMTL	89.20	72.52	0.8130
Grapevine Fairway - C70	GRAP	92.15	76.94	0.8349
Keller - C17	KELC	90.49	74.66	0.8250
Fort Worth Northwest - C13	FWMC	89.69	74.03	0.8254
Frisco - C31	FRIC	87.58	73.04	0.8340
Dallas North #2 - C63	DALN	87.00	73.30	0.8425
Parker County - C76	WTFD	86.07	69.91	0.8123
Dallas Executive Airport - C402	REDB	84.94	70.82	0.8338
Cleburne Airport - C77	CLEB	83.27	68.84	0.8267
Arlington Municipal Airport - C61	ARLA	85.82	71.55	0.8337
Dallas Hinton Street - C401	DHIC	87.22	73.55	0.8432

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of Days >75 ppb	2018 Average of Days >75 ppb	Relative Response Factor (RRF)
Granbury - C73	GRAN	83.24	67.93	0.8161
Midlothian Tower - C94	MDLT	83.41	69.63	0.8347
Pilot Point - C1032	PIPT	87.67	72.11	0.8224
Rockwall Heath - C69	RKWL	82.69	69.99	0.8463
Midlothian OFW - C52	MDLO	84.31	70.44	0.8355
Greenville - C1006	GRVL	79.16	65.41	0.8263
Kaufman - C71	KAUF	79.49	66.24	0.8333

The RRF is then multiplied by the 2006 DV_B to obtain the 2018 DV_F for each ozone monitor. In accordance with the former modeling guidance (EPA, 2007), the final DV_F is obtained by rounding to the tenths digit and truncating to zero decimal places. These results are presented in Table 3-42: *Summary of RRF and 2018 Future Ozone Design Values* and Figure 3-30: *2018 Future Design Values by DFW Monitoring Location*. Application of the attainment test results in only the Denton Airport South monitor above the 2008 eight-hour ozone standard of 75 ppb. The former guidance for the 84 ppb standard (EPA, 2007) states that when the maximum future design value falls within 82 and 87 ppb, a WoE "demonstration should be conducted to determine if aggregate supplemental analyses support the modeled attainment test." Application of the 82 to 87 ppb WoE range to the 75 ppb standard indicates that the currently applicable WoE range would be 73 to 78 ppb. As the Denton Airport South DV_F falls within this range, a WoE demonstration is included in Chapter 5: *Weight of Evidence* of this DFW AD SIP revision. Compared to the DFW AD SIP revision proposal, Table 3-41 and 3-42 report slight differences in the modeled average of days above 75 ppb, the RRF, and DV_F figures for each monitor. These differences are due to the incorporation of updated on-road, non-road emission, and oil and gas production emission inputs for 2018 discussed above in Section 3.5.

Table 3-42: Summary of RRF and 2018 Future Ozone Design Values

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2018 DV_F (ppb)	2018 Truncated DV_F (ppb)
Denton Airport South - C56	DENT	93.33	76.72	76
Eagle Mountain Lake - C75	EMTL	93.33	75.88	75
Grapevine Fairway - C70	GRAP	90.67	75.70	75
Keller - C17	KELC	91.00	75.08	75
Fort Worth Northwest - C13	FWMC	89.33	73.73	73
Frisco - C31	FRIC	87.67	73.11	73
Dallas North #2 - C63	DALN	85.00	71.61	71
Parker County - C76	WTFD	87.67	71.21	71
Dallas Executive Airport - C402	REDB	85.00	70.88	70
Cleburne Airport - C77	CLEB	85.00	70.27	70
Arlington Municipal Airport - C61	ARLA	83.33	69.47	69
Dallas Hinton Street - C401	DHIC	81.67	68.87	68

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2018 DV_F (ppb)	2018 Truncated DV_F (ppb)
Granbury - C73	GRAN	83.00	67.73	67
Midlothian Tower - C94	MDLT	80.50	67.20	67
Pilot Point - C1032	PIPT	81.00	66.62	66
Rockwall Heath - C69	RKWL	77.67	65.74	65
Midlothian OFW - C52	MDLO	75.00	62.67	62
Greenville - C1006	GRVL	75.00	61.97	62
Kaufman - C71	KAUF	74.67	62.22	62

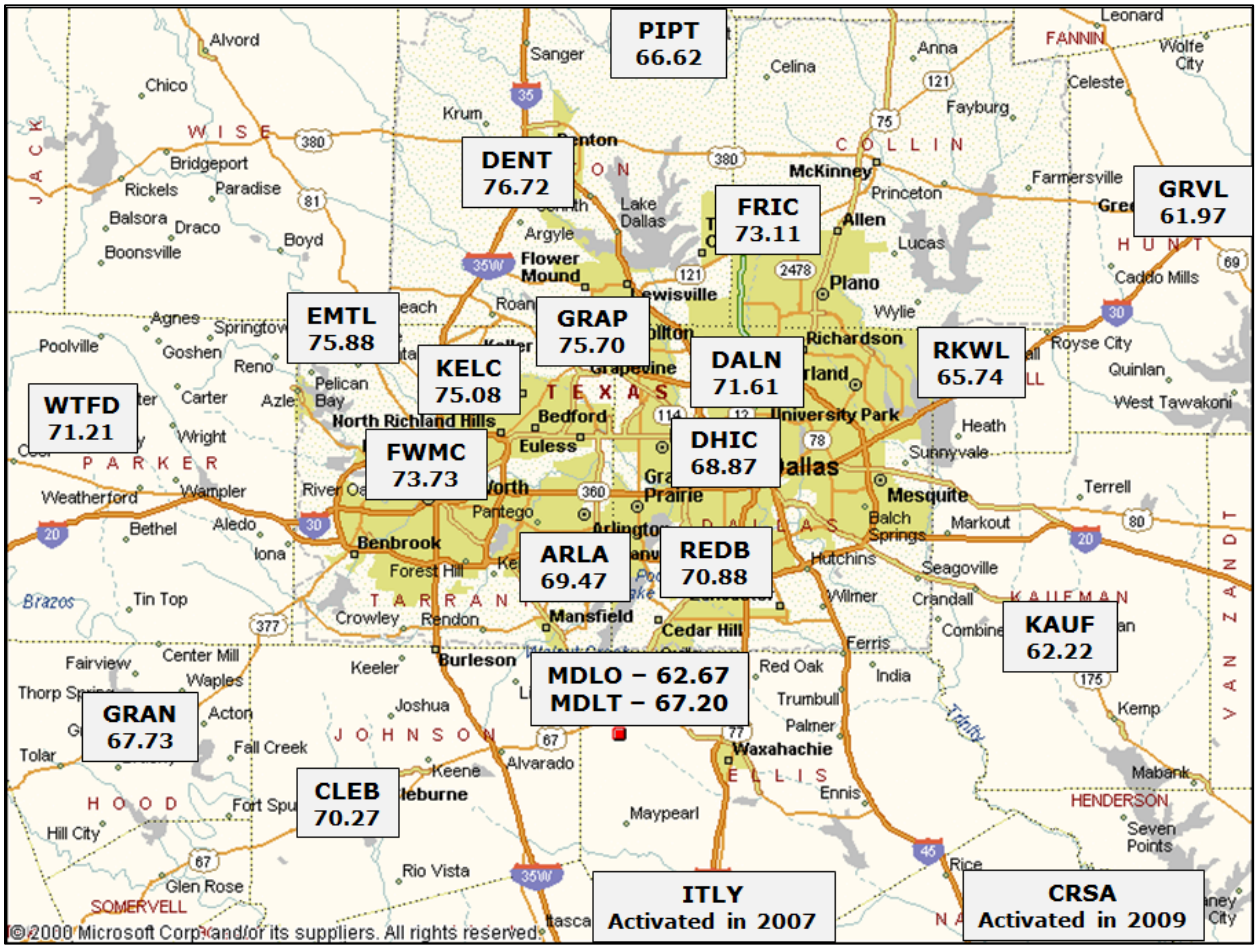


Figure 3-30: 2018 Future Design Values by DFW Monitoring Location

The EPA draft modeling guidance from December 2014 recommends the attainment test be performed for each monitor on the 10 episode days from the baseline with the highest modeled eight-hour ozone. A summary of how the RRF is obtained for each monitor using this approach is provided in Table 3-43: *RRF Calculations Using the 10 Highest Days*. Please note that the Denton Airport South RRF with the "top 10 days" test is 0.8063 instead of the 0.8221 value from the "all days" test referenced in Table 3-41.

Table 3-43: RRF Calculations Using the 10 Highest Days

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 Average of 10 Highest Days	2018 Average of 10 Highest Days	Relative Response Factor (RRF)
Denton Airport South - C56	DENT	102.48	82.63	0.8063
Eagle Mountain Lake - C75	EMTL	98.60	78.30	0.7941
Grapevine Fairway - C70	GRAP	105.69	86.07	0.8144
Keller - C17	KELC	102.29	82.71	0.8086
Fort Worth Northwest - C13	FWMC	100.54	81.79	0.8135
Frisco - C31	FRIC	99.36	82.02	0.8255
Dallas North #2 - C63	DALN	97.88	81.39	0.8315
Parker County - C76	WTFD	91.54	74.56	0.8145
Dallas Executive Airport - C402	REDB	95.76	79.62	0.8315
Cleburne Airport - C77	CLEB	88.54	71.44	0.8069
Arlington Municipal Airport - C61	ARLA	98.62	81.08	0.8221
Dallas Hinton Street - C401	DHIC	99.17	81.59	0.8228
Granbury - C73	GRAN	88.36	71.64	0.8108
Midlothian Tower - C94	MDLT	91.00	75.46	0.8292
Pilot Point - C1032	PIPT	99.39	80.52	0.8101
Rockwall Heath - C69	RKWL	89.84	75.84	0.8442
Midlothian OFW - C52	MDLO	92.22	76.56	0.8302
Greenville - C1006	GRVL	81.51	67.46	0.8275
Kaufman - C71	KAUF	81.94	68.84	0.8402

The RRF from the top 10 days methodology is then multiplied by the 2006 DV_B for each monitor to obtain the revised 2018 DV_F figures presented in Table 3-44: *Summary of 2018 Future Ozone Design Values Using Top 10 Days Test*. Similar to the former guidance, the draft guidance recommends rounding the final DV_F to the tenths digit and truncating to zero decimal places.

Table 3-44: Summary of 2018 Future Ozone Design Values Using Top 10 Days Test

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2018 DV_F (ppb)	2018 Truncated DV_F (ppb)
Denton Airport South - C56	DENT	93.33	75.25	75
Eagle Mountain Lake - C75	EMTL	93.33	74.12	74
Grapevine Fairway - C70	GRAP	90.67	73.84	73
Keller - C17	KELC	91.00	73.58	73
Fort Worth Northwest - C13	FWMC	89.33	72.67	72
Frisco - C31	FRIC	87.67	72.37	72
Dallas North #2 - C63	DALN	85.00	70.68	70
Parker County - C76	WTFD	87.67	71.40	71

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2006 DV_B (ppb)	2018 DV_F (ppb)	2018 Truncated DV_F (ppb)
Dallas Executive Airport - C402	REDB	85.00	70.68	70
Cleburne Airport - C77	CLEB	85.00	68.59	68
Arlington Municipal Airport - C61	ARLA	83.33	68.50	68
Dallas Hinton Street - C401	DHIC	81.67	67.20	67
Granbury - C73	GRAN	83.00	67.30	67
Midlothian Tower - C94	MDLT	80.50	66.75	66
Pilot Point - C1032	PIPT	81.00	65.62	65
Rockwall Heath - C69	RKWL	77.67	65.57	65
Midlothian OFW - C52	MDLO	75.00	62.27	62
Greenville - C1006	GRVL	75.00	62.07	62
Kaufman - C71	KAUF	74.67	62.73	62

3.7.3 Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis

A source apportionment analysis was conducted on the 2018 future case modeling. The two techniques of Anthropogenic Precursor Culpability Assessment (APCA) and Ozone Source Apportionment Technology (OSAT) were used to analyze contributions by different emission source categories in selected regions to the 2018 modeled ozone concentrations. Both APCA and OSAT keep track of the origin of the NO_X and VOC precursors creating the ozone during the model run, which can then be apportioned to specific user-defined geographic regions and source categories. A key difference between APCA and OSAT is that APCA recognizes that the biogenic source category is not controllable. Where OSAT would apportion ozone production to biogenic emissions, APCA reallocates that ozone production to the controllable or anthropogenic emissions that combined with the biogenic emissions to create ozone. Only ozone created from both biogenic NO_X and VOC precursors is apportioned to the biogenic emission source group by APCA.

For the APCA analysis, the three geographic regions of 10-county DFW, non-DFW Texas, and non-Texas were chosen. For display purposes, the anthropogenic emissions were divided into eight source categories for DFW, five for non-DFW Texas, and one aggregate category for non-Texas. The highest level of resolution in the anthropogenic emission categories that can be obtained for APCA analyses is driven by the number of separate EPS3 processing streams for CAMx input. For example, the on-road emissions processing with EPS3 is not split between streams for passenger cars and heavy-duty diesel trucks, so an APCA analysis is not able to provide separate ozone contribution estimates for these categories. Use of APCA requires tracking of biogenic emissions, initial conditions, and boundary conditions, but these are not allocated to any specific geographic area. Table 3-45: *APCA Geographic Region and Source Category Combinations* summarizes these 17 groups.

Table 3-45: APCA Geographic Region and Source Category Combinations

Geographic Region	Source Category
10-County DFW	On-Road

Geographic Region	Source Category
10-County DFW	Non-Road
10-County DFW	Off-Road - Airports and Locomotives
10-County DFW	Area Sources
10-County DFW	Oil and Gas Drilling and Production
10-County DFW	Point - Electric Utilities
10-County DFW	Point - Cement Kilns
10-County DFW	Point - Oil and Gas and Other *
Non-DFW Texas	On-Road
Non-DFW Texas	Non-Road, Off-Road, and Area Sources
Non-DFW Texas	Oil and Gas Drilling and Production
Non-DFW Texas	Point - Electric Utilities
Non-DFW Texas	Point - Cement Kilns, Oil and Gas, and Other
Non-Texas	All Anthropogenic
All Geographic Areas	Biogenic
NA	Boundary Conditions
NA	Initial Conditions

* For the 2018 future year, oil and gas point source NO_X is 16.37 tpd and the remaining "other" is 6.62 NO_X tpd.

The full 67-day combined episode was run with APCA for the 2018 future case to estimate the geographic region and source category contributions to the ozone formed for each hour and day. The APCA output was processed to obtain these contributions for each monitor within the DFW area. Graphical results for the Denton Airport South monitor are presented in Figure 3-31: *2018 Ozone Contributions for Denton Airport South from May 31 through June 16* and Figure 3-32: *2018 Ozone Contributions for Denton Airport South from August 13 through 27*. These time periods represent the first half of the June and August-September episodes, respectively. The photochemical model must be run with initial conditions that become less important once the earlier part of the episode has finished. Each peak represents the higher mid-day levels of modeled ozone, while each valley represents the nighttime low. Differing amounts of ozone are formed each day, and the contribution from each geographic region and source category combination varies due to changing meteorological conditions by day and hour. The gray, green, and pink colors towards the bottom of the charts reflect the boundary conditions, biogenic, and non-Texas anthropogenic contributions, respectively.

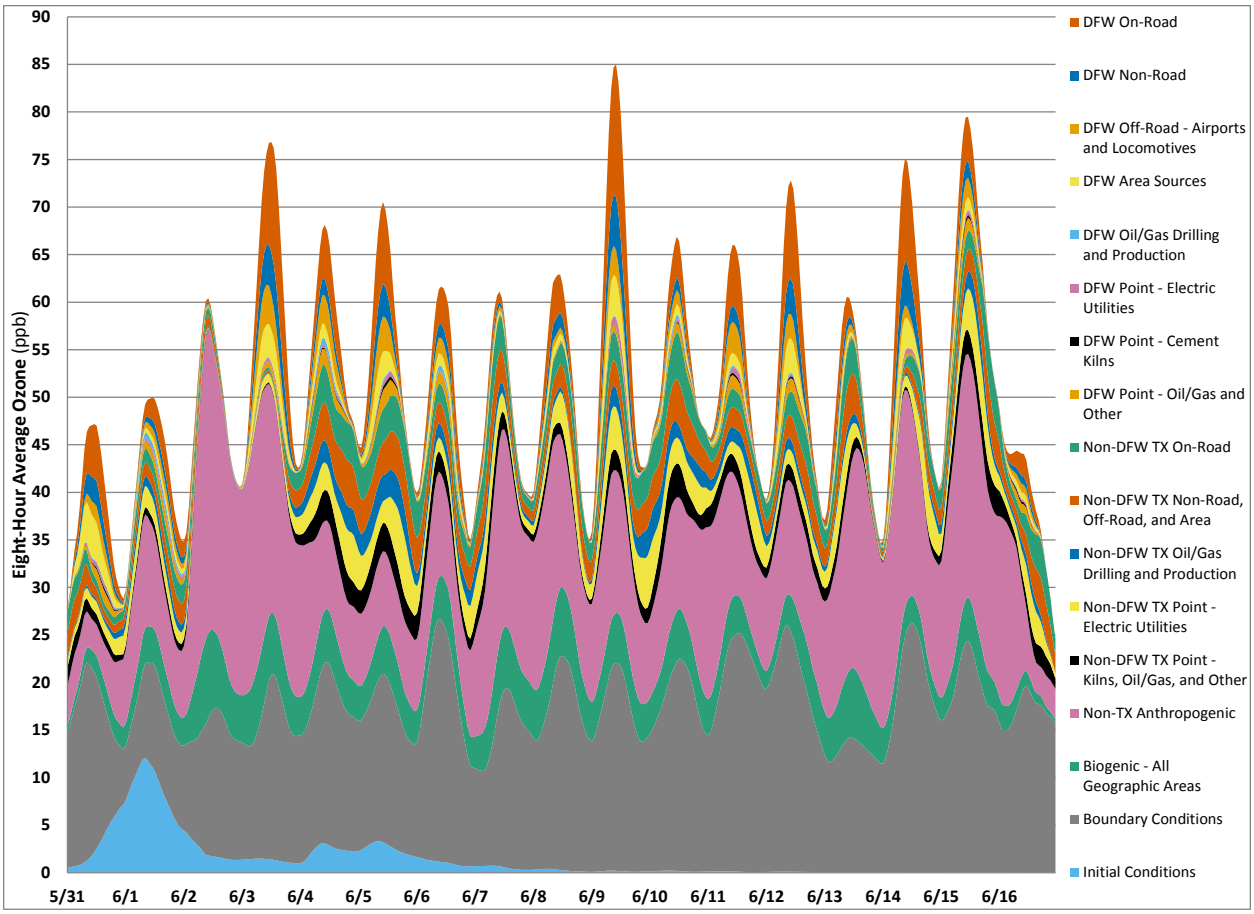


Figure 3-31: 2018 Ozone Contributions for Denton Airport South from May 31 through June 16

Figure 3-31 and Figure 3-32 present the ozone contributions for each day of the respective time periods, but not all of these days were used in the RRF calculations presented in Table 3-40, Table 3-41, and Table 3-42, which are based on the 2006 baseline episode days that had an eight-hour ozone modeled peak above 75 ppb. For each monitor, the maximum eight-hour ozone contributions from the APCA output were aggregated for the episode days used in the RRF calculations. A distribution by geographic area and source type was obtained by averaging the ozone contributions across the RRF days, and that distribution was then applied to the 2018 DV_F for each monitor.

The results of this analysis are presented in Figure 3-33: *2018 Ozone DV_F Contributions for Denton, Parker, and Kaufman* and for the Denton Airport South, Parker County, and Kaufman monitors. The Denton Airport South monitor was chosen for review because it has the highest 2018 DV_F and is located in the far northwestern downwind portion of the DFW nonattainment area, so its APCA results represent the maximum total ozone contribution from DFW nonattainment area precursors. The Kaufman monitor was chosen for review because it has the lowest 2018 DV_F and is located in the far southeastern upwind portion of the DFW nonattainment area, so its APCA results can best represent the background contribution. The Parker County monitor was chosen to evaluate ozone impacts of oil and gas operations because it is located in the far western portion of the DFW nonattainment area downwind of prevalent drilling and production activity.

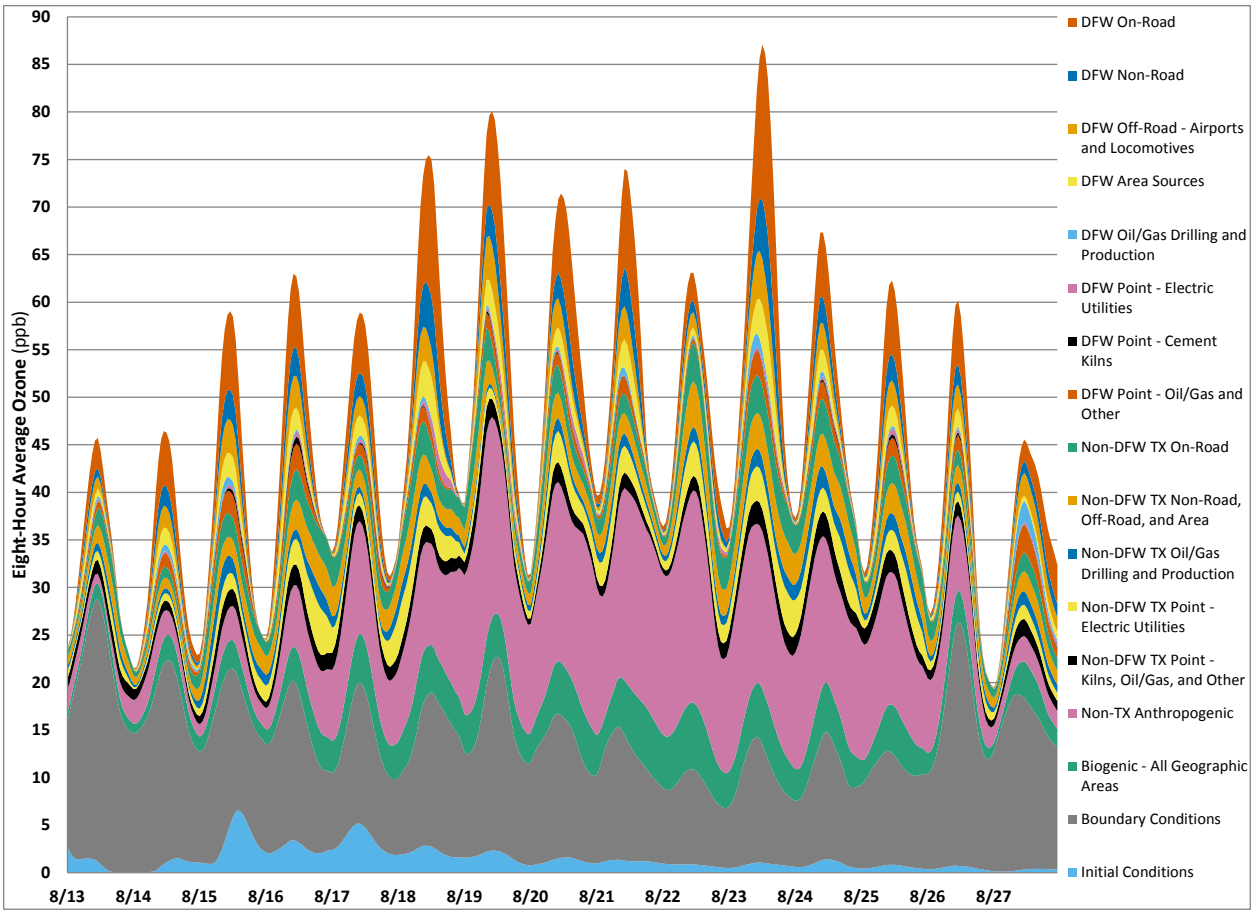


Figure 3-32: 2018 Ozone Contributions for Denton Airport South from August 13 through 27

Table 3-46: *2018 Ozone DV_F Denton, Parker, and Kaufman Contributions* presents the values for each of the geographic area and source categories referenced in Figure 3-32. Table 3-47: *2018 Ozone DV_F Denton, Parker, and Kaufman Aggregate Summary* groups the anthropogenic source category results from Table 3-46 into 10-County DFW, non-DFW Texas, and non-Texas areas. The southeastern upwind Kaufman monitor reflects the lowest DFW nonattainment area ozone contribution of 2.9 ppb to its DV_F, while the northwestern downwind Denton Airport South monitor reflects the highest DFW nonattainment area ozone contribution of 20.3 ppb. While the peak ozone at Kaufman is 14.5 ppb lower than at Denton Airport South, a greater portion of its ozone can be attributed to non-DFW Texas (16.8 ppb) and non-Texas (20.8 ppb) sources. The comparative non-DFW Texas and non-Texas anthropogenic contributions for Denton Airport South are 11.7 ppb and 18.6 ppb, respectively.

As shown in Table 3-46, the Parker monitor reflects higher ozone contributions from oil and gas operations compared with other DFW nonattainment area monitors. This is to be expected due its location downwind of much of this activity during ozone season. As noted in Table 3-45, the DFW nonattainment area point source contributions are divided into electric utilities, cement kilns, and a remaining category that combines oil and gas operations with "other". The 2018 figures in Table 3-22 and Table 3-32 show that the oil and gas portion is 16.37 NO_X tpd with 6.62 NO_X tpd comprising the remainder of the total 22.99 NO_X tpd for non-cement kiln non-EGUs. Appendix C contains more detail on the APCA analyses presented here.

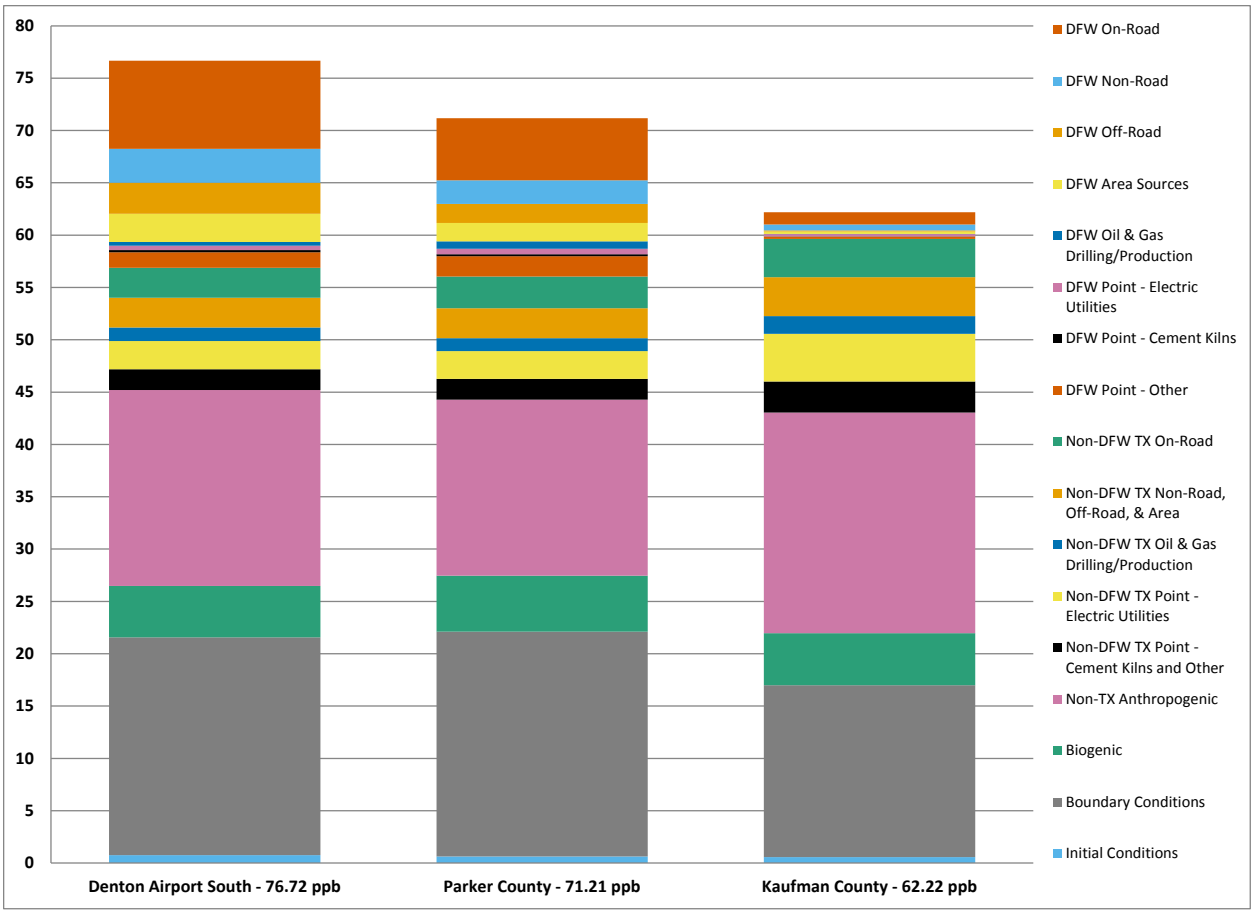


Figure 3-33: 2018 Ozone DV_F Contributions for Denton, Parker, and Kaufman

Table 3-46: 2018 Ozone DV_F Denton, Parker, and Kaufman Contributions

Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW On-Road	8.66	6.39	1.52
DFW Non-Road	3.39	2.26	0.55
DFW Off-Road - Airports and Locomotives	2.96	1.73	0.10
DFW Area Sources	2.77	1.73	0.23
DFW Oil/Gas Drilling and Production	0.40	0.79	0.02
DFW Point - Electric Utilities	0.41	0.50	0.21
DFW Point - Cement Kilns	0.21	0.17	0.03
DFW Point - Oil/Gas and Other	1.47	1.89	0.22
Non-DFW TX On-Road	2.56	2.72	3.42
Non-DFW TX Non-Road, Off-Road, and Area Sources	2.82	2.87	3.82
Non-DFW TX Oil/Gas Drilling and Production	1.67	1.44	1.94
Non-DFW TX Point - Electric Utilities	2.64	2.64	4.60

Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
Non-DFW TX Point - Cement Kilns, Oil/Gas, and Other	1.97	2.00	3.06
Non-TX Anthropogenic - All Sources	18.59	16.89	20.79
Biogenic - All Geographic Areas	4.40	4.86	4.46
Boundary Conditions	21.02	21.70	16.72
Initial Conditions	0.78	0.64	0.53
2018 Future Design Value	76.72	71.21	62.22

Table 3-47: 2018 Ozone DV_F Denton, Parker, and Kaufman Aggregate Summary

Aggregated Geographic Area and Source Type	Denton Airport South (ppb)	Parker County (ppb)	Kaufman County (ppb)
DFW Anthropogenic	20.27	15.46	2.88
Non-DFW Texas Anthropogenic	11.67	11.66	16.84
Non-Texas Anthropogenic	18.59	16.89	20.79
Biogenic - All Geographic Areas	4.40	4.86	4.46
Boundary and Initial Conditions	21.79	22.34	17.25
2018 Future Design Value	76.72	71.21	62.22

3.7.4 Future Case Modeling Sensitivities

Section 3.7.2 presented the 2018 future design values obtained from the running the photochemical model with the 2006 baseline and 2018 future case emission inventories discussed in Sections 3.5.3 and 3.5.4, respectively. Two sensitivity analyses were performed by holding the 2006 baseline emission inventories constant, but modifying the 2018 future case emission inventories for specific source categories. For each sensitivity test, the RRF analysis was performed and the 2018 future case design value impacts for each monitor were determined.

3.7.4.1 2018 Cross-State Air Pollution Rule (CSAPR) Sensitivity

The 2018 future case EGU emissions for this DFW AD SIP revision were projected based on CAIR Phase II allocations. In July of 2011, the EPA finalized CSAPR, which was intended to be a replacement for CAIR. Since that time, implementation of CSAPR was halted due to legal proceedings. In April 2014, the U.S. Supreme Court reversed a D.C. Circuit opinion that had vacated CSAPR and remanded the case. On October 23, 2014, the D.C. Circuit lifted the CSAPR stay and on November 21, 2014, the EPA issued rulemaking, which shifted the effective dates of the CSAPR requirements to account for the time that had passed after the rule was stayed in 2011. Phase 1 of the CSAPR took effect January 1, 2015 and Phase 2 is scheduled to begin January 1, 2017.

The TCEQ performed a 2018 sensitivity analysis that replaced the 2018 EGU emission estimates based on CAIR Phase II with the latest available CSAPR allocations for 2017-and-later years. The 28 states subject to CSAPR are Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina,

Tennessee, Texas, Virginia, West Virginia, and Wisconsin. The modeled 2018 ozone impacts for the DFW area monitors are presented in Table 3-48: *2018 Future Design Value Impacts from CSAPR Instead of CAIR II*. The maximum modeled reduction of 0.73 ppb is at the Rockwall Heath monitor located on the far eastern upwind side of DFW. The minimum reduction of 0.02 ppb is located at the Eagle Mountain Lake monitor located on the northwestern downwind side of DFW. The Fort Worth Northwest monitor is the only monitor that saw an ozone increase (0.22 ppb) for the CSAPR sensitivity.

Table 3-48: 2018 Future Design Value Impacts from CSAPR Instead of CAIR II

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2018 DV_F for CAIR II (ppb)	2018 DV_F for CSAPR (ppb)	2018 DV_F Change (ppb)
Denton Airport South - C56	DENT	76.72	76.52	-0.20
Eagle Mountain Lake - C75	EMTL	75.88	75.86	-0.02
Grapevine Fairway - C70	GRAP	75.70	75.46	-0.24
Keller - C17	KELC	75.08	74.97	-0.11
Fort Worth Northwest - C13	FWMC	73.73	73.95	+0.22
Frisco - C31	FRIC	73.11	72.74	-0.37
Dallas North #2 - C63	DALN	71.61	71.21	-0.40
Parker County - C76	WTFD	71.21	70.92	-0.29
Dallas Executive Airport - C402	REDB	70.88	70.34	-0.54
Cleburne Airport - C77	CLEB	70.27	70.13	-0.14
Arlington Municipal Airport - C61	ARLA	69.47	69.15	-0.32
Dallas Hinton Street - C401	DHIC	68.87	68.53	-0.34
Granbury - C73	GRAN	67.73	67.39	-0.34
Midlothian Tower - C94	MDLT	67.20	66.72	-0.48
Pilot Point - C1032	PIPT	66.62	66.37	-0.25
Rockwall Heath - C69	RKWL	65.74	65.01	-0.73
Midlothian OFW - C52	MDLO	62.67	62.23	-0.44
Greenville - C1006	GRVL	61.97	61.63	-0.34
Kaufman - C71	KAUF	62.22	61.56	-0.66

3.7.4.2 Discrete Emissions Reduction Credit (DERC) Sensitivity

When projecting DFW nonattainment area point source emission estimates from the most recently available data sources to 2018, emission caps were applied to the cement kilns and EGUs. The projection for non-cement kiln non-EGUs is the lesser of an economic projection or the TCEQ Emissions Banking and Trading Registry. For the 2018 future year, projection from the 2012 point source STARS data using economic factors resulted in a 0.55 NO_X tpd decrease for the DFW nonattainment area non-cement kiln non-EGU category. This is documented in Table 3-21 and Table 3-22, which show the 2012 non-cement kiln non-EGU emissions at 23.54 NO_X tpd and the 2018 level at 22.99 NO_X tpd.

A sensitivity analysis was performed where 17 NO_X tpd of DERCs were proportionally allocated to the 2018 non-cement kiln non-EGU emissions throughout DFW. If a single point source

facility in this group comprised 1% of the non-cement kiln non-EGU total, then that facility's NO_X emission level was increased by 0.17 NO_X tpd from this DERC sensitivity. The TCEQ is currently proposing rulemaking (Rule Project No. 2014-007-101-AI) that would replace the existing annually-calculated NO_X DERC limit in §101.379(c) with a fixed limit of 17.0 tpd of NO_X DERC use in the nine-county DFW 1997 eight-hour ozone nonattainment area. The proposed 17.0 tpd limit was selected based on the 2013 NO_X DERC limit of 16.9 tpd, which was the second highest limit that had been set at the time the modeling sensitivity was conducted. The proposed limit is one and a half times greater than the largest request to use DERCs submitted from 2009 through 2014 and more than eleven times greater than any actual DERC use during this same time. Table 3-49: *2018 DV_F Impacts from Maximum DERC Allocation to* non-EGUs summarizes the net ozone increases in the 2018 design values for each DFW area monitor.

Table 3-49: 2018 DV_F Impacts from Maximum DERC Allocation to Non-EGUs

2006 DFW Area Monitor and CAMS Code	DFW Area Monitor Alpha Code	2018 DV_F (ppb)	2018 DV_F Add 17 NO_X tpd (ppb)	2018 DV_F Change (ppb)
Denton Airport South - C56	DENT	76.72	77.06	+0.34
Eagle Mountain Lake - C75	EMTL	75.88	76.37	+0.49
Grapevine Fairway - C70	GRAP	75.70	75.97	+0.27
Keller - C17	KELC	75.08	75.47	+0.39
Fort Worth Northwest - C13	FWMC	73.73	74.17	+0.44
Frisco - C31	FRIC	73.11	73.29	+0.18
Dallas North #2 - C63	DALN	71.61	71.77	+0.16
Parker County - C76	WTFD	71.21	71.76	+0.55
Dallas Executive Airport - C402	REDB	70.88	71.07	+0.19
Cleburne Airport - C77	CLEB	70.27	70.60	+0.33
Arlington Municipal Airport - C61	ARLA	69.47	69.75	+0.28
Dallas Hinton Street - C401	DHIC	68.87	69.04	+0.17
Granbury - C73	GRAN	67.73	68.20	+0.47
Midlothian Tower - C94	MDLT	67.20	67.38	+0.18
Pilot Point - C1032	PIPT	66.62	66.90	+0.28
Rockwall Heath - C69	RKWL	65.74	65.84	+0.10
Midlothian OFW - C52	MDLO	62.67	62.86	+0.19
Greenville - C1006	GRVL	61.97	62.01	+0.04
Kaufman - C71	KAUF	62.22	62.26	+0.04

3.7.5 Unmonitored Area Analysis

EPA guidance (EPA, 2007) recommends that areas within or near nonattainment counties but not adjacent to monitoring locations (unmonitored areas (UMA)) be subjected to a UMA analysis to demonstrate that these areas are expected to reach attainment by the required future year. The standard attainment test is applied only at monitor locations, and the UMA analysis is intended to identify any areas not near a monitoring location that are at risk of not meeting the attainment date. Recently, the EPA provided Modeled Attainment Test Software (MATS), which can be used to conduct UMA analyses but has not specifically recommended using its software

in EPA guidance, instead stating that "States will be able to use the EPA-provided software or are free to develop alternative techniques that may be appropriate for their areas or situations."

The TCEQ chose to use its own procedure to conduct the UMA analysis instead of MATS for several reasons. Both procedures incorporate modeled predictions into a spatial interpolation procedure. However, the TCEQ Attainment Test for Unmonitored areas (TATU) is already integrated into the TCEQ's model post-processing stream while MATS requires that modeled concentrations be exported to a personal computer-based platform. Additionally, MATS requires input in latitude/longitude, while TATU works directly off the LCC projection data used in TCEQ modeling applications. Finally, MATS uses the Voronoi Neighbor Averaging (VNA) technique for spatial interpolation, while TATU relies on the more familiar kriging geospatial interpolation technique. More information about TATU is provided in Appendix C.

Figure 3-34: *Spatially Interpolated 2006 Baseline and 2018 Future Case Design Values for the DFW Area* shows two color contour maps of ozone concentrations produced by TATU, one for the 2006 baseline (top) and one for the 2018 future case (bottom). The figure shows the extent and magnitude of the expected improvements in ozone design values, with few grid cells at or above 76 ppb in the future case plot. Figure 3-34 indicates that the maximum 2018 design value in the domain of 76.8 ppb is located in cell 34 in the x-direction and 37 in the y-direction (34_X, 37_Y). This area wide maximum is located immediately to the southeast of the Denton Airport Monitor, which is in cell 33 in the x-direction and 38 in the y-direction (33_X, 38_Y). Table 3-42 shows that the Denton Airport South monitor has the highest 2018 DV_F of all DFW area monitors at 76.7 ppb, which is 0.1 ppb less than this area wide maximum of 76.8 ppb.

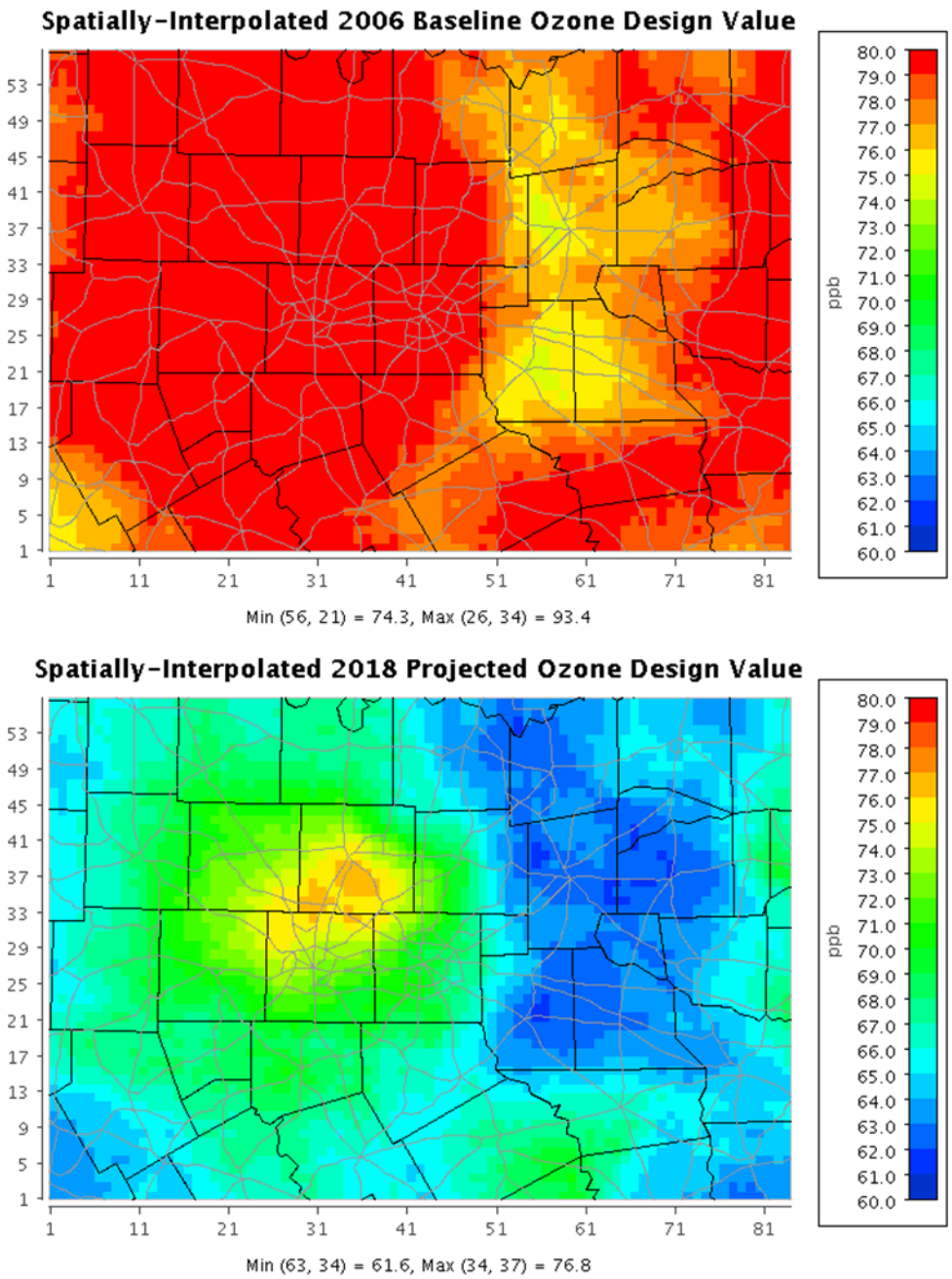


Figure 3-34: Spatially Interpolated 2006 Baseline and 2018 Future Case Design Values for the DFW Area

3.8 MODELING ARCHIVE AND REFERENCES

3.8.1 Modeling Archive

The TCEQ has archived all modeling documentation and modeling input/output files generated as part of the DFW AD SIP revision modeling analysis. Interested parties can contact the TCEQ for information regarding data access or project documentation. Most modeling files and performance evaluation products may be found on the TCEQ modeling FTP site, (ftp://amdaftp.tceq.texas.gov/pub/TX/camx/).

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CHAPTER 4: CONTROL STRATEGIES AND REQUIRED ELEMENTS

4.1 INTRODUCTION

The Dallas-Fort Worth (DFW) nonattainment area for the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS), which consists of Collin, Dallas, Denton, Tarrant, Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties, includes a wide variety of major and minor industrial, commercial, and institutional entities. The Texas Commission on Environmental Quality (TCEQ) has implemented stringent and innovative regulations that address emissions of nitrogen oxides (NO_X) and volatile organic compounds (VOC) from these sources. This chapter describes existing ozone control measures and ozone control measures being adopted concurrently with this state implementation plan (SIP) revision for the DFW nonattainment area, as well as how Texas meets the following moderate ozone nonattainment area SIP requirements for the 2008 eight-hour ozone NAAQS: reasonably available control technology (RACT), reasonably available control measures (RACM), motor vehicle emissions budget (MVEB), and contingency measures.

4.2 EXISTING CONTROL MEASURES

Since the early 1990s, a broad range of control measures have been implemented for each emission source category for ozone planning in the DFW nonattainment area, formerly consisting of nine counties, Collin, Dallas, Denton, Tarrant, Ellis, Johnson, Kaufman, Parker, and Rockwall. Wise County was added to the nonattainment area for the 2008 eight-hour ozone NAAQS. Table 4-1: *Existing Ozone Control Measures Applicable to the DFW Nine-County Nonattainment Area* lists the existing ozone control strategies that have been implemented for the one-hour and 1997 eight-hour ozone standards in the nine-county DFW nonattainment area.

Table 4-1: Existing Ozone Control Measures Applicable to the DFW Nine-County Nonattainment Area

Measure	Description	Start Date(s)
DFW Eight-Hour Ozone Nonattainment Area Industrial, Commercial, and Institutional (ICI) Major Source Rule 30 Texas Administrative Code (TAC) Chapter 117, Subchapter B, Division 4	Applies to all major sources (50 tons per year (tpy) of NO_X or more) with affected units Affected source categories included in rule: boilers; process heaters; stationary gas turbines, and duct burners used in turbine exhaust ducts; lime kilns; heat treat and reheat metallurgical furnaces; stationary internal combustion engines; incinerators; glass, fiberglass, and mineral wool melting furnaces; fiberglass and mineral wool curing ovens; natural gas-fired ovens and heaters; brick and ceramic kilns; lead smelting reverberatory and blast furnaces; and natural gas-fired dryers used in organic solvent, printing ink, clay, brick, ceramic tile, calcining, and vitrifying processes	March 1, 2009 or March 1, 2010, depending on source category Note: these NO_X control requirements are in addition to the NO_X control strategies previously implemented for ICI major sources in Collin, Dallas, Denton, and Tarrant Counties in March 2002 for the one-hour ozone NAAQS

Measure	Description	Start Date(s)
DFW Eight-Hour Ozone Nonattainment Area ICI Minor Source Rule 30 TAC Chapter 117, Subchapter D, Division 2	Applies to all minor sources (less than 50 tpy of NO_X) with stationary internal combustion engines	March 1, 2009 for rich-burn gas-fired engines, diesel-fired engines, and dual-fuel engines March 1, 2010 for lean-burn gas-fired engines
DFW Eight-Hour Ozone Nonattainment Area Major Utility Electric Generation Source Rule 30 TAC Chapter 117, Subchapter C, Division 4	NO_X control requirements for utility electric generating facilities Applies to utility boilers, auxiliary steam boilers, stationary gas turbines, and duct burners used in turbine exhaust ducts used in electric power generating systems Note: these NO_X control requirements are in addition to the NO_X control strategies implemented for utilities in Collin, Dallas, Denton, and Tarrant Counties in 2001 through 2005 for the one-hour ozone NAAQS	March 1, 2009
Utility Electric Generation in East and Central Texas 30 TAC Chapter 117, Subchapter E, Division 1	NO_X control requirements on utility boilers and stationary gas turbines (including duct burners used in turbine exhaust ducts) at utility electric generation sites in East and Central Texas, including Parker County	May 1, 2003 through May 1, 2005
DFW Eight-Hour Ozone Attainment Demonstration Cement Kiln Rule 30 TAC Chapter 117, Subchapter E, Division 2	NO_X control requirements for all Portland cement kilns located in Ellis County	March 1, 2009
NO_X Emission Standards for Nitric Acid Manufacturing – General 30 TAC Chapter 117, Subchapter F, Division 3	NO_X emission standards for nitric acid manufacturing facilities (state-wide rule – no nitric acid facilities in DFW)	November 15, 1999

Measure	Description	Start Date(s)
East Texas Combustion Sources 30 TAC Chapter 117, Subchapter E, Division 4	NO_X control requirements for stationary rich-burn, gas-fired internal combustion engines (240 horsepower (hp) and greater) Measure implemented to reduce ozone in the DFW nonattainment area although controls not applicable in the DFW nonattainment area	March 1, 2010
Natural Gas-Fired Small Boilers, Process Heaters, and Water Heaters 30 TAC Chapter 117, Subchapter E, Division 3	NO_X emission limits on small-scale residential and industrial boilers, process heaters, and water heaters equal to or less than 2.0 million British thermal units per hour	May 11, 2000
General VOC Control Measures 30 TAC, Chapter 115, Subchapters B, C, D, E, F, G, and J	Additional control technology requirements for VOC sources for RACT purposes including: storage, general vent gas, industrial wastewater, loading and unloading operations, general VOC leak detection and repair, solvent using processes, etc. (see Appendix F: *Reasonably Available Control Technology Analysis* for more details)	December 31, 2002 and earlier for Collin, Dallas, Denton, and Tarrant Counties June 15, 2007 or March 1, 2009 for Ellis, Johnson, Kaufman, Parker, and Rockwall Counties
Offset Lithographic Printing 30 TAC, Chapter 115, Subchapter E, Division 4	Control technology requirements for offset lithographic printing Revision to limit VOC content of solvents used by offset lithographic printing facilities and to include smaller sources in rule applicability	December 31, 2000 for Collin, Dallas, Denton, and Tarrant Counties and March 1, 2009 in Ellis, Johnson, Kaufman, Parker, and Rockwall Counties March 1, 2011 for major printing sources (50 tons of VOC per year or more) and March 1, 2012 for minor printing sources (less than 50 tons of VOC per year)
VOC Rules – Degassing Operations 30 TAC, Chapter 115, Subchapter F, Division 3	VOC control requirements for degassing during, or in preparation of, cleaning any storage tanks and transport vessels	May 21, 2011 for Collin, Dallas, Denton, and Tarrant Counties

Measure	Description	Start Date(s)
VOC Control Measures – Storage Tanks 30 TAC Chapter 115, Subchapter B, Division 1	Requires controls for slotted guidepoles and more stringent controls for other fittings on floating roof tanks, and control requirements or operational limitations on landing floating roof tanks Eliminates exemption for storage tanks for crude oil or natural gas condensate and regulates flash emissions from these tanks	March 1, 2013
VOC Control Measures – Solvent-Using Processes 30 TAC Chapter 115, Subchapter E	Revised rules to implement RACT requirements per control techniques guidelines issued by the United States Environmental Protection Agency (EPA) including new control, testing, monitoring and recordkeeping requirements for eight emission source categories in the DFW nonattainment area: paper, film, and foil coatings; large appliance coatings; metal furniture coatings; miscellaneous metal and plastic parts coatings; automobile and light-duty truck coating; industrial cleaning solvents; miscellaneous industrial adhesives; and flexible package printing (see Dallas-Fort Worth Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard Nonattainment Area (2010-022-SIP-NR))	March 1, 2013
Voluntary Energy Efficiency/Renewable Energy	Energy efficiency and renewable energy projects established by Senate Bill (SB) 7 from 76th session of Texas Legislature and SB 5 from 77th session of Texas Legislature	September 1, 1999 and September 1, 2001
Automotive Windshield Washer Fluid 30 TAC, Chapter 115, Subchapter G, Division 1	VOC content limitation on automotive windshield washer fluid sold, supplied, distributed, or manufactured for use in Texas	January 1, 1995
Refueling – Stage I 30 TAC, Chapter 115, Subchapter C, Division 2	Captures gasoline vapors that are released when gasoline is delivered to a storage tank Vapors returned to tank truck as storage tank is filled with fuel, rather than released into ambient air	1990

Measure	Description	Start Date(s)
Refueling – Stage II 30 TAC, Chapter 115, Subchapter C, Division 4	Captures gasoline vapors when vehicle is fueled at pump Vapors returned through pump hose to petroleum storage tank, rather than released into ambient air	1992 (Collin, Dallas, Denton, and Tarrant Counties) A SIP revision authorizing the decommissioning of Stage II vapor control equipment was approved by the EPA on March 17, 2014. Facilities may continue operating Stage II until August 31, 2018.
Federal Area/Non-Road Measures	Series of emissions limits implemented by the EPA for area and non-road sources Examples: diesel and gasoline engine standards for locomotives and leaf-blowers	Phase in through 2018
Texas Emissions Reduction Plan (TERP) 30 TAC Chapter 114, Subchapter K	Provides grant funds for on-road and non-road heavy-duty diesel engine replacement/retrofit. The first emissions reduction incentive grant projects funded under TERP were for fiscal years (FY) 2002-2003 (September 1, 2001, through August 31, 2003). To focus the emissions reduction benefits for the areas that needed them the most, applications were accepted only for projects in the Houston-Galveston-Brazoria (HGB) and DFW nonattainment areas for FY 2002-2003. An application period limited to DFW, HGB, and Beaumont-Port Arthur was done in 2006 and 2007. The allocation approach established by the commission for TERP included several grant programs for reducing emissions from mobile sources and encouraging the use of cleaner alternative fuels for transportation, including the Diesel Emissions Reduction Incentive Program providing grants to replace or upgrade heavy-duty on-road vehicles, non-road equipment, locomotives, marine vessels, and some stationary engines.	January 2002
California Gasoline Engines	California standards for non-road gasoline engines 25 hp and larger	May 1, 2004

Measure	Description	Start Date(s)
Texas Low Emission Diesel (TxLED) 30 TAC Chapter 114, Subchapter H, Division 2	Requires all diesel fuel for both on-road and non-road use to have a lower aromatic content and a higher cetane number	Phased in from October 31, 2005 through January 31, 2006
Texas Low Reid Vapor Pressure (RVP) Gasoline 30 TAC Chapter 114, Subchapter H, Division 1	Requires all gasoline for both on-road and non-road use to have RVP of 7.8 pounds per square inch or less from May 1 through October 1 each year	April 2000 in Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties
Voluntary Mobile Emissions Reduction Program	Voluntary measures administered by the North Central Texas Council of Governments (NCTCOG) (see Appendix H for more details)	2007
Federal On-Road Measures	Series of emissions limits implemented by the EPA for on-road vehicles Included in measures: Tier 1, Tier 2, and Tier 3 light-duty and medium-duty passenger vehicle standards, heavy-duty vehicle standards, low sulfur diesel standards, National Low Emission Vehicle standards, and reformulated gasoline	Phase in through 2010 Tier 3 phase in from 2017 through 2025

Measure	Description	Start Date(s)
Vehicle Inspection and Maintenance (I/M) 30 TAC Chapter 114, Subchapter C	Yearly treadmill-type testing for pre-1996 vehicles and computer checks for 1996 and newer vehicles	May 1, 2002 in Collin, Dallas, Denton, and Tarrant Counties May 1, 2003 in Ellis, Johnson, Kaufman, Parker, and Rockwall Counties The DFW area meets the Federal Clean Air Act (FCAA), §182(b)(4) requirements to implement an I/M program , and according to 40 Code of Federal Regulations (CFR) §51.350(b)(2), an I/M program is required to cover the entire urbanized area based on the 1990 census. The current I/M program in the DFW ozone nonattainment area sufficiently covers a population equal to the DFW urbanized area, thus expansion of the I/M program to include Wise County is not required.
Environmental Speed Limit (ESL)	Five miles per hour (mph) below what was posted before May 1, 2002, on roadways where speeds were 65 mph or higher ESLs adopted by the commission in April 2000 converted to Transportation Control Measures by the TCEQ in August 2010	September 2001
Transportation Control Measures	Various measures in NCTCOG's long-range transportation plans	2007
Voluntary Energy Efficiency/Renewable Energy	Energy efficiency and renewable energy projects encouraged by SB 5 and SB 7 from the 80th session of the Texas Legislature (See Chapter 5: *Weight of Evidence* for more details.)	December 2000

4.3 UPDATES TO EXISTING CONTROL MEASURES

This section includes updates to NO_X and VOC control measures that are being adopted concurrent with this DFW attainment demonstration (AD) SIP revision to satisfy RACT requirements in addition to other rulemakings that have updated DFW control measures since the previous DFW AD SIP submittal (Non-Rule Project Number 2010-022-SIP-NR).

4.3.1 Updates to NO_X Control Measures

Concurrent with this DFW AD SIP revision, the commission is adopting rulemaking (Rule Project Number 2013-049-117-AI) to update existing control requirements for NO_X major sources in the DFW nonattainment area to implement RACT. Additional detail concerning these updated control measures can be found in the RACT discussion in Section 4.5.2: *NO_X RACT Determination* of this chapter.

4.3.2 Updates to VOC Control Measures

Concurrent with this DFW AD SIP revision, the commission is adopting rulemaking (Rule Project Number 2013-048-115-AI) to update existing control requirements for VOC sources in the DFW nonattainment area to implement RACT. Additional detail concerning these updated control measures can be found in the RACT discussion in Section 4.5.3: *VOC RACT Determination* of this chapter.

4.3.3 Minor Source Stationary Diesel Engine Exemption

On April 10, 2013, the commission adopted a rule revision (Rule Project Number 2012-031-117-AI) to expand the list of sources exempt from the stationary diesel engine minor source rules in 30 TAC Chapter 117, Subchapter D, Division 2. This rulemaking revised §117.2103 to include stationary diesel engines that are used exclusively for product testing and personnel training, operate less than 1,000 hours per year on a rolling 12-month basis, and meet applicable Tier emission standards for non-road engines listed in 40 CFR §89.112(a), Table 1 (October 23, 1998) in effect at the time of installation, modification, reconstruction, or relocation. The adopted exemption was narrow in scope and consistent with the similar existing exemptions for stationary diesel engines located at minor sources.

4.3.4 Decommissioning of Stage II Vapor Recovery

The Stage II vapor recovery program involves use of technology that prevents gasoline vapors from escaping during refueling of on-road motor vehicles. The EPA mandated that Stage II refueling requirements apply to all public and private refueling facilities dispensing 10,000 gallons or more of gasoline per month. The federal throughput constitutes a minimum threshold, but a state may be more stringent in adopting a throughput standard. The TCEQ applied a more stringent throughput standard in the applicable ozone nonattainment counties by requiring all facilities constructed after November 15, 1992 to install Stage II vapor recovery regardless of throughput.

The EPA currently allows the state to revise its SIP to allow the removal of Stage II gasoline vapor recovery equipment if the state can demonstrate that widespread use of on onboard refueling vapor recovery has occurred at the gasoline dispensing facilities (GDF) dedicated to corporate or commercial fleets. Onboard Refueling Vapor Recovery (ORVR) systems are passive systems that force gasoline vapors displaced from a vehicle's fuel tank during refueling to be directed to a carbon-canister holding system and ultimately to the engine where they are consumed.

In the May 16, 2012 issue of the *Federal Register* (FR) (77 FR 28772), the EPA finalized a rulemaking for 40 CFR Part 51 determining that vehicle ORVR technology is in widespread use for the purposes of controlling motor vehicle refueling emissions throughout the motor vehicle fleet. This action allows the EPA to waive the requirement for states to implement Stage II gasoline vapor recovery systems at GDFs in nonattainment areas classified as moderate and above for the ozone NAAQS. States that have implemented a Stage II program may revise their Stage II SIP showing that the air quality will be maintained after removing the Stage II equipment.

According to the EPA's guidance document for decommissioning Stage II, it is necessary for the executive director to demonstrate under the FCAA, §110(l) that air quality is not affected by the decommissioning of, or failure to install, Stage II equipment. An assessment was performed of the amount of benefit loss from removing Stage II and any effect on air quality programs in the four Texas ozone air quality planning areas using the method documented in the EPA's guidance document. It was found that removal of Stage II requirements does not interfere with attainment or maintenance of the NAAQS in the Texas air quality plans.

On October 9, 2013, the commission adopted a revision (Rule Project Number 2013-001-115-AI) to 30 TAC Chapter 115, Subchapter C, Division 4 establishing that owners and operators of GDFs are no longer required to install Stage II equipment and requiring the decommissioning of Stage II equipment at all GDFs no later than August 31, 2018. This adopted rule change requires that GDFs electing to retain Stage II equipment until the mandatory removal date of August 31, 2018 continue to comply with current Stage II rules. A SIP revision authorizing the decommissioning of Stage II vapor control equipment was approved by the EPA on March 17, 2014.

4.3.5 Updates to Stage I Vapor Recovery

The Stage I vapor recovery rules regulate the filling of gasoline storage tanks at gasoline stations by tank trucks. To comply with Stage I requirements, a vapor balance system is typically used to capture the vapors from the gasoline storage tanks that would otherwise be displaced to the atmosphere as these tanks are filled with gasoline. The captured vapors are routed back to the tanker truck and processed by a vapor control system when the tanker truck is subsequently refilled at a gasoline terminal or gasoline bulk plant. The effectiveness of Stage I vapor recovery rules depends on the captured vapors being: effectively contained within the gasoline tanker truck during transit; and controlled when the transport vessel is refilled at a gasoline terminal or gasoline bulk plant.

On September 10, 2014, the commission adopted a revision (Rule Project Number 2013-022-115-AI) to the requirements for Stage I vapor recovery testing in 30 TAC Chapter 115, Subchapter C, Division 2. This rulemaking preserves existing Stage I testing requirements in ozone nonattainment counties and specify Stage I testing requirements for GDFs located in the 12 ozone nonattainment and four ozone maintenance counties that will be affected by the decommissioning of the Stage II vapor recovery equipment rule revision and in the 95 counties that are subject to the state Stage I rule but not Stage II requirements. The Stage I rule revision establishes testing requirements that are more consistent with federal Stage I testing in 40 CFR Part 63, Subpart CCCCCC.

4.4 NEW CONTROL MEASURES

4.4.1 Stationary Sources

4.4.1.1 NO_X RACT Control Measures for Wise County

In addition to the revised control requirements discussed in Section 4.3.1: *Updates to NO_X Control Measures* of this chapter, concurrent with this DFW AD SIP revision, the commission is adopting new rules (Rule Project Number 2013-049-117-AI) to implement RACT for major stationary sources in the ten-county DFW moderate nonattainment area. Additional detail concerning these new control measures can be found in the RACT discussion in Section 4.5.2 of this chapter.

4.5 RACT ANALYSIS

4.5.1 General Discussion

Nonattainment areas classified as moderate and above are required to meet the mandates of the FCAA under §172(c)(1) and §182(b)(2) and (f). According to the EPA's 2008 eight-hour ozone SIP requirements rule (80 FR 12264), states containing areas classified as moderate nonattainment or higher must submit a SIP revision to fulfill the RACT requirements for all control techniques guidelines (CTG) emission source categories and all non-CTG major sources of NO_X and VOC, and this SIP revision must contain adopted RACT regulations, certifications where appropriate that existing provisions are RACT, and/or negative declarations that there are no sources in the nonattainment area covered by a specific CTG source category. The major source threshold for moderate nonattainment areas is a potential to emit 100 tpy or more of either NO_X or VOC. The 100 tpy major source threshold applies in the newly designated Wise County. A 50 tpy major source threshold is retained for the remaining nine counties, which are currently classified as a serious nonattainment area under the 1997 eight-hour ozone NAAQS.

RACT is defined as the lowest emissions limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility (44 FR 53762, September 17, 1979). RACT requirements for moderate and higher classification nonattainment areas are included in the FCAA to assure that significant source categories at major sources of ozone precursor emissions are controlled to a reasonable extent, but not necessarily to best available control technology (BACT) levels expected of new sources or to maximum achievable control technology (MACT) levels required for major sources of hazardous air pollutants.

While RACT and RACM have similar consideration factors like technological and economic feasibility, there is a significant distinction between RACT and RACM. A control measure must advance attainment of the area towards the meeting the NAAQS for that measure to be considered RACM. Advancing attainment of the area is not a factor of consideration when evaluating RACT because the benefit of implementing RACT is presumed under the FCAA.

In 2008, the EPA approved the DFW NO_X rules in 30 TAC Chapter 117 (73 FR 73562). In 2009, the EPA approved the DFW VOC rules in 30 TAC Chapter 115 and NO_X rules for cement kilns in 30 TAC Chapter 117 as meeting the FCAA RACT requirements (74 FR 1903 and 74 FR 1927). In 2014, the EPA approved the 30 TAC Chapter 115 rules for VOC storage tanks as meeting the FCAA RACT requirements (79 FR 53299). State regulations in Chapter 115 that implement the controls recommended in CTG or alternative control techniques (ACT) documents or that implement equivalent or superior emission control strategies were determined to fulfill RACT requirements for any CTG or ACT documents issued prior to 2006 for the nine-county DFW 1997 eight-hour ozone nonattainment area.

The EPA issued 11 CTG documents between 2006 and 2008 with recommendations for VOC controls on a variety of consumer and commercial products. The RACT analysis included in the DFW Attainment Demonstration SIP revision for the 1997 Eight-Hour Ozone Standard adopted on March 10, 2010 addressed the following three CTG documents:

- Flat Wood Paneling Coatings, Group II issued in 2006;
- Offset Lithographic and Letterpress Printing, Group II issued in 2006; and
- Fiberglass Boat Manufacturing Materials, Group IV issued in 2008.

The RACT analysis included in the DFW Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard adopted on December 7, 2011 addressed the remaining eight CTG documents:

- Flexible Packaging Printing Materials, Group II issued in 2006;
- Industrial Cleaning Solvents, Group II issued in 2006;
- Large Appliance Coatings, Group III issued in 2007;
- Metal Furniture Coatings, Group III issued in 2007;
- Paper, Film, and Foil Coatings, Group III issued in 2007;
- Miscellaneous Industrial Adhesives, Group IV issued in 2008;
- Miscellaneous Metal and Plastic Parts Coatings, Group IV issued in 2008; and
- Auto and Light-Duty Truck Assembly Coatings, Group IV issued in 2008.

In 2014, the EPA approved the 30 TAC Chapter 115 rules for offset lithographic printing as meeting the FCAA RACT requirements (79 FR 45105). In 2015, the EPA approved the DFW VOC rules in 30 TAC Chapter 115 addressing the remaining CTGs issued between 2006 and 2008, in addition to approving the DFW RACT analysis as meeting the FCAA RACT requirements for all affected VOC and NO_X sources under the 1997 eight-hour ozone NAAQS (80 FR 16291).

TCEQ rules that are consistent with or more stringent than controls implemented in other nonattainment areas were also determined to fulfill RACT requirements. Federally approved state rules and rule approval dates can be found in 40 CFR §52.2270(c), EPA Approved Regulations in the Texas SIP. Emission sources subject to the more stringent BACT or MACT requirements were determined to also fulfill RACT requirements.

The TCEQ reviewed the emission sources in the DFW nonattainment area and the applicable TCEQ rules to verify that all CTG or ACT emission source categories and non-CTG or non-ACT major emission sources in the DFW nonattainment area were subject to requirements that meet or exceed the applicable RACT requirements, or that further emission controls on the sources were either not economically feasible or not technologically feasible. Additional detail can be found in Appendix F: *RACT Analysis* of this DFW AD SIP revision.

4.5.2 NO_X RACT Determination

The Chapter 117 rules represent one of the most comprehensive NO_X control strategies in the nation. The NO_X controls and reductions implemented through Chapter 117 for the nine-county DFW ozone nonattainment area encompass both RACT and beyond-RACT levels of control for the 1997 eight-hour ozone standard. The current EPA-approved Chapter 117 rules continue to fulfill RACT requirements for the 2008 eight-hour ozone standard for ACT NO_X source categories that exist in the nine counties that were previously designated nonattainment under the 1997 eight-hour ozone NAAQS. Only one new major source in a category not previously addressed by the Chapter 117 rules, a wood-fired boiler, was identified in Kaufman County. The stationary source type categories identified in Wise County are process heaters, stationary

internal combustion gas-fired engines, stationary gas turbines, and one utility electric generation source. The concurrent rulemaking (Rule Project No. 2013-049-117-AI) will address these source categories for Wise County and the wood-fired boiler in Kaufman County. Table F-1: *State Rules Addressing NO_X RACT Requirements in ACT Reference Documents* of Appendix F provides additional details on the ACT source categories.

For non-ACT major NO_X emission sources for which NO_X controls are technologically and economically feasible, RACT is fulfilled by existing source-specific rules in Chapter 117, other federally enforceable measures, and by concurrent revisions to Chapter 117. Additional NO_X controls on certain major sources were determined to be either not economically feasible or not technologically feasible. Tables F-4: *State Rules Addressing NO_X RACT Requirements for Major Emission Sources in the Nine-County DFW Area* and F-5: *State Rules Addressing NO_X RACT Requirements for Major Emission Sources in Wise County* provide additional detail on the non-ACT major emission sources.

4.5.2.1 Wise County Major Sources

The concurrent rulemaking (Rule Project No. 2013-049-117-AI) will satisfy major source RACT requirements for Wise County, which has a major source threshold of 100 tpy. New §117.405(b) in 30 TAC Chapter 117, Subchapter B, Division 4, will include the new emission specifications that will apply to the following unit types at major ICI stationary sources of NO_X located in Wise County: ICI process heaters; stationary, reciprocating internal combustion engines; and stationary gas turbines. Revised Subchapter C, Division 4 will include the emission specifications that will apply to units that are part of utility electric generation sources located in Wise County.

4.5.2.2 Wood-Fired Boilers

The concurrent rulemaking (Rule Project No. 2013-049-117-AI) will satisfy RACT for the one wood-fired boiler located in Kaufman County in the 2012 Point Source Emissions Inventory. New §117.405(a) in 30 TAC Chapter 117, Subchapter B, Division 4, will include a new emission specification for wood fuel-fired boilers in the ten-county DFW 2008 eight-hour ozone nonattainment area.

4.5.3 VOC RACT Determination

In the nine counties that were previously designated nonattainment under the 1997 eight-hour NAAQS, all VOC emission source categories addressed by CTG and ACT documents that exist in the area are controlled by existing rules in Chapter 115 or other EPA-approved regulations that fulfill RACT requirements. The concurrent rulemaking (Rule Project No. 2013-048-115-AI) will address these source categories for Wise County. Tables F-2: *State Rules Addressing VOC RACT Requirements in CTG Reference Documents* and F-3: *State Rules Addressing VOC RACT Requirements in ACT Reference Documents* of Appendix F provide additional details on the CTG and ACT source categories.

The TCEQ previously submitted negative declarations for the following CTG source categories for the nine-county DFW 1997 eight-hour ozone nonattainment area, and is resubmitting these negative declarations as part of this DFW AD SIP revision:

- Fiberglass Boat Manufacturing Materials;
- Manufacture of Pneumatic Rubber Tires;
- Shipbuilding and Ship Repair Surface Coating Operations;
- Flat Wood Paneling Coatings, Group II issued in 2006;

- Letterpress Printing; and
- Vegetable Oil Manufacturing.

For the newly designated Wise County, the TCEQ submits negative declarations for the following CTG source categories:

- Fiberglass Boat Manufacturing Materials;
- Graphic Arts – Rotogravure and Flexography;
- Flexible Package Printing;
- Refinery Vacuum Producing Systems and Process Unit Turnarounds;
- Manufacture of Pneumatic Rubber Tires;
- Shipbuilding and Ship Repair Surface Coating Operations;
- Flat Wood Paneling Coatings, Group II issued in 2006;
- Letterpress Printing;
- Wood Furniture Manufacturing;
- Manufacture of Synthesized Pharmaceutical Products; and
- Vegetable Oil Manufacturing.

For all non-CTG and non-ACT major VOC emission sources for which VOC controls are technologically and economically feasible, RACT is fulfilled by existing Chapter 115 rules, other federally enforceable measures, and by concurrent revisions to Chapter 115. Additional VOC controls on certain major sources were determined to be either not economically feasible or not technologically feasible. Tables F-6: *State Rules Addressing VOC RACT Requirements for Major Emission Sources in the Nine-County DFW Area* and F-7: *State Rules Addressing VOC RACT Requirements for Major Emission Sources in Wise County* of Appendix F provide additional detail on the non-CTG and non-ACT major emission sources.

4.5.3.1 Wise County CTG and non-CTG Major Source RACT

The concurrent rulemaking (Rule Project No. 2013-048-115-AI) will satisfy RACT requirements for Wise County, which has a major source threshold of 100 tpy. The following divisions of Chapter 115 will be revised to make the existing DFW VOC RACT rules applicable in Wise County:

- Subchapter B, Division 1, Storage of VOC;
- Subchapter B, Division 2, Vent Gas Control;
- Subchapter B, Division 3, Water Separation;
- Subchapter C, Division 1, Loading and Unloading of VOC;
- Subchapter C, Division 2, Filling of Gasoline Storage Vessels (Stage I) for Motor Vehicle Fuel Dispensing Facilities;
- Subchapter C, Division 3, Control of VOC Leaks from Transport Vessels;
- Subchapter D, Division 3, Fugitive Emission Control in Petroleum Refining, Natural Gas/Gasoline Processing, and Petrochemical Processes in Ozone Nonattainment Areas;
- Subchapter E, Division 1, Degreasing Processes;
- Subchapter E, Division 2, Surface Coating Processes;
- Subchapter E, Division 4, Offset Lithographic Printing;
- Subchapter E, Division 5, Control Requirements for Surface Coating Processes;
- Subchapter E, Division 6, Industrial Cleaning Solvents;
- Subchapter E, Division 7, Miscellaneous Industrial Adhesives; and
- Subchapter F, Division 1, Cutback Asphalt.

4.6 RACM ANALYSIS

4.6.1 General Discussion

FCAA, §172(c)(1) requires states to provide for implementation of all RACM as expeditiously as practicable and to include RACM analyses in the SIP. In the general preamble for implementation of the FCAA Amendments published in the April 16, 1992 issue of the *Federal Register* (57 FR 13498), the EPA explains that it interprets FCAA, §172(c)(1) as a requirement that states incorporate into their SIP all RACM that would advance a region's attainment date; however, states are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances.

The TCEQ used a two-step process to develop the list of potential control strategies evaluated during the RACM analysis. First, the TCEQ compiled a list of potential control strategy concepts based on an initial evaluation of the existing control strategies in the DFW nonattainment area and existing sources of VOC and NO_X in the DFW nonattainment area. The EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment; however, consideration of these sources is not a requirement of the FCAA. A draft list of potential control strategy concepts was developed from this initial evaluation. The TCEQ also invited stakeholders to suggest any additional strategies that might help advance attainment of the DFW nonattainment area. The final list of potential control strategy concepts for RACM analysis includes the strategies on the initial draft list and the strategies suggested by stakeholders during the informal stakeholder comment process.

Each control measure identified through the control strategy development process was evaluated to determine if the measure would meet established criteria to be considered reasonably available. The TCEQ used the general criteria specified by the EPA in the proposed approval of the New Jersey RACM analysis published in the January 16, 2009 issue of the *Federal Register* (74 FR 2945):

> *RACM is defined by the EPA as any potential control measure for application to point, area, on-road and non-road emission source categories that meets the following criteria:*

- *The control measure is technologically feasible*
- *The control measure is economically feasible*
- *The control measure does not cause "substantial widespread and long-term adverse impacts"*
- *The control measure is not "absurd, unenforceable, or impracticable"*
- *The control measure can advance the attainment date by at least one year.*

The EPA did not provide guidance in the *Federal Register* notice on how to interpret the criteria "advance the attainment date by at least one year." Considering the originally applicable December 31, 2018 attainment date for this DFW AD SIP revision, the TCEQ evaluated this aspect of RACM based on advancing the deadline for implementing control measures by one year, to December 31, 2017. As a result of the December 23, 2014 court decision that vacated the December 31, 2018 attainment date, the commission must reevaluate RACM based on the new attainment deadline of July 20, 2018, since the new attainment year is now 2017. Due to the timing of the court's ruling and the EPA's subsequent rulemaking action, it was not possible to complete a thorough review for all measures during the short time available after proposal of this DFW AD SIP revision. However, the RACM analysis based on a December 31, 2018 attainment deadline is still relevant and is being submitted to support the future RACM analysis based on a 2017 attainment year.

In order for a control measure to "advance attainment," it would need to be implemented prior to the beginning of ozone season in the attainment year, so suggested control measures that could not be implemented by March 1, 2018 could not be considered RACM because the measures would not advance attainment. To "advance the attainment date by at least one year" to December 31, 2017, suggested control measures would have to be fully implemented by March 1, 2017. In order to provide a reasonable amount of time to fully implement a control measure, the following must be considered: availability and acquisition of materials; the permitting process; installation time; and the availability of and time needed for testing.

The TCEQ also considered whether the control measure was similar or identical to control measures already in place in the DFW nonattainment area. If the suggested control measure would not provide substantive and quantifiable benefit over the existing control measure, then the suggested control measure was not considered RACM because reasonable controls were already in place. Tables G-1: *DFW Area Stationary Source RACM Analysis* and G-2: *DFW Area On-Road and Non-Road Mobile Source RACM Analysis* of Appendix G: *RACM Analysis* presents the final list of potential control measures as well as the RACM determination for each measure.

4.6.2 Results of the RACM Analysis

Based on the RACM analysis, the TCEQ determined that no potential control measures met the criteria to be considered RACM. All potential control measures evaluated for stationary sources were determined to not be RACM due to technological or economic feasibility, enforceability, adverse impacts, or ability of the measure to advance attainment of the NAAQS. In general, the inability to advance attainment is the primary determining factor in the RACM analyses. As discussed in Chapter 3: *Photochemical Modeling* and Chapter 5 of this DFW AD SIP revision, the current modeling results indicate that the DFW area will demonstrate attainment. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 parts per billion (ppb). Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the weight of evidence analysis included in Chapter 5 of this SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Based on a December 31, 2018 attainment deadline, a control measure would have to be in place by March 1, 2018 (prior to the beginning of ozone season in the attainment year) to be considered RACM. Furthermore, a control measure would have to be in place by March 1, 2017 in order for the measure to advance the attainment date by one year; and it is not possible for the TCEQ to reasonably implement any control measures that would provide for earlier attainment of the NAAQS. Negative RACM determinations for potential control measures that were based on technological or economic feasibility, enforceability, or adverse impacts remain relevant, regardless of attainment year. When the commission reevaluates RACM based on the new attainment year of 2017, the ability of the measures to advance attainment of the NAAQS will be reconsidered.

4.7 MVEB

The MVEB refers to the maximum allowable emissions from on-road mobile sources for each applicable criteria pollutant or precursor as defined in the SIP. The budget must be used in transportation conformity analyses. Areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. The attainment budget represents the on-road mobile source emissions that have been modeled for the AD, and includes all of the on-road control measures reflected in Chapter 4: *Control Strategies and Required Elements* of the demonstration. The narrative in this chapter, however, reflects the EPA's original proposed attainment date of December 31, 2018. These numbers are included to maintain consistency with the proposed version of the DFW AD SIP revision; to serve as a

reference for the contingency demonstration, and MVEB for the 2017 attainment year as provided in Chapter 4; and to provide an alternative submittal in the event that the 2018 attainment year requirement is reinstated.

The on-road emission inventory establishing this MVEB was developed with the 2014 version of the Motor Vehicle Emission Simulator (MOVES2014) model, and is shown in Table 4-2: *2018 Attainment Demonstration MVEB for the 10-County DFW Area*. For additional detail, refer to Chapter 3 of Appendix B*: Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard.*

Table 4-2: 2018 Attainment Demonstration MVEB for the 10-County DFW Area

10-County DFW Area On-Road Emissions Inventory Description	NO_X tons per day (tpd)	VOC (tpd)
2018 On-Road MVEB Based on MOVES2014	119.69	62.20

4.8 MONITORING NETWORK

The TCEQ operates a variety of monitors in support of assessing ambient air quality throughout the state of Texas. These monitors meet the requirements for several federally required networks including the State and Local Air Monitoring Stations network (SLAMS), Photochemical Assessment Monitoring Stations network, Chemical Speciation Network, National Air Toxics Trends Stations network, and National Core network (NCore).

The Texas annual monitoring network plan provides information on ambient air monitors established to meet federal ambient monitoring requirements including comparison to the NAAQS. The plan presents the current Texas network, as well as proposed changes to the network from July 1, 2013, through December 31, 2015. Under 40 CFR §58.10, all states are required to submit an annual monitoring network plan to the EPA by July 1 of each year. The annual monitoring network plan is made available for public inspection for at least 30 days prior to submission to the EPA. The plan and any comments received during the 30 day inspection period are forwarded to the EPA for final review and approval.

The current DFW area monitoring network in 2014 includes 20 regulatory ozone monitors. There are 17 ozone monitors located in Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties and an additional three ozone monitors in Navarro, Hood, and Hunt Counties. The TCEQ ensures compliance with monitoring siting criteria and data quality requirements for these and all other federally required monitors in accordance with 40 CFR Part 58. The TCEQ utilizes this data to support determinations regarding air quality in the DFW nonattainment area.

4.9 CONTINGENCY PLAN

AD SIP revisions for nonattainment areas are required by FCAA, §172(c)(9) to provide for specific measures to be implemented should a nonattainment area fail to meet reasonable further progress (RFP) requirements or attain the applicable NAAQS by the EPA's prescribed attainment date. If these conditions are not met, these contingency measures are to be implemented without further action by the state or the EPA. In the General Preamble for implementation of the FCAA Amendments of 1990 published in the April 16, 1992 issue of the *Federal Register* (57 FR 13498), the EPA interprets the contingency requirement to mean additional emissions reductions that are sufficient to equal up to 3% of the emissions in the adjusted base year (ABY) inventory. These emissions reductions should be realized in the year

following the year in which the failure is identified (i.e., an RFP milestone year or attainment year).

The narrative in this chapter, however, reflects the EPA's original proposed attainment date of December 31, 2018. These numbers are included to maintain consistency with the proposed version of the DFW AD SIP revision; to serve as a reference for the contingency demonstration, and MVEB for the 2017 attainment year as provided in Chapter 4; and to provide an alternative submittal in the event that the 2018 attainment year requirement is reinstated.

This 2008 eight-hour ozone DFW AD SIP revision uses the ABY inventory as the inventory from which to calculate the required 3% reduction for contingency. The 3% contingency analysis for 2019 is based on a 3% reduction in NO_X, with no emissions reductions coming from VOC, to be achieved between 2018 and 2019. Emissions inventories analyses were performed on the fleet turnover effects for the federal emissions certification programs for on-road and non-road vehicles. The emissions reductions from 2018 through 2019 were estimated for those programs. A summary of the 2019 contingency analysis is provided in Table 4-3*: 2019 DFW Attainment Contingency Demonstration (tons per day)*. The analysis demonstrates that the 2019 contingency reductions exceed the 3% reduction requirement; therefore, the AD contingency requirement is fulfilled for the DFW nonattainment area.

The on-road mobile source category emissions inventories and control reductions, which are components of the contingency demonstration calculations for this DFW AD SIP revision, were developed using the MOVES2014 model. The EPA released the, MOVES2014, on October 7, 2014. The schedule for the inventory development for the proposal version of this DFW AD SIP revision did not allow time to incorporate MOVES2014. The TCEQ, working with the NCTCOG, recently completed development of 2011, 2017, 2018, and 2019 on-road emission inventories using MOVES2014 for the DFW nonattainment area, which replaced the on-road components of the contingency calculations referenced in this section. The planning assumptions, fleet characteristics, and vehicle miles traveled estimates were updated to incorporate the latest available information at the time the inventories were developed. As a result of the update from MOVES2010b to MOVES2014,the attainment year-AD contingency demonstrations are different than those reported in the proposal version of this DFW AD SIP revision.

Table 4-3: 2019 DFW Attainment Contingency Demonstration (tons per day)

Contingency Element Description	NO_X	VOC
2018 10 DFW nonattainment counties, ABY emissions inventory (EI)	445.35	484.16
Percent for contingency calculation (total of 3%)	3.00	0.00
2018 to 2019 AD required contingency reductions (ABY EI x contingency percent)	**13.36**	**0.00**
Excess reductions from 2018 AD	0.00	0.00
Subtract reductions reserved for 2018 AD MVEB safety margin	0.00	0.00
Federal Motor Vehicle Control Program (FMVCP), I/M, reformulated gasoline (RFG), East Texas Regional Low Reid Vapor Pressure Gasoline Program, 2017 Low Sulfur Gasoline Standard and TxLED	29.96	11.99

Contingency Element Description	NO_X	VOC
Federal non-road mobile new vehicle certification standards, non-road RFG, and non-road TxLED	5.13	2.86
Total AD contingency reductions	**35.09**	**14.85**
Contingency Excess (+) or Shortfall (-)	**+21.73**	**+14.85**

4.9.1 Attainment Demonstration Contingency for 2017 Attainment Year

On December 23, 2014, the United States Court of Appeals for the District of Columbia (D.C.) Circuit ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31, 2018 attainment date for the 2008 0zone NAAQS. In response, the EPA promulgated the 2008 ozone standard SIP requirements rule, published in the *Federal Register* on March 6, 2015 (80 FR 12264) based on the D.C. Circuit Court's ruling. Therefore, the attainment date for the DFW nonattainment area has changed from December 31, 2018 to July 20, 2018. Since the attainment date changed after proposal of this DFW AD SIP revision, an AD contingency demonstration for analysis year 2018 is provided.

The 2018 AD contingency assessment uses the attainment year (2017) ABY inventory as the inventory to calculate the required 3% reduction for contingency. The 3% contingency analysis for 2018 is based on a 3% reduction in NO_X to be achieved between 2017 and 2018; no VOC emissions reductions are included in the contingency analysis. Emissions inventories analyses were performed on the fleet turnover effects for the federal emissions certification programs for on-road and non-road vehicles. The emissions reductions from these programs were estimated for 2017 through 2018. A summary of the 2018 contingency analysis is provided in Table 4-4: *2018 DFW Attainment Contingency Demonstration for 2017 Attainment Year (tons per day)*. The analysis demonstrates that the 2018 contingency reductions exceed the 3% reduction requirement; therefore, if the attainment year is 2017, the AD contingency requirement is fulfilled for the DFW nonattainment area.

Table 4-4: 2018 DFW Attainment Contingency Demonstration for 2017 Attainment Year (tons per day)

Contingency Element Description	NO_X	VOC
2017 10 DFW nonattainment counties, ABY EI	445.93	484.39
Percent for contingency calculation (total of 3%)	3.00	0.00
2017 to 2018 AD required contingency reductions (ABY EI x contingency percent)	**13.38**	**0.00**
Excess reductions from 2017 AD	0.00	0.00
Subtract reductions reserved for 2017 AD MVEB safety margin	0.00	0.00
Federal Motor Vehicle Control Program (FMVCP), I/M, reformulated gasoline (RFG), East Texas Regional Low Reid Vapor Pressure Gasoline Program and TxLED	35.68	13.86

Contingency Element Description	NO_X	VOC
Federal non-road mobile new vehicle certification standards, non-road RFG, and non-road TxLED	6.06	3.50
Total AD contingency reductions	**41.21**	**17.47**
Contingency Excess (+) or Shortfall (-)	**+27.83**	**+17.47**

4.10 REFERENCES

EPA, 1993. NO_X Substitution Guidance (http://www.epa.gov/ttncaaa1/t1/memoranda/noxsubst.pdf)

EPA, 2005. Clean-Fuel Vehicle Standards, no. CCD-05-1

CHAPTER 5: WEIGHT OF EVIDENCE

5.1 INTRODUCTION

The corroborative analyses presented in this chapter demonstrate the progress that the Dallas-Fort Worth (DFW) nonattainment area is making towards attainment of the 2008 eight-hour ozone National Ambient Air Quality Standard (NAAQS) of 75 parts per billion (ppb). This corroborative information supplements the photochemical modeling analysis presented in Chapter 3: *Photochemical Modeling* to support a conclusion that the DFW nonattainment area will reach attainment of the 2008 eight-hour ozone standard by December 31, 2018, and possibly earlier, which would meet the newly effective 2017 attainment year. The United States Environmental Protection Agency's (EPA) *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* (EPA, 2007) states that all modeled attainment demonstrations (AD) should include supplemental evidence that the conclusions derived from the basic attainment modeling are supported by other independent sources of information. This chapter details the supplemental evidence, i.e., the corroborative analyses, for this AD.

This chapter describes analyses that corroborate the conclusions of Chapter 3. First, information regarding trends in ambient concentrations of ozone, ozone precursors, and reported emissions in the DFW nonattainment area is presented. Analyses of ambient data and reported emissions trends corroborate the modeling analyses and independently support the AD. An overview is provided of background ozone levels transported into the DFW nonattainment area. More detail on these ozone and emission trends is provided in Appendix D: *Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard*. Second, this chapter also discusses the results of additional air quality studies and their relevance to the DFW AD. Third, this chapter describes air quality control measures that are not quantified but are nonetheless expected to yield tangible air quality benefits, even though they were not included in the AD modeling discussed in Chapter 3. Finally, information is provided to inform the public regarding on-going initiatives that are expected to improve the scientific understanding of ozone formation in the DFW nonattainment area.

5.2 ANALYSIS OF AMBIENT TRENDS AND EMISSION TRENDS

When development work on this DFW AD SIP revision commenced in 2012, the EPA's April 2007 *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2007) was the latest modeling guidance available. The EPA released an update to this guidance in December 2014 entitled *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA, 2014). The April 2007 document will be referred to as the "former guidance" and the December 2014 one will be referred to as the "draft guidance." Section 7.0: *How Can Additional Analyses Be Used to Support the Attainment Demonstration?* of the former EPA modeling guidance from 2007 states that a simple way to qualitatively assess progress toward attainment is to examine recently observed air quality and emissions trends. Downward trends in observed air quality and in emissions (past and projected) are consistent with progress toward attainment. The strength of evidence produced by emissions and air quality trends is increased if an extensive monitoring network exists, which is the case in an area like DFW that currently has 20 operational monitors for ozone, 15 for nitrogen oxides (NO_X), and 15 automated gas chromatographs (Auto-GC) for volatile organic compounds (VOC). More detail on these specific locations and pollutants measured per monitor can be found on the Texas Commission on Environmental Quality (TCEQ) Air Monitoring Sites Web page. This section examines the emissions and ambient trends from the extensive ozone and ozone precursor monitoring network in the DFW area. Despite a continuous increase in the population

of the 10-county DFW nonattainment area, a strong economic development pattern, and other factors that includes, but is not limited to, growth in vehicle miles traveled (VMT), the observed emission trends are downward for ozone and its precursors of NO_X and VOC. More details regarding ambient and emissions trends are included in Appendix D.

Appendix D provides an extensive set of graphics that detail ozone trends in the region from 1991 through 2013. The graphics and analyses also illustrate the wealth of monitoring data examined including regulatory ozone monitors and a network of Auto-GCs. The one-hour and the eight-hour ozone design values both have overall sustained decreasing trends over the past 18 years. The DFW area has monitored attainment of the revoked one-hour ozone standard since 2006. At the end of the 2014 ozone season, the eight-hour design value is 81 ppb, which is in attainment of the 1997 eight-hour ozone standard of 84 ppb. No monitor in the region had measured a fourth high in 2014 above the 1997 standard of 84 ppb, and only two had fourth highs in 2014 above the 2008 ozone standard of 75 ppb. These 2014 fourth high values of 77 ppb and 79 ppb were measured at the Denton Airport South and Fort Worth Northwest monitors, respectively.

An analysis conducted by the TCEQ (https://www.tceq.texas.gov/assets/public/implementation/air/am/committees/pmt_dfw/20131105/20131105-DFW-Ozone-75ppb-Kite.pdf) and presented at a DFW area air quality technical meeting in November 2013 graphically shows changes in design value by monitor over the period 2003 through 2013 with the largest reduction of design values at the northwestern area monitors that historically have recorded the highest ozone levels. For example, the Keller monitor design value dropped 15 ppb in that period and Grapevine Fairway dropped 14 ppb. Additional analyses tracked the historic fourth highest eight-hour ozone levels at five northwest DFW monitors from 2001 to 2013. When 2012 and 2013 are examined, there is a strong suggestion that the 2011 fourth highest levels monitored may be outliers in the downward trend. These 2011 fourth-high values are included in the DFW nonattainment area design value calculations from 2011 through 2013, but are not part of the 2014 design value determination. The ozone measurements through 2014 combined with the overall historic ozone trends at all DFW area monitors suggest that the region will reach attainment of the 2008 standard by December 31, 2018.

As documented in Chapter 2: *Anthropogenic Emissions Inventory Description* of this DFW AD SIP revision, emissions trends examined through reported and developed inventories support the downward trends in ozone and ozone precursors observed through the measurements of pollutant concentrations at monitors. While NO_X emissions are more significant in the formation of ozone in the DFW nonattainment area, VOC trends are examined as well. On-road mobile sources are the single largest contributors to NO_X emissions in the DFW nonattainment area. According to the TCEQ emissions inventory (EI) estimates for 2011, on-road mobile represents 54% of the total NO_X for the DFW nonattainment area, non-road and off-road mobile accounts for 26.3%, area sources account for 10.3%, and point sources account for 9.1%. The downward trend in total NO_X emissions is in large part due to the downward trends in NO_X emissions from on-road mobile sources, which the TCEQ has limited ability to control. Even though human population and VMT in the DFW nonattainment area have both increased roughly 38% from 1999 to 2014, NO_X emission trends from on-road mobile sources as well as total NO_X emissions have decreased since 1999, due largely due to targeted emissions reductions strategies implemented by state rules, federal measures, and local initiatives. Mobile strategies are listed with all existing DFW emission reduction strategies in Table 4.1: *Existing Ozone Control Measures Applicable to the DFW Nine-County Nonattainment Area* of this DFW AD SIP revision. NO_X emissions from point sources, over which the TCEQ does have more direct

regulatory control compared with mobile sources, have shown decreases of 62% over the past 16 years. Ambient NO_X monitoring data corroborate these trends in reported emissions, with decreases in ambient NO_X monitoring concentrations observed in the DFW nonattainment area over the past 17 years.

Since the mid-1990s, the TCEQ has collected 40-minute measurements on an hourly basis of up to 58 VOC compounds using Auto-GC instruments. These instruments automatically measure and report chemical compounds resident in ambient air. The TCEQ has also employed two types of ambient monitoring canisters in the DFW nonattainment area, one that samples ambient air over a 24-hour period and another that samples ambient air for a single hour at a time, usually at four different times of day. Since 1999, peak VOC concentrations above the 90th percentile have generally trended downward. During the same time period, mean VOC concentrations trended downward until roughly 2005 and have been relatively constant since 2006. On-road VOC emission trends discussed later in this chapter show a more distinct downward trend for 1999-2005 than for 2006-and-later years. Ozone formation in DFW is much more sensitive to anthropogenic NO_X than to anthropogenic VOC. This is due to the primarily NO_X-limited character of ozone formation in DFW, coupled with an abundance of naturally occurring reactive VOC from biogenic sources, such as isoprene emitted by oak trees. Much of the anthropogenic VOC emitted in the DFW nonattainment area is in the form of compounds with relatively low reactivity such as ethane and propane. Appendix D provides more detail on these VOC trend analyses and their impacts on ozone formation in DFW.

The Anthropogenic Precursor Culpability Assessment and Ozone Source Apportionment Technology (OSAT) analyses detailed in Chapter 3 and Appendix C: *Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard* indicate that emission sources outside of the 10-county DFW nonattainment area also contribute to the eight-hour ozone concentrations within the 10-county DFW nonattainment area. On average, the ozone produced outside of the DFW nonattainment area, in addition to the natural background ozone, accounts for a large portion of the maximum ozone concentrations within the DFW nonattainment area. Analyses (Berlin et al., 2013; Cooper et al., 2012) suggest that background ozone is trending downward across the United States (U.S.), which can reduce peak ozone in the DFW nonattainment area. The EPA Air Quality Trends Web page highlights the significant percent changes in NO_X reductions between 2000 and 2012. Some of these NO_X reductions can be attributed to strategies implemented in Texas. For example, electric generating units (EGU) in the counties east of the DFW nonattainment area, which is the area that is predominately upwind on high ozone days, have reduced emissions of NO_X by about 58% over the past 16 years.

As part of the examination of emissions trends, it is also important to examine the variability of NO_X concentrations by the day of the week. As discussed in Chapter 3, NO_X concentrations are lower on Saturdays and Sundays compared to weekdays. The lower concentrations of ozone precursors on weekends are likely due to the absence of morning commuter traffic during that time. This finding further supports the conclusion that lowering NO_X reduces ozone since NO_X is the primary precursor in ozone formation when naturally occurring reactive VOC from biogenic sources is abundant.

The VOC or NO_X limitation of an air mass is an important way to evaluate how immediate reductions in VOC and NO_X concentrations affect ozone concentrations. A detailed analysis of the DFW nonattainment area's NO_X or VOC limitation is included in Appendix D. Ozone responds best to VOC reductions in VOC-limited areas and to NO_X reductions in NO_X-limited areas. In transitional areas, both VOC and NO_X reductions should be effective. Analysis of VOC to NO_X ratios indicates that the urban core of the DFW nonattainment area is transitional and

trending towards NO_X-limitation, while the more rural parts of the DFW nonattainment area are NO_X-limited and are trending towards more strongly NO_X-limited. Because the DFW nonattainment area overall is trending towards NO_X-limited and the northwest locations of the design value setting monitors are NO_X-limited, this result also supports reducing NO_X as a method to control ozone overall in the DFW nonattainment area.

It is more difficult to control ozone in the urban core because the emissions in that area, which is transitional and not strongly NO_X-limited, are primarily from on-road mobile sources, for which the TCEQ has limited authority to regulate. However, both state and federal regulation have resulted in estimated downward trends in NO_X emission and VOC emissions since 1999 from on-road and non-road mobile emission inventories. These reductions have contributed to the downward trend in ozone levels monitored within the urban core during the same 15 year period. More detail regarding emissions trends can be found in Chapter 3 as well as in Section 5.2.2.1: *NO_X Emission Trends* of this chapter. The ambient ozone and emissions trends briefly discussed above lead to the following conclusions:

- Emissions of NO_X, VOC, and their monitored ambient concentrations have been decreasing across the DFW nonattainment area, despite a rapidly expanding population and strong continued economic development over a sustained period as documented by the Federal Reserve Bank of Dallas Economic Indicators (http://www.dallasfed.org/research/update/dfw/index.cfm).
- Observed NO_X concentrations and reported NO_X emissions are both trending downward, which suggests lower ozone concentrations should follow in an area that is primarily NO_X-limited.
- The decrease in NO_X emissions is largely due to reductions of on-road and non-road mobile sources, which are the largest source of NO_X in the DFW nonattainment area. The reductions can be attributed to an increasingly modern and cleaner motor vehicle fleet, as well as implementation of on-road control programs such as inspection and maintenance and Texas Low Emission Diesel. In addition, controls on point sources both in the DFW nonattainment area and statewide have contributed to these NO_X reductions.
- Modeled emissions from on-road and non-road mobile sources as well as trend analyses indicate that NO_X concentrations will continue trending downward out to the attainment year of 2018 and beyond.
- The one-hour ozone design value has decreased over the past few years to 108 ppb. The eight-hour ozone design value decreased from 100 ppb in 2003 to 81 ppb in 2014.
- Given the currently implemented control programs, total DFW nonattainment area NO_X in 2018 is expected to be reduced by roughly 51% from 2006 levels, with projected NO_X reductions of 58% for on-road sources and 57% for non-road sources. More detail is contained in Chapter 3 on these expected reductions from 2006 to 2018.

Accordingly, the strong and lasting historic downward trends in observed air quality and in emissions (past and projected) are consistent with progress toward attainment and are positive evidence supporting the results of the photochemical modeling documented in Chapter 3, indicating that the DFW nonattainment area will attain the 2008 ozone NAAQS in 2018, and possibly earlier.

5.2.1 Ozone Design Value and Background Ozone Trends

As noted above, eight-hour ozone design values have decreased over the past 18 years, as shown in Figure 5-1: *One-Hour and Eight-Hour Ozone Design Values in the DFW Area from 1997 through 2014*. The 2014 one-hour ozone design value is 102 ppb, which demonstrates continued attainment of the revoked one-hour ozone NAAQS, at levels substantially below the one-hour

ozone standard. The 2014 eight-hour ozone design value for the DFW nonattainment area is 81 ppb and occurred at Denton Airport South, which is in attainment of the former 84 ppb standard and demonstrates progress toward the current 75 ppb standard. This monitor is located to the north-northwest of the DFW nonattainment area, which is downwind of the urban core considering prevailing winds.

The trend line for the one-hour ozone design value shows a decrease of about 2.1 ppb per year, but the trend line for the eight-hour ozone design value only shows a decrease of about 1.1 ppb per year. The one-hour ozone design values decreased about 27% from 1991 through 2014 and the eight-hour ozone design values decreased about 23% over that same time. The slower change in the eight-hour ozone design values compared to the one-hour ozone design values could relate to the background ozone, which appears to affect the eight-hour ozone much more than the one-hour ozone.

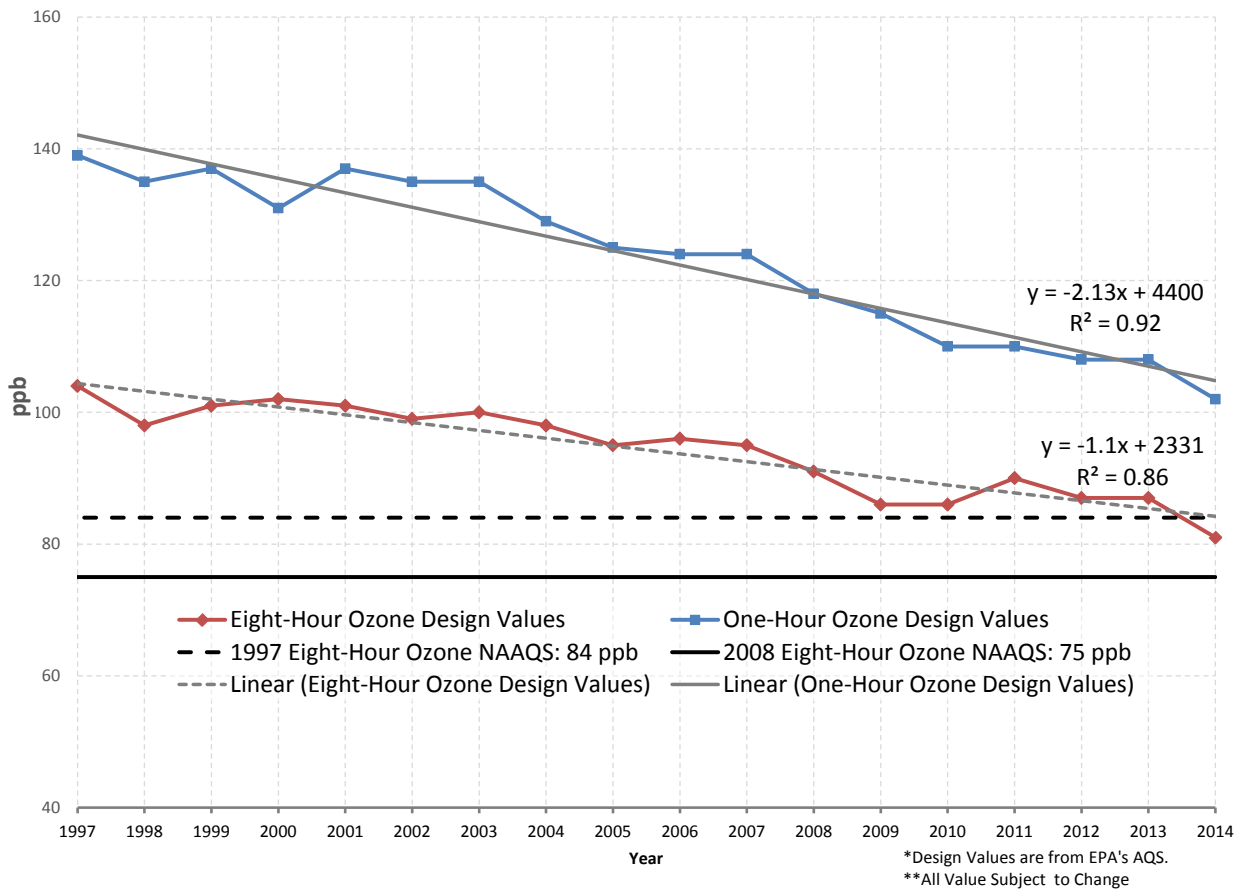

Figure 5-1: One-Hour and Eight-Hour Ozone Design Values in the DFW Area from 1997 through 2014

A background ozone trend analysis was conducted to define background ozone and the ozone concentration carried into the DFW nonattainment area. Background ozone reflects the ozone produced from all sources outside of the 10-county DFW nonattainment area. Continental and natural background ozone concentrations are generally assumed to be about 40 ppb. Ozone levels in the DFW nonattainment area are the sum of the background ozone entering the area and the locally produced ozone. The local ozone contribution is found by subtracting the background ozone concentration from the maximum ozone concentration.

To obtain the background ozone concentrations, monitors outside of the urban core were identified. The analysis used the months of May through September, the peak of ozone season, for years 1998 through 2003. Out of this subset of background ozone monitors, the minimum ozone concentration was identified during the time that the maximum ozone concentration was measured. This minimum eight-hour ozone concentration is considered the background ozone for the DFW nonattainment area (Nielson-Gammon et al., 2004). Figure 5-2: *Eight-Hour Ozone in the DFW area from 1998 through 2003 (Nielson-Gammon et al., 2004)* shows that in the DFW nonattainment area, the average background ozone contribution is a larger part of the maximum eight-hour ozone than the local ozone contribution. The inter-seasonal variability in the peak ozone concentrations seems to come from the seasonal variability in the background ozone concentrations as opposed to the local ozone contributions (Nielson-Gammon et al., 2004). Because background ozone contributes a large portion of the total eight-hour ozone in the DFW nonattainment area, it would be difficult to see large decreases in the eight-hour ozone concentration if the background ozone does not also decrease.

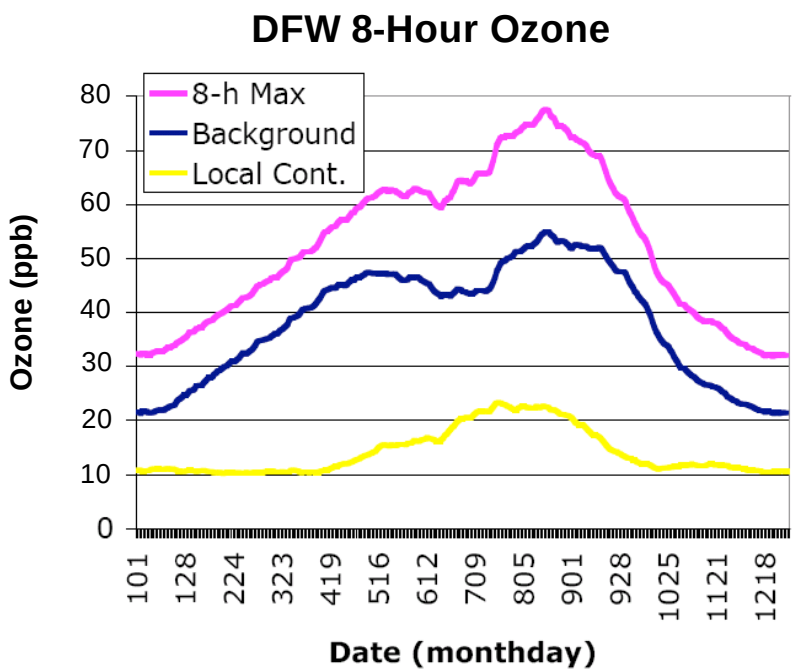

Figure 5-2: Eight-Hour Ozone in the DFW area from 1998 through 2003 (Nielson-Gammon et al., 2004)

Using a similar method, a background eight-hour ozone analysis was conducted for the 1997 through 2013 period to determine the background trend. Results from this analysis are shown in Figure 5-3: *DFW Background Ozone for 1997 through 2013*. The findings show that there is a slight downward trend in the background ozone. The percent change in average background ozone from the 1997 to 2013 ozone seasons is 4.51%, and the percent change in the 95th percentile average ozone concentrations is 5.67% over that same time. The current estimated average background ozone in the DFW nonattainment area is 52 ppb, but can vary greatly depending on the day of interest. Evidence of background eight-hour ozone in the DFW nonattainment area is another positive factor indicating support for the photochemical modeling results documented in Chapter 3.

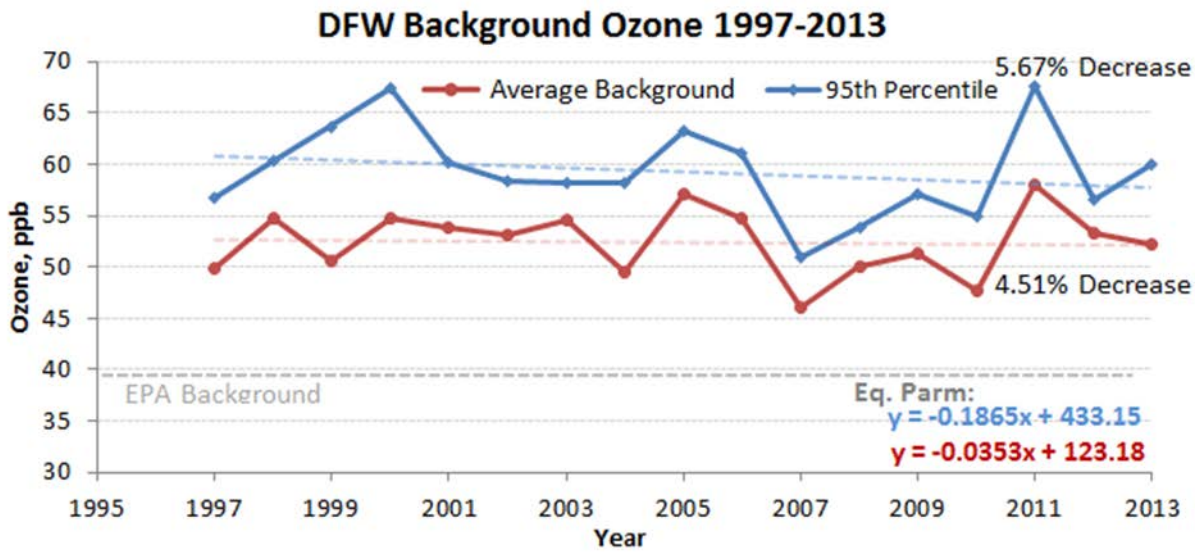

Figure 5-3: DFW Background Ozone for 1997 through 2013

5.2.2 NO_X Trends

NO_X, a precursor to ozone formation, is a mixture of nitrogen oxide and nitrogen dioxide (NO_2). NO_X is primarily emitted by fossil fuel combustion, lightning, biomass burning, and soil (Martin, et al., 2006). Examples of common NO_X emission sources in urban areas are automobiles, diesel engines, other small engines, residential water heaters, industrial heaters, flares, and industrial and commercial boilers. Mobile, residential, and commercial NO_X sources are usually numerous smaller sources distributed over a large geographic area, while industrial sources are usually large point sources, or numerous small sources, clustered in a small geographic area. Because of the large number of NO_X sources, elevated ambient NO_X concentrations can occur throughout the DFW nonattainment area. This section will discuss trends in both NO_X emissions and ambient NO_X concentrations. The overall downward trends in both NO_X emissions and ambient NO_X concentrations in the DFW nonattainment area are another positive factor indicating support for the photochemical modeling results documented in Chapter 3.

5.2.2.1 NO_X Emission Trends

DFW nonattainment area anthropogenic emissions are from the following four aggregate categories: point sources, on-road mobile sources, non-road mobile sources, and area sources. Specific industry types can be categorized under one or more of these aggregate groups. The data used in this trend analysis come from several sources. Companies in the DFW nonattainment area report annual point source EI data. The Texas Transportation Institute (TTI) prepared the on-road mobile source emission inventories for the TCEQ. The TCEQ prepared the area and the non-road mobile source data for 2006 and 2018 using EPA-approved models and techniques.

The annually reported point source NO_X emissions from 1997 through 2012 are shown in Figure 5-4: *Reported Point Source NO_X Emissions for the 10-County DFW Area*. The emissions are reported in tons per year (tpy) and are aggregated by year. The aggregation is of all NO_X sources located within the 10 counties of the DFW nonattainment area. The graph shows an overall downward trend in NO_X emissions and the pattern closely matches that of the observed NO_X concentrations at the DFW nonattainment area monitors, which will be shown later in this document.

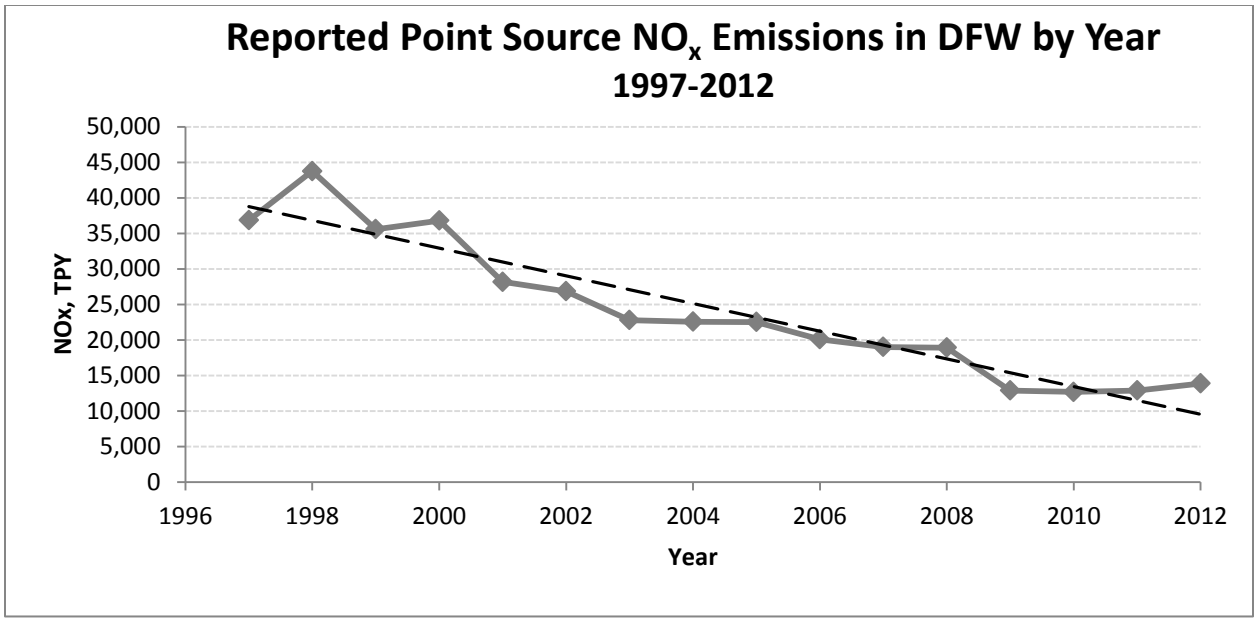

Figure 5-4: Reported Point Source NO_X Emissions for the 10-County DFW Area

Historically, much of the point source NO_X emission reductions have come from cement kilns located within Ellis County. In 2007, a source cap for cement kilns in Ellis County was adopted (30 Texas Administrative Code §117.3123). In 2008, 2010, and 2011, further reductions were achieved with changes in cement kiln operations and shutdown of certain processes and kilns. In large part, the downward trends in reported emissions are attributable to the reductions and facility shutdowns in Ellis County.

The decrease in point source NO_X emissions from 1997 through 2012 is seen more clearly in Figure 5-5: *Reported Point Source NO_X Emissions by DFW County*. Ellis County reports the greatest amounts of point source NO_X emissions as well as the greatest reductions in point source NO_X emissions. A large portion of these reductions took place from 2006 to 2009. Other large reductions in point source NO_X emissions can be seen in Dallas and Tarrant Counties due to the implementation of many of the point source rules summarized in Table 4-1. The remaining counties consistently report substantially lower point source NO_X emissions, with no appreciable trend over the 2006 to 2009 period. Since Wise County was designated nonattainment in 2012, some facilities have only recently started to report as point sources because they exceed the 25 NO_X tpy and/or 10 VOC tpy thresholds applicable to nonattainment counties. Newly reported NO_X sources in Wise County are reflected by a small increase in the point source NO_X emission totals for the 2011 and 2012 periods.

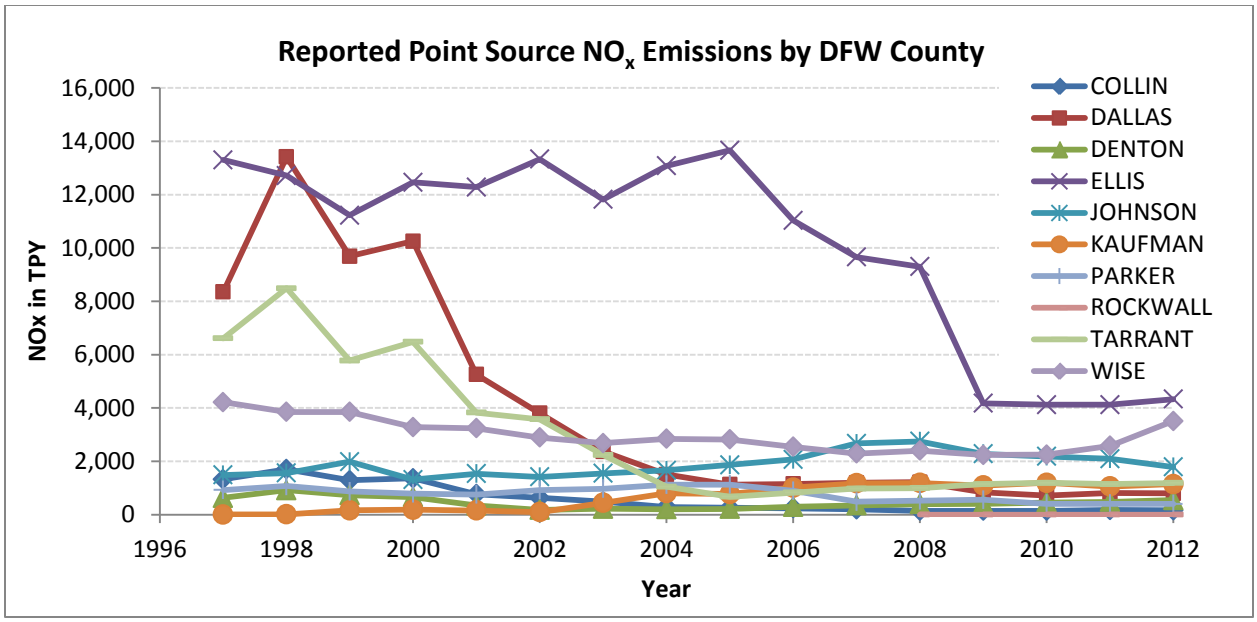

Figure 5-5: Reported Point Source NO_X Emissions by DFW County

Other point sources of NO_X are EGUs located within and outside of the DFW nonattainment area. NO_X emissions from EGUs are displayed in Figure 5 6: *Trends in EGU NO_X Emissions in the DFW 10-County Area* and show a downward trend due to the implementation of EGU rules described in Table 4-1. NO_X emissions from EGUs in the 10-county DFW nonattainment area have decreased by 88.9% from 1997 through 2012.

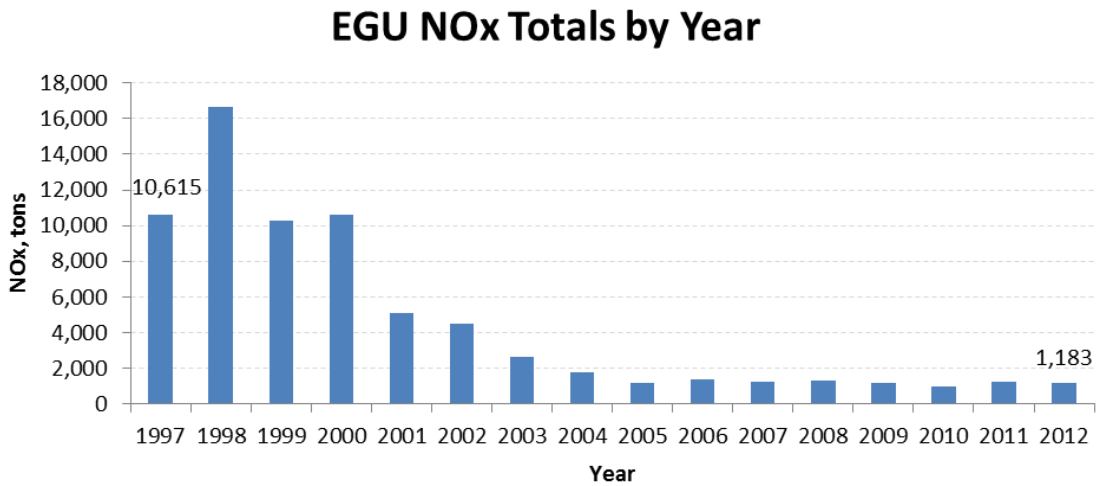

Figure 5-6: Trends in EGU NO_X Emissions in the DFW 10-County Area

On-road mobile sources are the biggest contributor to NO_X emissions in the DFW nonattainment area. With on-road mobile NO_X sources accounting for over half of the total NO_X emissions in the DFW nonattainment area, it is important to discuss the trends in NO_X emissions for this source category. TTI has estimated the emissions of NO_X, VOC, carbon monoxide, and VMT from 1999 through 2030 using the 2010a version of the EPA's Motor Vehicle Emission Simulator (MOVES2010a) model. Figure 5-7: *MOVES2010a 10-County DFW Area On-Road Emission Trends for 1999 through 2030* shows the results of this work from TTI. The estimates show that NO_X emissions have and will continue to decrease through to year

2028, though at different rates over time. These emission decreases occur even though VMT is projected to increase out to 2030 because cleaner newer vehicles will continuously replace higher-emitting older ones. The downward trend in NO_X emissions from on-road sources mirrors the trends in ambient NO_X concentrations observed at urban monitors, which will be discussed in the following section. If the downward trend in on-road NO_X emissions continues as projected, observed NO_X concentrations would be expected to decrease as well, thus reducing ozone-producing precursors in the DFW airshed.

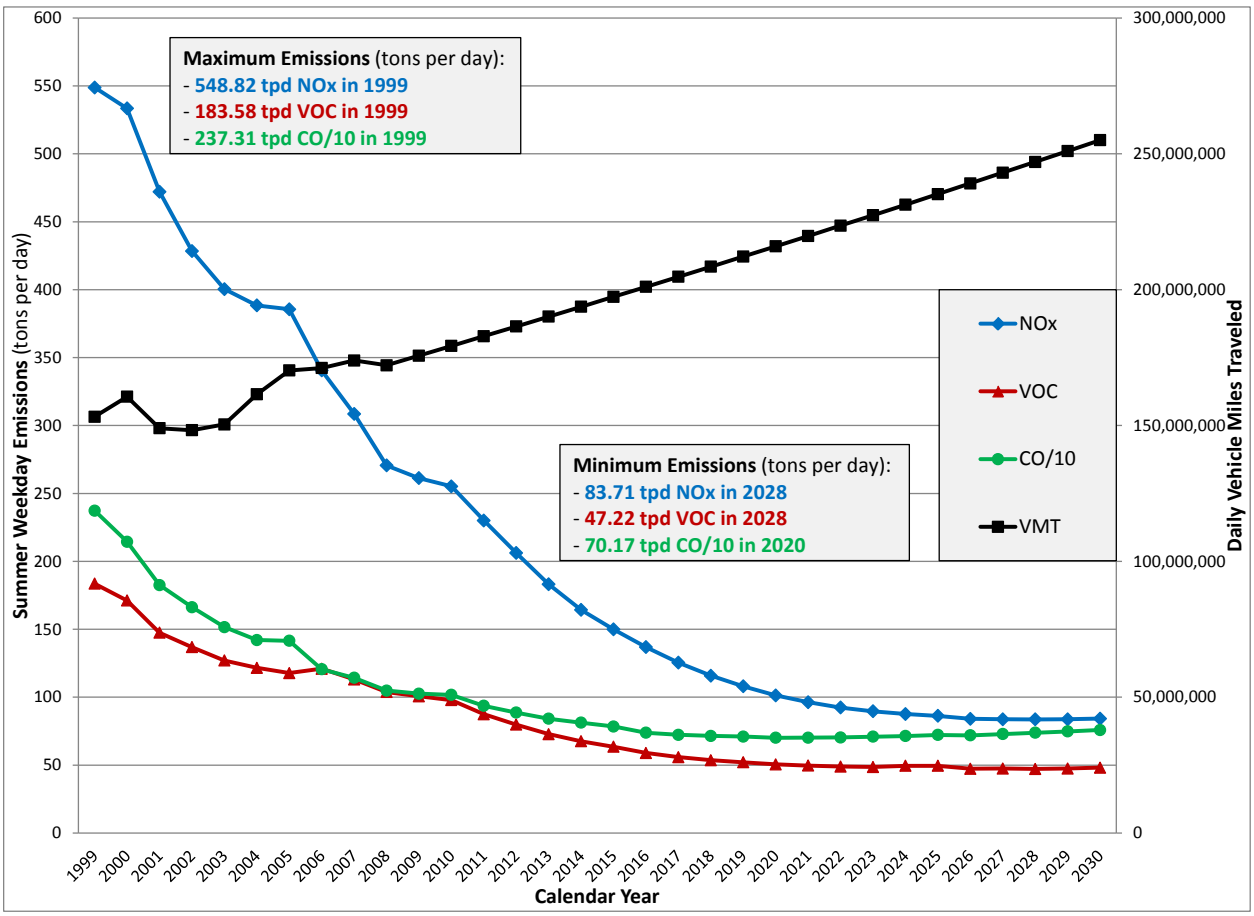

Figure 5-7: MOVES2010a 10-County DFW Area On-Road Emission Trends for 1999 through 2030

Similar to on-road, the non-road source category contributes sufficient amounts to total NO_X emissions in the DFW nonattainment area. Emission projections of non-road NO_X emissions were estimated using the Texas NONROAD (TexN) model, and are shown in Figure 5-8: *TexN DFW Area Non-Road Emission Trends for 2000 through 2050*. The results show that NO_X emissions from non-road sources will decrease through year 2031, though at different rates over time. Since on-road and non-road NO_X sources account for the vast majority of NO_X emissions in the DFW nonattainment area, and since these two source categories are projected to have continuously lower emissions over the next several years, and because ozone production is dependent on NO_X emissions, it is expected that future ozone concentrations will also be reduced.

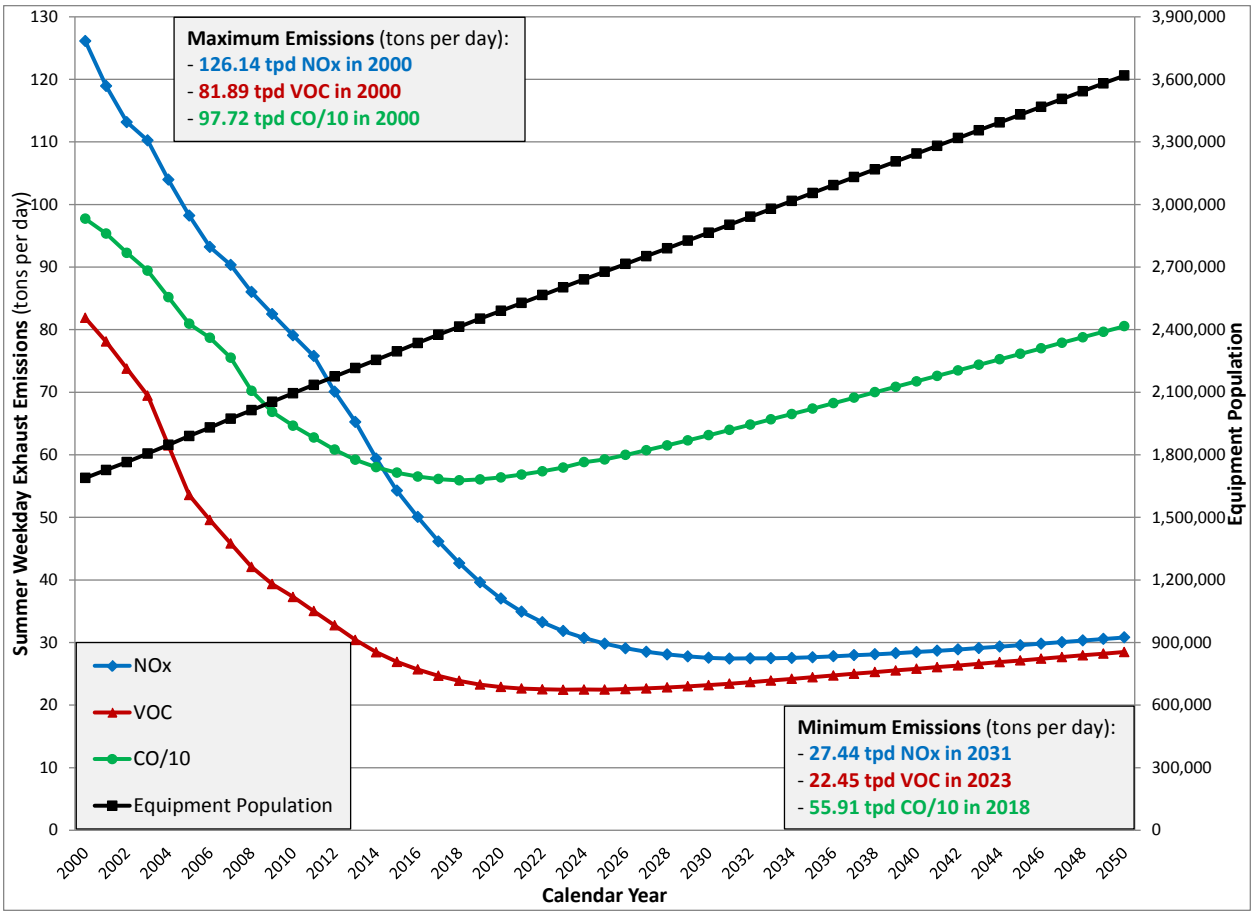

Figure 5-8: TexN DFW Area Non-Road Emission Trends for 2000 through 2050

5.2.2.2 Ambient NO_X Trends

Trends for ambient NO_X concentrations are presented in Figure 5-9: *Ozone Season (March through October) Daily Peak NO_X Trends in the DFW Area*. Trends are for the ozone season (March through October) and represent the 90th percentile, the 50th percentile, and the 10th percentile of daily peak NO_X concentrations in the DFW nonattainment area. The largest NO_X concentrations and the median NO_X concentrations in the DFW nonattainment area appear to be decreasing over time, while the 10th percentile concentrations have remained flat. A dotted line is provided to highlight the trend in ambient NO_X concentrations.

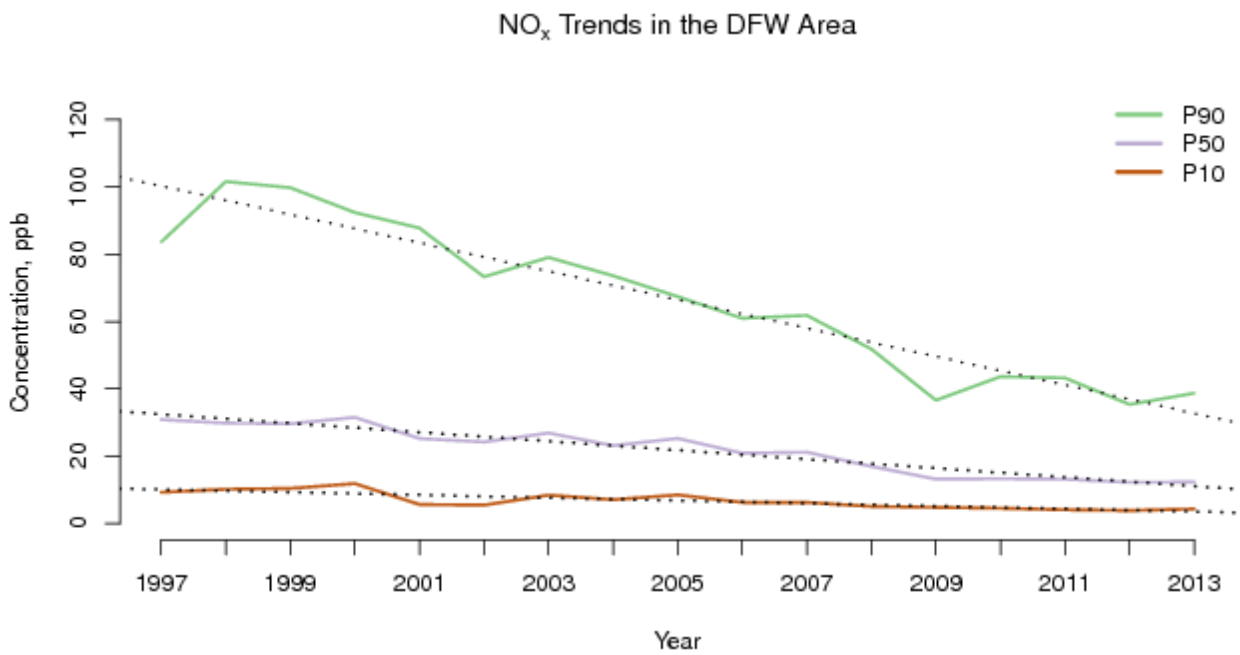

Figure 5-9: Ozone Season (March through October) Daily Peak NO_X Trends in the DFW Area

The NO_X trends in the DFW nonattainment area are more pronounced at urban monitors as seen in Figure 5-10: *90th Percentile Daily Peak NO_X Concentrations in the DFW Area*. The downward trends in ambient NO_X concentrations are observed at all monitors except at the Parker County monitor, for which the trend is flat. The Parker County monitor measures the lowest NO_X concentrations because it is located in a rural area 34 miles west of the Fort Worth area with very little on-road activity or nearby NO_X sources. All other monitors, however, demonstrate downward NO_X trends. The monitors with smaller downward trends do not record high NO_X concentrations, mostly because they are rural monitors with little on-road activity. The typical ozone design value setting monitors (Denton Airport South, Keller, and Grapevine Fairway) show downward trends in ambient NO_X concentrations. Because of the prevailing winds during ozone season, these monitors also observe transported NO_X from the DFW urban areas and benefit from lower transported NO_X emissions.

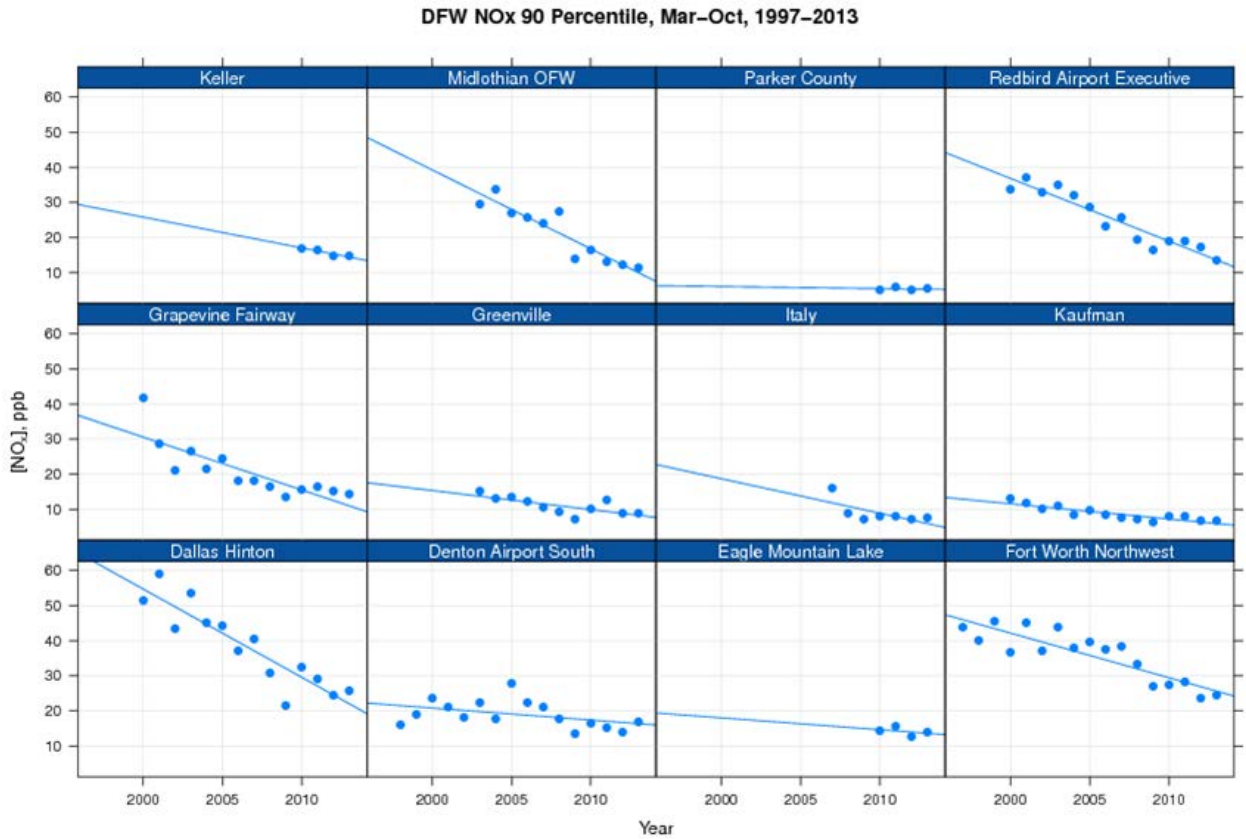

Figure 5-10: 90th Percentile Daily Peak NO_X Concentrations in the DFW Area

Ambient NO_X concentrations in the overall DFW nonattainment area are trending downward, especially in the DFW urban areas. This downward trend results from the state controls placed on point sources, along with the federal standards implemented for on-road vehicles and non-road equipment.

5.2.3 VOC and NO_X Limitations

The VOC and NO_X limitation of an air mass can help determine how immediate reductions in VOC and NO_X concentrations might affect ozone concentrations. A NO_X-limited region occurs where the radicals from VOC oxidation are abundant, and therefore the ozone formation is more sensitive to the amount of NO_X present in the atmosphere. In these regions, controlling NO_X would be more effective in reducing the ozone concentrations. In VOC-limited regions, NO_X is abundant, and therefore the ozone formation is more sensitive to the amount of radicals from VOC oxidation present in the atmosphere. In VOC-limited regions, controlling VOC emissions would be more effective in reducing the ozone concentrations. Areas where ozone formation is not strongly limited by either VOC or NO_X are considered transitional, and controlling either VOC or NO_X emissions would reduce ozone concentrations in these regions.

The annual median VOC to NO_X ratios at the Dallas Hinton Street, Eagle Mountain Lake, and Fort Worth Northwest Auto-GC monitors are shown in Figure 5-11: *Trend in VOC to NO_X ratios using AutoGC Data*. VOC to NO_X ratios at the three AutoGC monitors show that the DFW nonattainment area is becoming more NO_X-limited over time. The Dallas Hinton Street and Fort Worth Northwest monitors were VOC-limited, but have begun to trend towards NO_X-limited, and are currently showing transitional conditions. This result can be attributed to the lower

ambient NO_X concentrations due to NO_X reductions taking place in the urban DFW nonattainment area.

The more rural Eagle Mountain Lake monitor is NO_X-limited and shows a trend towards even more NO_X-limited conditions. This monitor not only observes biogenic emissions and oil and gas emissions, but also observes emissions from the urban DFW nonattainment area because it is located downwind of the urban core. Because total VOC emissions at this monitor are not increasing, the increase in the VOC to NO_X ratio can be attributed to decreasing NO_X emissions from the urban DFW nonattainment area.

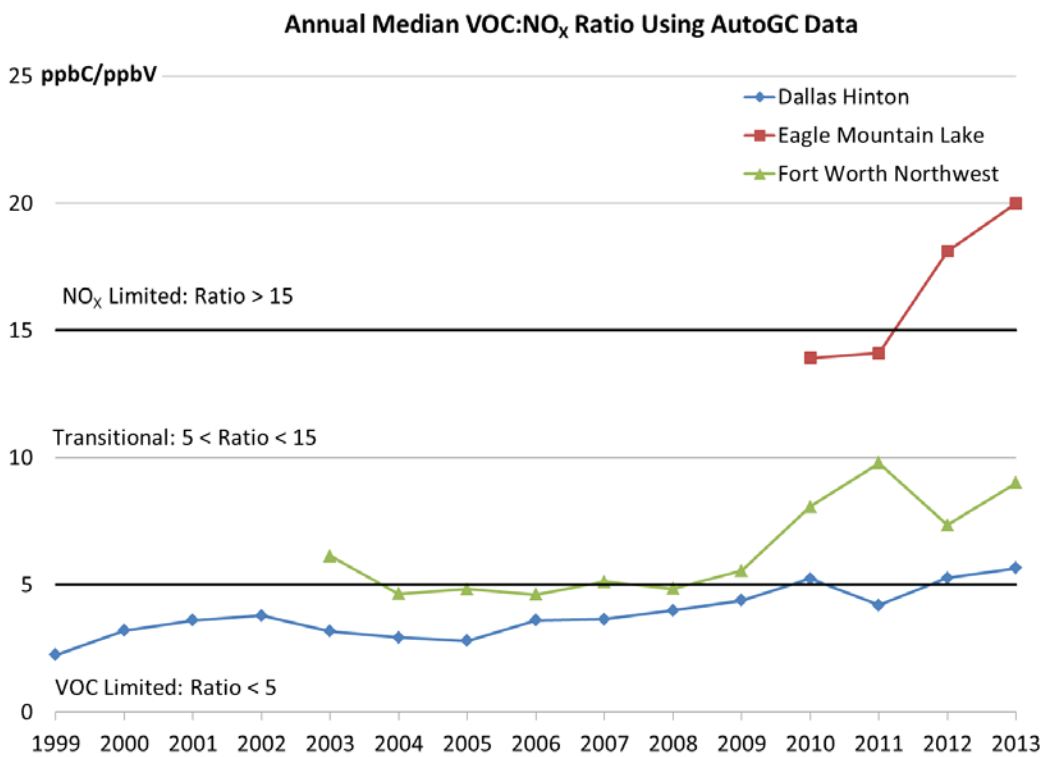

Figure 5-11: Trend in VOC to NO_X ratios using AutoGC Data

This evidence of continued NO_X-limitation in the DFW nonattainment area is another positive factor indicating support for the photochemical modeling results which also indicate the NO_X-limited nature of the DFW nonattainment area, as documented in Chapter 3.

5.2.4 Weekday/Weekend Effect

The trends in NO_X concentrations by day of the week show how local control strategies might affect the ozone concentrations. Examining the way ozone behaves on days with lower NO_X concentrations will help demonstrate how ozone might behave if there were overall reductions in NO_X. To investigate if there is a day of the week effect in the DFW nonattainment area, NO_X concentrations were calculated by the day of the week from 1997 to 2013. The NO_X data at Fort Worth Northwest are from 2003 and 2004 only.

Results displayed in Figure 5-12: *Day of Week NO_X Concentrations* show that at urban monitors, weekends observe lower NO_X than most weekdays. This implies that there is less NO_X generated on weekends, most likely due to less on-road activity as discussed in Chapter 3 and Appendix C. Since NO_X is a precursor to ozone formation, controlling NO_X should in turn reduce ozone concentrations.

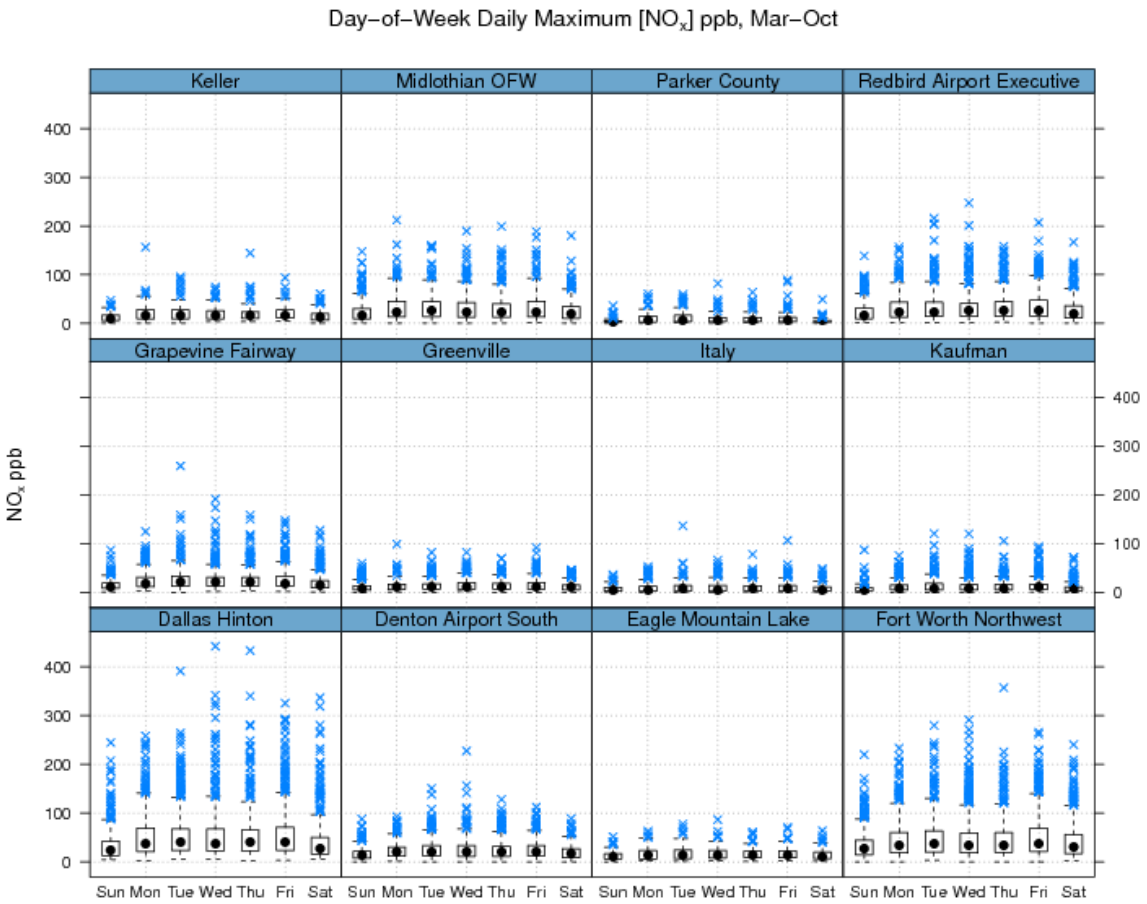

Figure 5-12: Day of Week NO_X Concentrations

Given that there is less NO_X generated on weekends, there accordingly should be fewer high ozone days on weekends. To determine the number of days with high eight-hour ozone on weekends, days with eight-hour ozone over 75 ppb were counted using all DFW area monitors.

Figure 5-13: *Weekday/Weekend Effect for Ozone in the DFW Area* shows that the total number of days with eight-hour ozone concentrations greater than 75 ppb is greater on weekdays compared to weekends. Fewer high eight-hour ozone days occur on Sundays (85 days) compared to other days of the week. Sunday had 18 fewer high eight-hour ozone days than Mondays, which had the second lowest amount of high eight-hour ozone days (103 days). High eight-hour ozone days occur most often on Fridays, with 137 days. It appears that high ozone occurs less frequently on Sunday, when there are also lower amounts of NO_X from on-road sources. By the end of the week, the DFW nonattainment area begins to experience higher ozone as well as higher NO_X emissions. This result corroborates the hypothesis that local NO_X reductions will lead to lower ozone concentrations, and this weekday/weekend analysis using monitoring data corroborates the weekday/weekend modeling analysis summarized in Chapter 3.

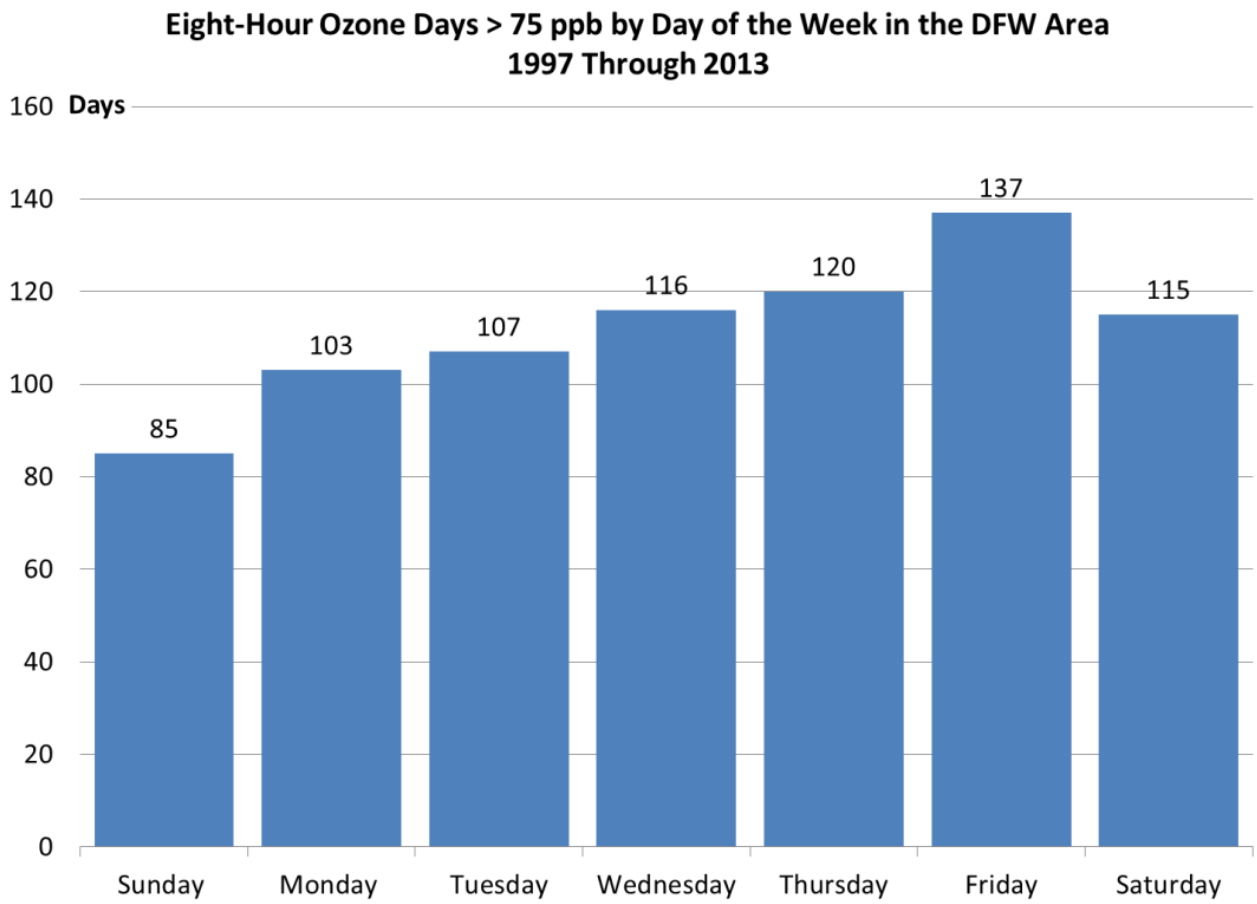

Figure 5-13: Weekday/Weekend Effect for Ozone in the DFW Area

5.2.5 VOC Trends

Total non-methane organic carbon (TNMOC), which is used to represent VOC concentrations, can enhance ozone production in combination with NO_X and sunlight. TNMOC is an important precursor to ozone formation. However, because the DFW air shed is more NO_X-limited, controlling TNMOC is not as effective as controlling NO_X to reduce ozone concentrations. Nevertheless, these precursors to ozone formation are discussed below.

Two types of monitors record TNMOC data in the DFW nonattainment area: AutoGCs, which record hourly data, and canisters, which record 24-hour data. Because the canisters have more long-term data than the AutoGCs, they can provide more long-term trend information. The annual geometric mean TNMOC concentrations from the seven canisters in the DFW nonattainment area are presented in Figure 5-14: *Annual Geometric Mean TNMOC Concentrations*. The chart shows that annual geometric mean TNMOC concentrations in the DFW nonattainment area are declining, although there appear to be fewer decreases occurring after 2006. Due to the NO_X-limited nature of the DFW nonattainment area, controlling TNMOC is not as effective at controlling NO_X to reduce ozone concentrations. Since the rate of decline in TNMOC concentrations since 2006 is much less pronounced than that for NO_X, we would expect TNMOC controls to have a much smaller effect for reducing ozone. This information also supports the photochemical modeling results documented in Chapter 3.

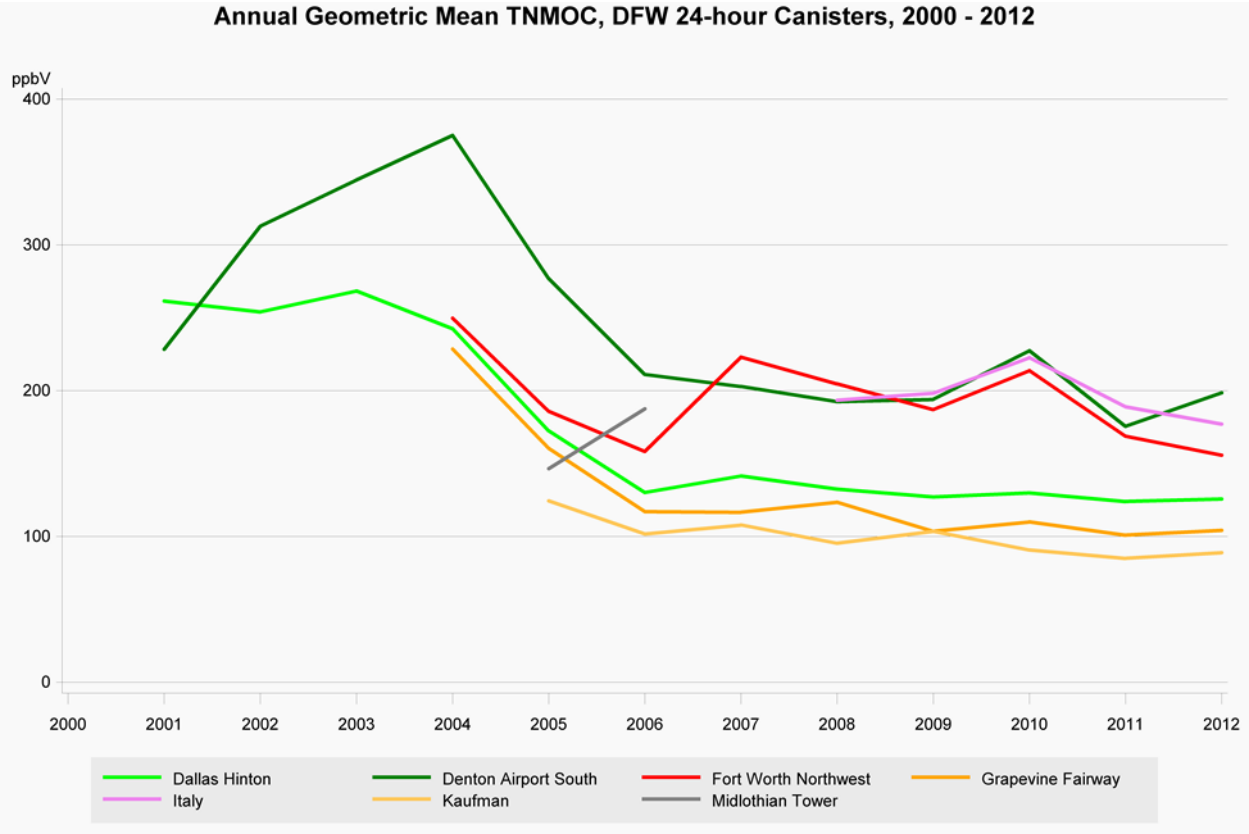

Figure 5-14: Annual Geometric Mean TNMOC Concentrations

5.3 STUDIES OF OZONE FORMATION, ACCUMULATION, AND TRANSPORT RELATED TO DFW

A number of peer-reviewed studies have been performed that relate to air quality in the DFW nonattainment area and ozone ADs in general. These studies are an important component of the WoE analyses in that in several cases it corroborates the conclusion that there are downward trends in ozone, NO_X, and VOC. Additional research also provides support of the improvements in the use of photochemical modeling as a predictive tool. Several of the studies summarized below relate to the effects of precipitation on biogenic emissions, VOC profiles for oil and gas production, and the effects of oil and gas operations on ozone formation. Each study is fully referenced in the bibliography.

One study by Sather and Cavender (2012) examined trends in ozone and its precursors at several cities in the south central U.S., including DFW. Several parameters associated with meteorology conducive to high ozone were also examined, including days with temperatures ≥90 degrees Fahrenheit, days with resultant wind speeds ≤4 miles per hour, and the number of days with precipitation. They evaluated five five-year periods from 1986 through 1990 and continuing from 2006 through 2010. They found that ozone-conducive days were lowest from 2001 through 2005, and highest during 1991 through 1995 and 2006 through 2010. In spite of the increase in ozone-conducive days during 2006 through 2010, the number of hours above 75 ppb at four DFW monitoring sites decreased by more than 70 hours per site compared to 2001 through 2005. The downward trends observed by Sather and Cavendar for NO_X and VOC matched those calculated by the TCEQ.

Another study by Tang et al. (2013) relating to emissions inventories used two advanced numerical techniques to estimate a top-down NO_X EI based upon the NO_2 column density measurements from the Ozone Monitoring Instrument (OMI) satellite. These two techniques, the discrete Kalman filter and the decoupled direct method, allowed the Comprehensive Air Quality Model with Extensions (CAMx) to adjust the original bottom-up TCEQ inventory for 2006 ozone episodes iteratively until it matched the satellite-derived NO_2 column observations. A second top-down adjustment was calculated based upon ground-based NO_X measurements. The two methods gave widely diverging results, with the OMI measurement pushing the inventory slightly higher, and the ground monitoring pushing the inventory much lower. The original TCEQ 2006 inventory included emissions of NO_X from lightning and other sources often not included in standard emissions inventories, but the two top-down inventories were still different.

Each of the top-down inventories was substituted into the CAMx modeling to see if ozone model performance was improved. Neither alternative inventory showed substantial improvements over the original inventory. The tendency of the Tang et al. modeling to overestimate ground NO_2 concentrations and underestimate column densities could not be corrected by the techniques used in this study. Other model weaknesses aside from potential emission inventory error could explain this discrepancy, particularly the simulation of planetary boundary layer dynamics. Another explanation is that different data retrieval techniques used for OMI data have shown large variations, even though they are supposed to match each other. Revisions to the retrieval algorithms are being implemented to try to correct the problem. The results of this study did not compel any changes in the SIP modeling for DFW.

A third emissions/modeling related study evaluated by TCEQ staff was by Lamsal et al. (2008), which attempted to infer the ground-based NO_2 concentrations based upon the OMI satellite data. Since the ground-based NO_2 monitors have a known high bias, due to their inability to distinguish between NO_2 and other oxidized nitrogen compounds, the authors developed a correction for the ground-based NO_2 data. They found that OMI NO_2 column analysis was able to predict ground NO_2 concentrations reasonably well, which may allow these data to fill gaps in the NO_2 measurement network across the country. Tarrant County was an area that they specifically examined to see how well OMI NO_2 column analysis could predict ground NO_2. However, the OMI NO_2 results for Tarrant County did not include sufficient resolution that could be used to alter the NO_X emission estimates by source category for the 2006 and 2018 SIP modeling performed for DFW.

A fourth study related to emissions evaluated by the TCEQ was by Huang et al. (2014), which examined drought effects on biogenic emissions during two drought years (2006 and 2011) and one “wet” year (2007) to elucidate the relationship between leaf area index (LAI) and emissions. Drought severity was evaluated using the Standard Precipitation Index and the Palmer Drought Severity Index. Monthly average LAI was estimated from the Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data for four different regions in eastern Texas; DFW was included in the “North Central” region. The study found large differences in LAI between the wet year and the drought years, with up to 50% decreases during the drought years relative to 2007. Isoprene and monoterpene emissions estimated with the Model of Emissions of Gases and Aerosols from Nature (MEGAN) and Texas-specific land cover categories were lower during drought years by 25-30%. The authors also looked at which month showed the largest inter-annual variations, and determined which factor was most important (i.e., inter-annual meteorological variations or LAI). September showed the greatest emission variation due to LAI variations. April showed the largest emission variation due to meteorological conditions, and to the combination of meteorology and LAI. These results may ultimately help improve biogenic

emissions modeling by taking into account drought conditions when modeling the emissions from vegetation.

A fifth modeling support study evaluated by the TCEQ was Lefohn et al. (2014), which modeled background ozone using the Goddard Earth Observing System with Chemistry (GEOS-Chem) global model and CAMx for 2006. The source apportionment tools in CAMx were invoked to track the sources of background ozone simulated throughout the country. Many sites were examined in detail, including the Dallas Executive Airport monitoring site, which was used to assess the impact of background ozone on DFW. Twelve kilometer (km) CAMx modeling yielded decent mean fractional bias of hourly ozone in DFW during April, May, September, and October, but biased by about +20% during June and July, and by about -20% for the other months. For April, May, and October, the estimated global average background was about 58-63% of the total ozone for the Dallas Executive Airport site. During June through September, the global average background was only about 43-48% of the total ozone. Overall, the percentage of total ozone attributed to background tended to decrease at higher concentrations of total ozone. Using their estimation method, they found indications of stratospheric contributions to background in March and June 2006, though the contributions were not quantified or focused upon specific days. Because the contributions were not quantified, there is no quantification of the uncertainty of this assessment. The results presented in this paper are consistent with DFW regional background ozone assessments developed by the TCEQ using an upwind-downwind method.

A sixth study evaluated by the TCEQ was Pacsi et al. (2013), which carried out CAMx modeling for eastern Texas at 12 km after making adjustments to the 2012 future case inventory used by the TCEQ for the June 2006 ozone episode that was included with the DFW AD SIP adopted in December 2011. The study estimated how regional NO_X emissions and consequent ozone formation would vary based on four natural gas price scenarios of $1.89, $2.88, $3.87, and $7.74 per Million British Thermal Units (MMBTU). Using the $2.88 scenario as a baseline, the $1.89 scenario resulted in lower NO_X at EGUs since more natural gas was being used instead of coal. However, NO_X emissions from natural gas production were increased to account for the increase in demand from EGUs. The regional ozone decrease was 0.2-0.5 ppb for this $1.89 scenario, but some localized ozone increases were seen downwind of natural gas production areas. Conversely, the $3.87 and $7.74 scenarios resulted in regional ozone increases of 0.2-0.7 ppb because the use of higher NO_X emitting coal for EGUs was favored over natural gas.

A seventh study evaluated by the TCEQ was Pegues et al. (2012), which examined how well photochemical grid models and weight of evidence (WoE) assessments in ozone SIPs were able to predict attainment of the 1997 eight-hour ozone standard of 84 ppb. This study included a review of the May 23, 2007 DFW SIP and the modeled 2009 future design value. They found that the photochemical grid model results were reliable: the photochemical grid modeling for 12 nonattainment areas correctly predicted attainment at 69 monitors, and correctly predicted nonattainment at six monitors, including two in DFW. The modeling gave false negative results (prediction of attainment that was not reached) at only 3% of the monitoring sites. By contrast, the WoE assessments resulted in five areas incorrectly predicting attainment, including DFW. The authors suggest that WoE arguments are still an essential and valuable part of the SIP process, but that greater scrutiny of WoE demonstrations may be needed to avert false negative predictions. These results verify that photochemical grid modeling can assess the effectiveness of control strategies. They also indicate, however, that WoE assessments, as they have been used in the past, may be less effective at predicting attainment. This indication is not inconsistent with EPA guidance on use of WoE and that WoE determinations can be used in some cases to demonstrate attainment conclusions that differ from conclusions of the model attainment test.

The prospective modeling discussed in Chapter 3 shows that the newer tools available have improved the forecasting effectiveness of photochemical modeling efforts. The updated meteorological model, chemical mechanism, and emission inputs led to better correlation between measured 2012 ozone design values in the DFW nonattainment area and those predicted by the photochemical model in forecast mode, compared to modeling conducted for the December 2011 DFW AD SIP revision.

Overall, the studies evaluated by the TCEQ are supportive of the use of photochemical modeling as a predictive tool in determining attainment.

5.4 QUALITATIVE CORROBORATIVE ANALYSIS

5.4.1 Additional Measures

5.4.1.1 Energy Efficiency and Renewable Energy (EE/RE) Measures

Energy efficiency (EE) measures are typically programs that reduce the amount of electricity and natural gas consumed by residential, commercial, industrial, and municipal energy consumers. Examples of energy efficiency measures include increasing insulation in homes, installing compact fluorescent light bulbs, and replacing motors and pumps with high efficiency units. Renewable energy (RE) measures include programs that generate energy from resources that are replenished or are otherwise not consumed as with traditional fuel-based energy production. Examples of renewable energy include wind energy and solar energy projects.

Emission reductions resulting from these programs were not explicitly included in the photochemical modeling for this DFW AD SIP Revision because local efficiency efforts may not result in local emissions reductions or may be offset by increased demand in electricity. The complex nature of the electrical grid makes accurately quantifying emission reductions from EE/RE measures difficult. At any given time, it is impossible to determine exactly where a specific user's electricity was produced. The electricity for a user in the DFW nonattainment area could be generated by a power plant in west Texas, in a nearby attainment county, or within the nonattainment area. If electrical demand is reduced in the DFW nonattainment area due to these local efficiency measures, then emission reductions from power generation facilities may occur in any number of locations around the state.

The Texas Legislature has enacted a number of EE/RE measures and programs. The following is a summary of Texas EE/RE legislation since 1999.

76th Texas Legislature, 1999

- Senate Bill (SB) 7
- House Bill (HB) 2492
- HB 2960

77th Texas Legislature, 2001

- SB 5
- HB 2277
- HB 2278
- HB 2845

78th Texas Legislature, 2003

- HB 1365 (Regular Session)

79th Texas Legislature, 2005

- SB 20 (First Called Session)
- HB 2129 (Regular Session)
- HB 2481 (Regular Session)

80th Texas Legislature, 2007

- HB 66
- HB 3070
- HB 3693
- SB 12

81st Texas Legislature, 2009

- None

82nd Texas Legislature, 2011

- SB 898 (Regular Session)
- SB 924 (Regular Session)
- SB 981 (Regular Session)
- SB 1125 (Regular Session)
- SB 1150 (Regular Session)
- HB 51 (Regular Session)

83rd Texas Legislature, 2013

- None

Renewable Energy

SB 5, 77th Texas Legislature, 2001, set goals for political subdivisions in affected counties to implement measures to reduce energy consumption from existing facilities by 5% each year for five years from January 1, 2002 through January 1, 2006. In 2007, the 80th Texas Legislature passed SB 12, which extended the timeline set in SB 5 through 2007 and made the annual 5% reduction a goal instead of a requirement. The State Energy Conservation Office (SECO) is charged with tracking the implementation of SB 5 and SB 12. Also during the 77th Texas Legislature, the Energy Systems Laboratory, part of the Texas Engineering Experiment Station, Texas A&M University System, was mandated to provide an annual report on EE/RE efforts in the state as part of the Texas Emissions Reduction Plan (TERP) under Texas Health and Safety Code (THSC), §388.003(e).

The 79th Texas Legislature, 2005, Regular and First Called Sessions, amended SB 5 through SB 20, HB 2129, and HB 2481 to add, among other initiatives, renewable energy initiatives which require: 5,880 megawatts of generating capacity from renewable energy by 2015; the TCEQ to develop a methodology for calculating emission reductions from renewable energy initiatives

and associated credits; the Energy Systems Laboratory to assist the TCEQ in quantifying emissions reductions from EE/RE programs; and the Public Utility Commission of Texas to establish a target of 10,000 megawatts of installed renewable technologies by 2025.

Wind power producers in Texas have exceeded the renewable energy generation target by installing over 10,000 megawatts of wind electric generating capacity by 2010 and total capacity should exceed 14,600 megawatts by December 2014.

HB 2129, 79th Texas Legislature, 2005, Regular Session, directed the Energy Systems Laboratory to collaborate with the TCEQ to develop a methodology for computing emission reductions attributable to use of renewable energy and for the Energy Systems Laboratory to annually quantify such emission reductions. HB 2129 directed the Texas Environmental Research Consortium to use the Texas Engineering Experiment Station to develop this methodology. With the TCEQ's guidance, the Energy Systems Laboratory produces an annual report, Statewide Air Emissions Calculations from Energy Efficiency, Wind and Renewables, detailing these efforts.

In addition to the programs discussed and analyzed in the Energy Systems Laboratory report, local governments may have enacted measures beyond what has been reported to SECO and the Public Utility Commission of Texas (PUCT). The TCEQ encourages local political subdivisions to promote EE/RE measures in their respective communities and to ensure these measures are fully reported to SECO and the PUCT.

SB 981, 82nd Texas Legislature, 2011, Regular Session, allows a retail electric customer to contract with a third party to finance, install, or maintain a distributed renewable generation system on the customer's side of the electric meter, regardless of whether the customer owns the installed system. SB 981 also prohibits the PUCT from requiring registration of the system as an electric utility if the system is not projected to send power to the grid.

Residential and Commercial Building Codes and Programs

THSC, Chapter 388, Texas Building Energy Performance Standards, as adopted in SB 5 of the 77th Texas Legislature, 2001, states in §388.003(a) that single-family residential construction must meet the energy efficiency performance standards established in the energy efficiency chapter of the International Residential Code. The Furnace Pilot Light Program includes energy savings accomplished by retrofitting existing furnaces. Also included is a January 2006 federal mandate raising the minimum Seasonal Energy Efficiency Ratio (SEER) for air conditioners in single-family and multi-family buildings from 10 to 13.

THSC, Chapter 388, as adopted in SB 5 of the 77th Texas Legislature, 2001, states in §388.003(b) that non-single-family residential, commercial, and industrial construction must meet the energy efficiency performance standards established in the energy efficiency chapter of the International Energy Conservation Code.

HB 51, 82nd Legislature, 2011, Regular Session, requires municipalities to report implementation of residential and commercial building codes to SECO.

Federal Facility EE/RE Projects

Federal facilities are required to reduce energy use by Presidential Executive Order 13123 and the Energy Policy Act of 2005 (Public Law 109-58 EPACT20065). The Energy Systems Laboratory compiled energy reductions data for the federal EE/RE projects in Texas.

Political Subdivisions Projects

SECO funds loans for energy efficiency projects for state agencies, institutions of higher education, school districts, county hospitals, and local governments. Political subdivisions in nonattainment and affected counties are required by SB 5, 77th Texas Legislature, 2001, to report EE/RE projects to SECO. These projects are typically building systems retrofits, non-building lighting projects, and other mechanical and electrical systems retrofits such as municipal water and waste water treatment systems.

Electric Utility Sponsored Programs

Utilities are required by SB 7, 76th Texas Legislature, 1999, and SB 5, 77th Texas Legislature, 2001, to report demand-reducing energy efficiency projects to the PUCT (see THSC, §386.205 and Texas Utilities Code (TUC), §39.905). These projects are typically air conditioner replacements, ventilation duct tightening, and commercial and industrial equipment replacement.

SB 1125, 82nd Texas Legislature, 2011, Regular Session, amended the TUC, §39.905 to require energy efficiency goals to be at least 30% of annual growth beginning in 2013. The metric for the energy efficiency goal remains at 0.4% of peak summer demand when a utility program accrues that amount of energy efficiency. SB 1150, 82nd Texas Legislature, 2011, Regular Session, extended the energy efficiency goal requirements to utilities outside the Electric Reliability Council of Texas area.

State Energy Efficiency Programs

HB 3693, 80th Texas Legislature, 2007, amended the Texas Education Code, Texas Government Code, THSC, and TUC. The bill:

- requires state agencies, universities and local governments to adopt energy efficiency programs;
- provides additional incentives for electric utilities to expand energy conservation and efficiency programs;
- includes municipal-owned utilities and cooperatives in efficiency programs;
- increases incentives and provides consumer education to improve efficiency programs; and
- supports other programs such as revision of building codes and research into alternative technology and renewable energy.

HB 51, 82nd Texas Legislature, 2011, Regular Session, requires new state buildings and major renovations to be constructed to achieve certification under an approved high-performance design evaluation system.

HB 51 also requires, if practical, that certain new and renovated state-funded university buildings comply with approved high-performance building standards.

SB 898, 82nd Texas Legislature, 2011, Regular Session, extended the existing requirement for state agencies, state-funded universities, local governments, and school districts to adopt energy efficiency programs with a goal of reducing energy consumption by at least 5% per state fiscal year (FY) for 10 state FYs from September 1, 2011 through August 31, 2021.

SB 924, 82nd Texas Legislature, 2011, Regular Session, requires all municipally-owned utilities and electric cooperatives that had retail sales of more than 500,000 megawatt hours in 2005 to report each year to SECO information regarding the combined effects of the energy efficiency

activities of the utility from the previous calendar year, including the utility's annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals.

5.4.1.2 Cement Kiln Consent Decree

Cement kilns located in Ellis County are subject to the requirements of Chapter 117, Subchapter E, Division 2. Ash Grove Cement Company operated three kilns in Ellis County, with an established source cap under §117.3123 of 4.4 tpd . The AD modeling includes this 4.4 tpd source cap as the maximum allowable cement kiln NO_X emissions from this site.

However, a 2013 consent decree between Ash Grove and the EPA required by September 10, 2014 shutdown of two kilns and reconstruction of kiln #3 with selective noncatalytic reduction with an emission limit of 1.5 lbs NO_X/ton of clinker and a 12-month rolling tonnage limit for NO_X of 975 tpy. The reconstructed kiln is a dry kiln with year-round SNCR operation. The redesign allows 949,000 tpy of clinker, or 1.95 tpd of NO_X, which is well below the 4.4 tpd source cap. Ash Grove's enforceable limit continues to be 4.4 tpd, which continues to be the value included in the AD modeling, although actual emissions are expected to be below the consent decree limit. Any modifications or new construction would be required to meet nonattainment new source review with best available control technology requirements, and would be subject to the same 1.5 lbs NO_X/ton of clinker emission limit in the New Source Performance Standards for Portland Cement Plants. It would also be subject to other regulatory requirements, including the National Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry.

5.4.1.3 Clean Air Interstate Rule (CAIR) and Cross-State Air Pollution Rule (CSAPR)

In March 2005, the EPA issued CAIR to address EGU emissions that transport from one state to another. The rule incorporates the use of three cap and trade programs to reduce sulfur dioxide (SO_2) and NO_X: the ozone-season NO_X trading program, the annual NO_X trading program, and the annual SO_2 trading program.

Texas was not included in the ozone season NO_X program but was included for the annual NO_X and SO_2 programs. As such, Texas must make necessary reductions in annual SO_2 and NO_X emissions from new and existing EGUs to demonstrate that emissions from Texas do not contribute to nonattainment or interfere with maintenance of the 1997 particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$) NAAQS in another state. CAIR consists of two phases for implementing necessary NO_X and SO_2 reductions. Phase I addresses required reductions from 2009 through 2014. Phase II addresses reductions in 2015 and thereafter.

In July 2006, the commission adopted a SIP revision to address how the state would meet emissions allowance allocation budgets for NO_X and SO_2 established by the EPA to meet the federal obligations under CAIR. The commission adopted a second CAIR-related SIP revision in February 2010. This revision incorporated various federal rule revisions that the EPA had promulgated since the TCEQ's initial submittal. It also incorporated revisions to 30 Texas Administrative Code Chapter 101 resulting from legislation during the 80th Texas Legislature, 2007.

A December 2008 court decision found flaws in CAIR but kept CAIR requirements in place temporarily while directing the EPA to issue a replacement rule. In July 2011, the EPA finalized the CSAPR to meet Federal Clean Air Act (FCAA) requirements and respond to the court's order to issue a replacement program. Texas was included in CSAPR for ozone season NO_X, annual NO_X, and annual SO_2 due to the EPA's determination that Texas significantly contributes to

nonattainment or interferes with maintenance of the 1997 eight-hour ozone NAAQS and the 1997 and 2006 $PM_{2.5}$ NAAQS in other states. As a result of numerous EGU emission reduction strategies already in place in Texas, the annual and ozone season NO_X reduction requirements from the CSAPR were relatively small but still significant. The CSAPR required an approximate 7% reduction in annual NO_X emissions and less than 5% reduction in ozone season NO_X emissions.

On August 21, 2012, the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit vacated the CSAPR. Under the D.C. Circuit Court's ruling, CAIR remained in place until the EPA developed a valid replacement.

The EPA and various environmental groups petitioned the Supreme Court of the United States to review the D.C. Circuit Court's decision on CSAPR. On April 29, 2014, a decision by the Supreme Court reversed the D.C. Circuit and remanded the case. On October 23, 2014, the D.C. Circuit lifted the CSAPR stay and on November 21, 2014, the EPA issued rulemaking, which shifted the effective dates of the CSAPR requirements to account for the time that had passed after the rule was stayed in 2011. Phase 1 of CSAPR took effect January 1, 2015 and Phase 2 is scheduled to begin January 1, 2017.

On January 22, 2015, the EPA issued a memorandum to provide information on how it intends to implement FCAA interstate transport requirements for the 2008 ozone NAAQS. The EPA provided preliminary modeling results for 2018, which show contribution to nonattainment of the 2008 ozone NAAQS in the DFW area from sources outside of Texas. The EPA intends to update the modeling results for 2018 to include EI data provided by states. Once the EPA has established final contributions to nonattainment and maintenance of the 2008 ozone NAAQS, it will work with states to address their interstate transport obligations. The TCEQ used CAIR in its modeling analysis; see Chapter 3, Section 3.7.4.1: *2018 Cross-State Air Pollution Rule (CSAPR) Sensitivity*.

5.4.1.4 TERP

The TERP program was created in 2001 by the 77th Texas Legislature to provide grants to offset the incremental costs associated with reducing NO_X emissions from high-emitting heavy-duty internal combustion engines on heavy-duty vehicles, non-road equipment, marine vessels, locomotives, and some stationary equipment.

The primary emissions reduction incentives are awarded under the Diesel Emissions Reduction Incentive Program (DERI). The DERI incentives are awarded to projects to replace, repower, or retrofit eligible vehicles and equipment to achieve NO_X emission reductions in Texas ozone nonattainment areas and other counties identified as affected counties under the TERP where ground-level ozone is a concern.

From 2001 through August, 2014, $905 million in DERI grants were awarded for projects projected to help reduce 160,836 tons of NO_X. Over $313 million in DERI grants were awarded to projects in the DFW area, with a projected 57,052 tons of NO_X reduced. These projects are projected to reduce up to 19.08 tons per day of NO_X in the DFW area during 2014. Of that $313 million, $22 million were awarded to North Central Texas Council of Governments (NCTCOG) through third-party grants to administer subgrants in the DFW area.

The current DERI Emissions Reduction Incentive Grants Program grant round opened on September 3, 2014, and closed December 16, 2014. Over $188 million in applications were received for a total funding amount of approximately $60 million. Final grant selections were

made in March 2015, with awards and contracting completed by August 2015. An additional $15 million is anticipated to be awarded under the DERI Rebate Grants Program which opened to applications on February 9, 2015, and extends until June 26, 2015, or until all funds are awarded.

Three other incentive programs under the TERP will result in the reduction in NO_X emissions in the DFW area. The Texas Clean Fleet Program (TCFP) was established in 2009 to provide grants for the replacement of light-duty and heavy-duty diesel vehicles with vehicles powered by alternative fuels, including: natural gas, liquefied petroleum gas, hydrogen, methanol (85% by volume), or electricity. This program is for larger fleets, with a requirement that an applicant apply for replacement of at least 20 vehicles at a time. From 2009 through August 2014, almost $23.6 million in TCFP grants were awarded for projects to help reduce a projected 314.5 tons of NO_X. Over $3.3 million in TCFP grants were awarded to projects in the DFW area, with a projected 89.4 tons of NO_X reduced. The projects are projected to reduce up to 0.07 tons per day of NO_X in the DFW area starting in 2015. The latest grant application period ended October 3, 2014. Over $7.8 million will be awarded under this grant round, with grant contracts expected to be completed before August 2015.

The Texas Natural Gas Vehicle Grant Program (TNGVGP) was established in 2011 to provide grants for the replacement of medium-duty and heavy-duty diesel vehicles with vehicles powered by natural gas. This program may include grants for individual vehicles or multiple vehicles. The majority of the vehicle's operation must occur in the Texas nonattainment areas, other counties designated as affected counties under the TERP, and the counties in and between the triangular area between Houston, San Antonio, Dallas, and Fort Worth. T From 2011 through August 2014 over $36.4 million in TNGVGP grants were awarded for projects to help reduce a projected 1,137 tons of NO_X. Over $13.2 million in TNGVGP grants were awarded to projects where the applicant indicated the primary operation of the vehicle would occur in and around the DFW area, with a projected 452 tons of NO_X reduced. These projects are projected to reduce up to 0.36 tons per day of NO_X in the DFW area starting in 2015. The latest grant application period will extend through May 31, 2015, or until all available funds are awarded, whichever occurs earlier. Almost $15 million is available to award between August 31, 2014, and close of the application period on May 31, 2015. Through February 2015, the program had received a sufficient number of applications to use most of the remaining funds and it was anticipated that all available funds would be awarded.

A new Drayage Truck Incentive Program was established in 2013 to provide grants for the replacement of drayage trucks operating in and from seaports and rail yards located in the nonattainment areas. The first grant application period for this program opened September 22, 2014, with an application deadline of May 29, 2015, or until all allocated funds totaling $3,103,846 for the fiscal biennium are awarded, whichever occurs earlier.

The TERP program is currently authorized through 2019, which will result in continued reductions in the significant emissions source categories of heavy-duty on-road and non-road engines. TERP projects require reporting and documentation of emissions reductions over a multiple-year activity period, and a number of the existing TERP projects will still be reporting emissions reductions during the attainment year.

5.4.1.5 Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program (LIRAP)

SB 12, 80th Texas Legislature, 2007, enhanced the LIRAP, also known as AirCheckTexas Drive a Clean Machine (DACM), to expand participation by increasing the income eligibility to 300% of

the federal poverty rate and increasing the amount of assistance toward the replacement of a retired vehicle. HB 3272, 82nd Texas Legislature, 2011, Regular Session, further enhanced the LIRAP to expand participation by allowing a motorist to participate if their vehicle has been registered in a participating county for 12 of the 15 months preceding application for assistance. HB 3272 also revised program requirements for vehicles available as replacements.

The LIRAP provides $3,000 for cars of the current or previous three model-years; $3,000 for trucks of the current or previous two model-years; and $3,500 for hybrids, electric, natural gas, and all vehicles that have been certified to meet federal Tier 2, Bin 3 or cleaner standards of the current or previous three model-years. Replacement vehicles cannot cost more than $35,000, or $45,000 for hybrids, electric, natural gas, and all vehicles that have been certified to meet federal Tier 2, Bin 3 or cleaner standards before tax, title, and license fees. In addition, replacement vehicles must have an odometer reading of not more than 70,000 miles. The retired vehicle must be ten years or older or have failed an emissions test. The LIRAP also provides up to $600 for repair assistance to qualified motorists of a vehicle that has failed an emissions inspection.

In the DFW nonattainment area, the LIRAP is available to vehicle owners in nine counties: Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall and Tarrant. Between December 2007 and February 28, 2015, the LIRAP/DACM program has repaired 36,360 vehicles and retired and replaced 53,758 vehicles at a cost of $180,679,583.52. The LIRAP was appropriated $7 million annually for Fiscal Years 2014 and 2015 by the 82nd Texas Legislature.

5.4.1.6 Local Initiatives

The NCTCOG submitted an assortment of locally implemented strategies in the DFW nonattainment area including pilot programs, new programs, or programs with pending methodologies. These programs are expected to be implemented in the ten-county nonattainment area by 2018. Due to the continued progress of these measures, additional air quality benefits will be gained and will further reduce precursors to ground level ozone formation. A summary of each strategy is included in Appendix H: *Local Initiatives Submitted by the North Central Texas Council of Governments.*

5.4.1.7 Voluntary Measures

While the oil and natural gas industry is required to install controls either due to state or federal requirements, the oil and natural gas industry has in some instances voluntarily implemented additional controls and practices to reduce VOC emissions from oil and natural gas operations in the DFW nonattainment area as well as other areas of the state. Examples of these voluntary efforts include: installing vapor recovery units on condensate storage tanks; using low-bleed natural gas actuated pneumatic devices; installing plunger lift systems in gas wells to reduce gas well blowdown emissions; and implementing practices to reduce VOC emissions during well completions (i.e., "Green Completions"). The EPA's Natural Gas STAR Program provides details on these and other practices recommended by the EPA as voluntary measures to reduce emissions from oil and natural gas operations and improve efficiency. Additional information on the EPA Natural Gas STAR Program may be found on the EPA's Natural Gas STAR Program Web page (http://www.epa.gov/gasstar/).

The results from the TCEQ's Barnett Shale Special Inventory Phase One and Phase Two, which may include examples of these voluntary practices, have been analyzed and used to update controlled emissions estimates for area (nonpoint) sources. For example, special inventory data indicate approximately 12 percent of condensate production in the Barnett Shale area was controlled at an efficiency level of 97%. These data have been incorporated into the 2011

periodic inventory for area source condensate tank emissions; details may be found in the report Condensate Tank Oil and Gas Activities (http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5821199776FY1211-20121031-ergi-condensate_tank.pdf).

Additional information on the Barnett Shale Special Inventory Phase One and Phase Two preliminary results may be found on the TCEQ's Point Source Emissions Inventory Web page (http://www.tceq.texas.gov/airquality/point-source-ei/psei.html).

While voluntary industry practices are not enforceable under the SIP, these efforts help reduce VOC emissions in the nonattainment area. The TCEQ supports and encourages these proactive efforts to reduce emissions in the DFW nonattainment area.

All of the measures discussed in this qualitative analysis section assist in reducing emissions in the DFW nonattainment area, but are not able to be quantified at this time. All emission reduction strategies would be expected to have a downward effect on ozone formation in the DFW nonattainment area. In conjunction with the photochemical modeling documented in Chapter 3, these strategies will assist the DFW nonattainment area in reaching attainment of the 2008 eight-hour ozone standard by 2018, if not sooner.

5.5 CONCLUSIONS

The TCEQ has used several sophisticated technical tools to evaluate the past and present causes of high ozone in the DFW nonattainment area in an effort to predict the area's future air quality. Photochemical grid modeling performance has been rigorously evaluated, and 2006 ozone episodes from both June and August-September have been used to match the times of year when the highest ozone levels have historically been measured in the DFW nonattainment area. Historical trends in ozone and ozone precursor concentrations and their causes have been investigated extensively. The following conclusions can be reached from these evaluations.

First, as documented in Chapter 3 and Appendix C, the photochemical grid modeling performs relatively well, with one weakness being an overproduction of ozone primarily during night-time hours and days when lower ozone concentrations are measured. Problems observed with the base case ozone modeling are those that are known to exist in all photochemical modeling exercises, particularly when multiple consecutive weeks are modeled rather than short time periods of just one or two weeks. The model can be used with confidence to project future ozone design values because the EPA guidance recommends applying the relative response in modeled ozone to monitored design values. The photochemical grid modeling predicts that the 2018 future year ozone design value at one monitor, the Denton Airport South monitor, will be 76 ppb, and that all the remaining monitors will be either at or below the 75 ppb eight-hour ozone standard. The 2018 future design values for all DFW area monitors are either below or within the 73-78 ppb WoE range inferred for the 75 ppb standard from the 82-87 ppb WoE range specified in the former EPA guidance for the 84 ppb standard.

Additionally, the 76 ppb future design value for the Denton Airport South monitor is based on the "all days" attainment test recommended by the former EPA modeling guidance from April 2007. Application of the "top 10 days" attainment test recommended by the draft EPA modeling guidance from December 2014 results in a 2018 future design value of 75 ppb at the Denton Airport South monitor, with the values for all other monitors ranging from 62-74 ppb. The draft guidance recommends the newer top 10 days test over the former all days test because "model response to decreasing emissions is generally most stable when the base ozone predictions are highest. The greater model response at higher concentrations is likely due to more 'controllable'

ozone at higher concentrations." The TCEQ concurs with this assessment, and feels that the top 10 days test is a superior predictor of future ozone design values for this AD. The EPA's draft guidance no longer specifies a WoE range for future year design values, and instead requires "a fully-evaluated, high-quality modeling analysis that projects future values that are close to the NAAQS." With inclusion of the superior top 10 days test, this DFW AD SIP revision and all of its appendices document a fully-evaluated high-quality modeling analysis with future year design values that are at or below the 75 ppb eight-hour ozone standard for all DFW area ozone monitors.

The prospective and weekday-weekend evaluations presented in Chapter 3 show that the model response to emission decreases is similar to the response observed in the atmosphere, suggesting that the NO_X and VOC emission levels projected for 2018 will lead to lower ozone concentrations recorded at the DFW area monitors. The prospective analysis presented in Chapter 3 and Appendix C showed that applying 2012 emission estimates to the 2006 base case meteorology did a satisfactory job of estimating the 2012 eight-hour ozone design values at various DFW area monitors. This is particularly significant because this 2012 modeling performed significantly better than that submitted in the 2011 AD SIP revision. As summarized in Table 3-37: *Summary of Ozone Modeling Platform Changes*, the current modeling platform relies on improved tools and methodologies that were not available when the 2011 AD SIP revision work was performed: updated version of the photochemical model; improved meteorological model; improved chemical mechanism for VOC speciation; superior biogenic emissions model; updated anthropogenic emission inventories; and larger fine and coarse grid modeling domains.

Second, the ozone trend analyses show that ozone has decreased significantly since 2000 when the eight-hour ozone design value at the Denton Airport South monitor was 102 ppb. As of 2014, the Denton Airport South monitor has an eight-hour ozone design value of 81 ppb. NO_X and VOC precursor trends also show significant decreases, which has led to this reduced ozone formation. These reductions in precursors in the DFW nonattainment area are due to a combination of federal, state, and local emission controls. As shown in this chapter, Chapter 3, and Appendix B, the on-road and non-road mobile source categories are the primary sources of NO_X emissions in the DFW nonattainment area, and are expected to continue their downward decline due to fleet turnover where older high-emitting sources are replaced with newer low-emitting ones. The current TERP program managed by the TCEQ continues to accelerate the mobile source fleet turnover effect by providing financial incentives for purchases of lower-emitting vehicles and equipment. Ozone formation is expected to steadily decline through the 2018 attainment year as lower amounts of NO_X are emitted from these sources. Based on the photochemical grid modeling results and these corroborative analyses, the WoE indicates that the DFW nonattainment area will attain the 2008 eight-hour ozone standard by December 31, 2018, and possibly earlier.

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CHAPTER 6: ONGOING INITIATIVES

6.1 INTRODUCTION

The Texas Commission on Environmental Quality (TCEQ) is committed to improving the air quality in the Dallas-Fort Worth (DFW) area and continues to work toward identifying and reducing ozone precursors. Texas is investing resources into technological research and development for advancing pollution control technology and refining quantification of emissions, improving the science for ozone modeling and analysis. Refining emissions quantification helps improve understanding of ozone formation, which benefits the state implementation plan (SIP). Additionally, the TCEQ is working with the United States Environmental Protection Agency (EPA), local area leaders, and the scientific community to evaluate new measures for reducing ozone precursors. This chapter describes ongoing technical work that will be beneficial to improving air quality in Texas and the DFW nonattainment area.

6.2 ONGOING WORK

6.2.1 EPA Oil and Gas Emission Estimation Tool

Under EPA Contract EP-D-11-006, Work Assignment (WA) 2-05, Eastern Research Group, Inc. (ERG) has developed a Microsoft Access-based tool that may be used by the EPA, states, and local agencies to develop state- or region-specific non-point (area source) emission inventories for the upstream oil and gas sector based on user-supplied activity and emissions inputs. The tool is currently being reviewed by the Oil and Gas National Committee, a collection of representatives from national, state, and local environmental agencies. As part of the Oil and Gas National Committee, the TCEQ has provided feedback on the calculation methodologies used by the tool as well as provided Texas-specific emission factors and activity data for several source categories. The TCEQ also identified some source categories where additional research should be done to try to improve the default national tool activity data with Texas-specific data.

6.2.2 Oil and Gas Well Drilling Activities

There has been a large increase in drilling activity in certain regions of Texas over the past ten years, in particular for unconventional horizontal wells in shale formations such as the Barnett Shale, which overlaps the western portion of the 2008 DFW ozone nonattainment area. With the increase in horizontal drilling, the TCEQ has made efforts to improve emissions inventory (EI) estimates related to drilling activities. For example, emissions from mud degassing and hydraulic pump engines are a relatively new category of emissions that the TCEQ has begun to report to the National Emissions Inventory. The TCEQ used the EPA Oil and Gas Emission Estimation Tool to develop the 2011 emissions. Also, ERG recently completed (August 2014) a study through a contract with the TCEQ to improve the emission factors and activity data for these two categories with Texas basin-specific data. The updated factors and activity data were incorporated in the attainment demonstration (AD) and reasonable further progress (RFP) SIP revisions. In January 2015, the TCEQ published a technical supplement to this DFW AD SIP revision, *Technical Supplement to the December 10, 2014 Proposal of the Dallas-Fort Worth Attainment Demonstration State Implementation Plan Revision for the 2008 Eight-Hour Ozone Standard Nonattainment Area*, that provided further detail on how these estimates were incorporated into the AD SIP revision EI.

6.2.3 New Source Performance Standards Subpart OOOO

The New Source Performance Standards (NSPS) in 40 Code of Federal Regulations (CFR), Part 60, Subpart OOOO, require companies to reduce VOC emissions from newly constructed or modified oil and gas sources which were not previously regulated at the national level. The rule

includes requirements to control emissions from unconventional natural gas well completions, oil and condensate storage tanks, and pneumatic devices, along with other sources. Many of the control requirements had a compliance date in 2012, although some sources have a compliance date in 2015. The TCEQ is continuing to evaluate how the NSPS Subpart OOOO rules will affect area source oil and gas emissions estimates now and in the future. These control requirements were incorporated as appropriate into the area source oil and gas 2013 EI for this DFW AD SIP revision. The January 2015 technical supplement provides further detail on how these controls were incorporated into the AD SIP revision EI.

6.2.4 Biogenic Emissions Projects

There are four ongoing Air Quality Research Program (AQRP) projects dedicated to improving the estimates of biogenic emissions throughout Texas.

- AQRP 14-008: Investigation of input parameters for biogenic emissions modeling in Texas during drought years (University of Texas).
- AQRP 14-016: Improved land cover and emission factor inputs for estimating biogenic isoprene and monoterpene emissions for Texas air quality simulations (Environ, National Oceanic and Atmospheric Administration, and Pacific Northwest National Laboratory).
- AQRP 14-017: Incorporating space-borne observations to improve biogenic emission estimates in Texas (University of Alabama-Huntsville, Rice University).
- AQRP 14-030: Improving modeled biogenic isoprene emissions under drought conditions and evaluating their impact on ozone formation (Texas A&M University).

These four projects will investigate biogenic emissions using modeling, aircraft-measured concentration data, satellite-estimated solar radiation and temperature data, and field study data from a forest research site, respectively. The wide-ranging efforts of these projects will benefit SIP modeling for the DFW nonattainment area by expanding our understanding of biogenic emissions and the factors that drive them.

6.3 COMMITMENT FOR 2017 ATTAINMENT YEAR

6.3.1 Altered Attainment Date Background

As discussed in the Executive Summary and Chapter 1: *General*, of this DFW AD SIP revision, the proposed DFW AD SIP revision was developed based on the EPA's May 21, 2012 implementation rule for the 2008 ozone National Ambient Air Quality Standard (NAAQS) (77 *Federal Register* [FR] 30160), which set 2018 as the attainment year for areas classified as moderate. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 ozone NAAQS is July 20, 2015, which the EPA has not altered.

On December 23, 2014, the United States Court of Appeals for the District of Columbia Circuit (D.C. Circuit Court) ruled on a lawsuit filed by the Natural Resources Defense Council, which resulted in vacatur of the EPA's December 31 attainment date for the 2008 0zone NAAQS. As part of the EPA's Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; Final Rule (2008 ozone standard SIP requirements rule), published in the Federal Register on March 6, 2015 (80 FR 12264), the EPA modified 40 CFR §51.1103 consistent with the D.C. Circuit Court decision to establish attainment dates that run from the effective date of designation, i.e., July 20, 2012, rather than the end of the 2012 calendar year. As a result, the attainment date for the DFW moderate nonattainment area has changed from December 31, 2018 to July 20, 2018. In addition, because the attainment year ozone season is the ozone season immediately preceding a nonattainment area's attainment date, the attainment year for the DFW moderate nonattainment area has changed from 2018 to 2017.

6.3.2 Commitment to Develop SIP Revision

As discussed above, due to the timing of the court's ruling and the EPA's subsequent rulemaking action to alter the attainment date, it was not possible to complete all work necessary for this DFW AD SIP revision to completely address a 2017 attainment year.

Therefore, the commission commits to develop a new DFW AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, a reasonably available control measures (RACM) analysis, and a Motor Vehicle Emissions Budget.

Appendices available upon request.

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RESPONSE TO COMMENTS RECEIVED CONCERNING THE DALLAS-FORT WORTH (DFW) ATTAINMENT DEMONSTRATION (AD) STATE IMPLEMENTATION PLAN (SIP) REVISION FOR THE 2008 EIGHT-HOUR OZONE STANDARD

PROPOSED DECEMBER 10, 2014

The commission conducted a public hearing in Arlington on January 15, 2015, at 6:30 p.m., and in Austin on January 22, 2015, at 10:00 a.m. During the comment period, which closed on February 11, 2015, the commission received comments from the Children's Health System of Texas, the DFW Regional Concerned Citizens, Dallas County Medical Society, Downwinders at Risk (Downwinders), State Representative Lon Burnam (Representative Burnam), the Greater Fort Worth Sierra Club, the Health and Wellness Alliance for Children, the League of Women Voters of Dallas, the Lone Star Chapter of the Sierra Club, Mayor John Monaco of the City of Mesquite (City of Mesquite), the North Texas Chapter of American Solar Energy Society, the Regional Transportation Council (RTC), the Texas Medical Association, Public Citizen, the Sierra Club, Solar Turbines Incorporated (Solar), Sustainable Energy and Economic Development (SEED) Coalition, Texas Pipeline Association (TPA), the United States Environmental Protection Agency (EPA), and 56 individuals.

Comments more directly related to the concurrent rulemaking in 30 Texas Administrative Code (TAC) Chapter 117 Nitrogen Oxides (NO_X) Reasonably Available Control Technology (RACT) Rule Revisions (Rule Project No. 2013-049-117-AI) and 30 TAC Chapter 115 Volatile Organic Compounds (VOC) RACT Rule Revisions (Rule Project No. 2013-048-115-AI), which were incorporated by reference into the DFW AD SIP revision, are responded to in the Response to Comments sections of the preambles to those rulemakings.

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GENERAL COMMENTS

General Support

The League of Women Voters of Dallas thanked the employees of the Texas Commission on Environmental Quality (TCEQ) for working hard to protect public health and the environment and submitted an article, *League of Women Voters Launches Clean Air Promise Campaign*. Public Citizen thanked TCEQ staff for doing a thankless job with good intentions. The Sierra Club and Downwinders noted appreciation for the work of TCEQ staff in the development of the proposed DFW AD SIP revision. One individual expressed appreciation for TCEQ staff.

The TCEQ appreciates the support and is committed to working with local entities and interested parties to keep them updated on SIP developments and informed about technical issues related to air quality. The TCEQ has included a copy of the article, *League of Women Voters Launches Clean Air Promise Campaign*, in the record. No changes were made in response to these comments.

Public Participation

An individual commented that the TCEQ does not take the public participation process seriously and will not make any modifications to the DFW AD SIP revision in response to comments received at public hearings. One individual noted concern that no action will result from comments submitted.

The TCEQ encourages public participation in the SIP development process and appreciates the efforts of those who took the time to evaluate the proposed DFW AD SIP revision and provide oral and written comments. The TCEQ takes its duties very seriously and has reviewed and analyzed all testimony related to this DFW AD SIP revision, provided responses to comments, and made changes in the DFW AD SIP revision as appropriate. All public comments received have been included in the DFW AD SIP revision package that will be submitted to the EPA. No changes were made in response to these comments.

Air Quality Concerns

One individual expressed concern about poor air quality in the DFW area and one individual expressed concern regarding numerous days in the DFW area with red-brown haze on the horizon and the skyline fuzzed with smog. An individual stated that the TCEQ should begin to address air pollution problems in Texas. One individual commented that bad air quality limits time outdoors. Eight individuals requested clean air to breathe. One individual commented that they saw the need for a higher standard for clean air. Two individuals stated that air quality improvements have taken too long to achieve and desires to breathe clean air. One individual commented that Dallas has some of the worst air quality in the entire nation.

The Greater Fort Worth Sierra Club and three individuals stated that the TCEQ should help our children instead of the polluting industries. The Lone Star Sierra Club and seven individuals commented that the TCEQ supports industry and not public health. One individual commented that the highest standards should be upheld for clean air and that they would be willing to pay higher taxes and higher costs for clean air. One individual commented that the TCEQ should take the side of the community so that the corporations get the guidance they need to meet the needs of the community. An individual stated that the TCEQ should take action for citizens and not political pressure groups, industry, and lobbyists. One individual noted that businesses are

appropriately designed to make money; and the government is supposed to regulate appropriately, and requested the TCEQ be on the side of the community. One individual commented that the DFW AD SIP revision does not address the needs of the community. Two individuals commented that the state should take care of its citizens.

The TCEQ strives to protect our state's human and natural resources consistent with sustainable economic development and in accord with federal and state laws. The TCEQ is committed to attaining the 2008 eight-hour ozone standard as expeditiously as practicable. The purpose of this DFW AD SIP revision is to demonstrate attainment of the 2008 eight-hour ozone standard in accordance with the EPA's guidance and Federal Clean Air Act (FCAA) requirements. The DFW area has made considerable improvement in air quality, as evidenced by the information provided in this DFW AD SIP revision. For example, between 2000 and 2014 the eight-hour ozone design value has trended downward 21 ppb, as a result of both state and federal rules. The number of DFW eight-hour ozone exceedance days has also decreased from 36 to three over the same period. Progress toward attainment of the ozone standard has been significant, even in light of the increasing population and vehicle miles traveled in the DFW area, which is largely influenced by mobile emissions. All emissions in the area (on-road mobile, non-road mobile, stationary point sources, and area sources) were reviewed in this DFW AD SIP revision for appropriate emission controls.

The rules associated with this DFW AD SIP revision include achievable and cost-effective emissions standards for sources in and around the DFW ozone nonattainment area. An achievable and cost-effective level of control for a particular source category depends on the current levels of emissions, available control technologies for the source category, and other technical and economic factors that may be specific to a source or to a region. The TCEQ determined the appropriate level of control for sources in the DFW ozone nonattainment area considering all appropriate factors, including information obtained during the public comment period. Discussion regarding the level of control required on specific source categories is provided in the preambles to the rules associated with this DFW AD SIP revision. No changes were made in response to these comments.

An individual commented that the language used to define nonattainment area classifications is misleading and that the term "moderate nonattainment" implies that air quality in the DFW area is not so bad.

The TCEQ's authority regarding the designation and classification of nonattainment areas is limited under the FCAA to providing recommendations to the EPA. In accordance with the FCAA, ozone nonattainment areas are classified by the EPA based on the ambient ozone design value in an area at the time of designations. The classifications range in severity. There are five classifications – marginal, moderate, serious, severe, and extreme. A "moderate" classification is the second level on this scale, and indicates an area that is significantly closer to attaining the ozone standard than areas classified as serious, severe, or extreme. The EPA finalized a rule on May 21, 2012 (77 *Federal Register* [FR] 30160) establishing the air quality classification thresholds for the 2008 eight-hour ozone standard and classified the 10-county DFW area as "moderate nonattainment"

according to that rule, and the DFW area's design value. No changes were made in response to these comments.

An individual commented that earthquakes have caused or could cause water main ruptures, explosions, and residential and business damage. Another individual commented that earthquakes are a result of oil and gas activities, and voiced concern over explosions and tap water catching fire. An individual commented that the TCEQ should put a stop to drilling and hydraulic fracturing (fracking) activities that occur close to the city limits as they cause earthquakes.

Comments related to earthquakes or water contamination, including incidents allegedly linked to fracking, are beyond the scope of this DFW AD SIP revision. No changes were made in response to these comments.

An individual commented that the President's plan to include methane and other associated chemical releases from the gas drilling activities in our densely populated environment must be studied and the chemicals must be measured.

The President's Climate Action Plan proposes actions to reduce methane emissions from the oil and gas sector by 40-45% from 2012 through 2025. The purpose of this DFW AD SIP revision is to demonstrate attainment of the 2008 eight-hour ozone standard. The EPA's definition of VOC, found in 40 Code of Federal Regulations §51.100(s), specifically excludes methane from this class of ozone precursors. Therefore, this comment is outside the scope of this DFW AD SIP revision. No changes were made in response to these comments.

Health Effects

Eleven individuals noted concern for health and air quality and one individual expressed concern regarding a decrease in quality of life due to air quality. One individual commented that smog generates and exacerbates adverse health conditions.

The SEED Coalition commented that the health of our children, our elderly, and those with chronic lung problems should be put first and foremost. Two individuals noted general concern for children's health and air quality. One individual commented that the health and well-being of our future should be protected.

One individual noted that a research study should be considered regarding the growing number of children with asthma in the DFW area. The Health and Wellness Alliance with the Children's Health System of Texas commented that consistently high ozone levels impact the well-being of all children and endanger the lives of children with asthma. Two individuals expressed concern regarding children developing asthma due to bad air in the DFW area.

The Dallas County Medical Society commented that ozone days between 90 – 100 ppb provide a serious threat to pediatric asthma patients, elderly emphysema patients, and middle-aged patients with coronary heart disease. The commenter also noted concern regarding three coal power plants that need to reduce air pollution emissions to current EPA standards to protect patients in North Texas with asthma and chronic lung disease and to prevent premature death.

One individual questioned the effects of outside workers' daily exposure to toxins in the air and noted that migraine headaches are worse during severe pollution days. The League of Women Voters of Dallas expressed concern that the human health impact regarding the cumulative mix of chemicals in the air has not been fully investigated.

One individual commented that ozone damages our lungs. One individual commented that chronic obstructive pulmonary disease (COPD) and asthma are caused by poisoned air and VOC. Six individuals expressed general concern for asthma and air quality. The League of Women Voters of Dallas commented that ozone can cause health problems such as throat irritation, reduced lung function, inflammation in airways, and cardiac problems and that ozone pollution deaths in the DFW area rank second in the country behind the northeast.

The Health and Wellness Alliance for Children of Children's Medical Center commented that consistently high ozone levels across the North Texas region are impacting the well-being of all children and endangering the lives of children burdened by asthma. Annual economic costs to Dallas County, including costs to families in medical care facilities across the community, are estimated to be a staggering $60 million. Mortality rates are 12 deaths per 100,000 for asthma among children in Dallas County.

An individual commented that as a teacher, she has seen asthma in children increase in her school in Fort Worth to two to three students per class. She is concerned that the medical expenses associated with asthma are increasing and many can't afford their prescription medicine. She stated the greed of a few is fed at the expense of innocents and asked the TCEQ not to allow this to continue.

The Sierra Club and Downwinders commented on the prevalence of asthma in Texas, in particular in the DFW region, and how this disease disproportionately affects minorities and low-income families. They commented that ozone is a significant driver of unhealthy air in Texas, and that ozone exposure significantly impacts health, particularly respiratory health. They expressed concern both about acute and long-term exposures to ozone, particularly how those exposures impact respiratory and cardiovascular morbidity, premature mortality, perinatal and reproductive diseases, as well as suggested impacts on the central nervous system. They commented that physiological impacts that are seen in healthy individuals are relatively low concentrations of ozone, but that certain sensitive and at-risk groups may have an increased susceptibility to ozone-induced health impacts. In addition, they stated that acute and chronic ozone exposure can have respiratory impacts including respiratory symptoms, lung function defects, inflammation, and lung injury. They commented that epidemiology studies show that ozone is associated with respiratory hospital admissions and emergency department visits and increases respiratory mortality. They commented that ozone exposure is linked to both new-onset asthma and asthma exacerbations and that, increasingly, ozone has been associated with cardiovascular effects as well as respiratory effects. They also commented that both acute and chronic exposure to ozone has been linked to premature mortality. In particular, they noted that daily changes in ambient ozone concentrations are linked to premature mortality, even at very low pollution levels. They also commented that there are health impacts related to ozone exposure on newborns and the developing fetus.

The TCEQ appreciates the comments related to health effects of ozone and is committed to working with area stakeholders to attain the 2008 eight-hour ozone standard, which is a health-based standard. The primary National Ambient Air

Quality Standards (NAAQS) are those that the EPA determines are necessary to protect public health, including sensitive members of the population such as children, the elderly, and those with pre-existing conditions. Breathing relatively high levels of ground-level ozone may cause acute respiratory problems like cough and respiratory irritation and may aggravate the symptoms of asthma. Health effects from ozone can generally resolve quickly once an individual is no longer exposed to high levels. The TCEQ agrees with the League of Women Voters of Dallas that there are not many studies determining the health effects of ozone in combination with other pollutants. This lack of data prevents the TCEQ from making assessments on the health effects of ozone-pollutant mixtures.

Between 2000 and 2014, the eight-hour ozone design value in the DFW area has trended downward by 21 ppb. This decrease in ozone design value has coincided with significant reductions in ozone precursor emissions. Analyzing the anthropogenic emissions inventory (EI) from 2005 to 2011 for the 10-county DFW 2008 eight-hour ozone nonattainment area indicates that NO_X emissions have decreased by approximately 29,000 tons (16%) and VOC emissions have decreased by approximately 80,000 tons (34%).

Several health-related concerns have been broached by commenters, and responses to these concerns are listed below.

Asthma:

Despite decreasing levels of both precursors and ozone, diagnosis of asthma continues to increase. As a result, it is not clear that there is a definite link between ozone levels and asthma development.

Although the causes of asthma are not fully understood, there are many factors that influence the development and exacerbation of asthma. According to the World Health Organization, one of the strongest risk factors for developing asthma is genetic predisposition. In addition, indoor allergens (dust mites, pet dander, and presence of pests such as rodents or cockroaches) together with outdoor allergens (pollen and mold), tobacco smoke, or other triggers such as cold air, extreme emotions (anger or fear), and physical exercise can all provoke symptoms in those with asthma. The Centers for Disease Control and Prevention estimates that asthma prevalence has increased over recent years. The reason for this increase is unknown, but some scientists have suggested changes in exposure to microorganisms (hygiene hypothesis) or the rise in sedentary lifestyle (affecting lung health) and obesity, which results in inflammation, may be to blame.

Recent, large, multi-city studies, which have included Dallas, have shown that current ambient concentrations of ozone do not increase asthma symptoms (O'Connor, 2008, Schildcrout, 2006). In addition, a recent study has shown that the most important factors affecting asthma are not urban (more polluted) areas, but rather ethnicity and poverty (Keet, 2015).

Ozone-induced mortality:

The TCEQ does not support the assertion that ambient concentrations of ozone are causing death because the scientific data does not support it.

Tests on human subjects have shown that when people are exposed to ozone at ambient concentrations (i.e. 40 ppb – 120 ppb) for up to eight hours while exercising vigorously, a range of mild respiratory effects occur. It is not consistent with toxicological principles that a concentration of ozone that only causes a mild, reversible effect, or no effect at all, also causes death. The doses of ozone that kill animals is orders of magnitude higher than ambient ozone (the National Institute for Occupational Safety and Health (NIOSH) Immediately Dangerous to Life or Health value for ozone is 5000 ppb; NIOSH 2005), and so, again, does not support assertions that there is a mechanism for ambient ozone to contribute to mortality. The epidemiology studies that are the basis for the conclusions about ozone affecting mortality have a crucial error; these studies do not consider the actual exposure of the people in the study. Rather, these studies assume that people are exposed to the level of ozone at the ambient monitor (sometimes to the highest ambient monitor in the entire metropolitan area), which could be up to 10-times higher than their actual exposure (Lee 2004), and may not even correlate with the person's exposure (Sarnat, 2001, Sarnat, 2005).

Respiratory effects of ozone:

Studies done in the last several years have shown that people who are exposed to ozone at 60, 72, or 80 ppb, while vigorously exercising for 6.6 hours, experience mild, reversible respiratory effects that are not clinically significant by the EPA's standards (Adams, 2006, Kim, 2011, Schelegle, 2009). Exposure to 88 ppb caused clinically significant effects by the EPA's standards, but the DFW area's eight-hour ozone design value (the 4th highest level averaged over three years) was 81 ppb in 2014, which is below the 88 ppb level required to cause clinically significant effects. Children and asthmatics have been shown to have the same respiratory effects after ozone exposure as healthy adults (McDonnell, 1985, Koenig, 1987, Holz, 1999, Stenfors, 2002). Clinical studies have not shown increased lung function responses to ozone of people with COPD compared to healthy individuals (Gong 1997). There is little consistent data from epidemiology studies showing lung function effects of ozone on individuals with COPD (Peacock 2011, Lagorio 2006).

Long-term exposure to ozone:

The EPA concludes that there is a likely causal relationship between ozone and long-term respiratory mortality, based on a single epidemiology study (Jerrett, 2009). The relationship between long-term ozone exposure and mortality has been investigated in at least 12 epidemiology studies. When considering other potential causes of mortality, such as other air pollutants, only one of those studies (Jerrett, 2009) showed a statistically significant (but very small) effect of ozone on respiratory mortality. Interestingly, the effect only occurred at temperatures above 82°F. Paradoxically, the increased mortality was not observed in United States (U.S.) regions with the highest ozone concentrations (southern California) nor in areas with the highest number of respiratory deaths (the Northeastern U.S. and the industrial Midwest). Other studies that looked at the same dataset as Jerret, 2009 did not find an association between long-term ozone exposure and cardiopulmonary mortality (Pope, 2002, Jerret, 2005).

The evidence for other long-term effects of ambient concentrations of ozone is even weaker than the respiratory mortality data. A recent study of children in the Los Angeles (LA) area,which has much higher levels of ozone than the DFW area (the 2014 eight-hour ozone design value was 102 ppb in LA and 81 ppb in DFW) has shown that ozone has no effect on lung development (Gauderman, 2015).

Cardiovascular effects of ozone:

Several recent studies have integrated all of the evidence for both short-term and long-term ozone exposure effects on cardiovascular disease and mortality. For both short-term and long-term exposure, the study authors found that the evidence was "below equipoise." This means that the evidence is not good enough to conclude that either short-term or long-term exposure to ambient concentrations of ozone causes cardiovascular health effects (Goodman, 2014, Prueitt, 2014).

Other health effects:

Many different health effects have been investigated after ozone exposure. However, only those with consistent, robust data are considered in the TCEQ and the EPA's health risk assessments. Those that do not have robust datasets, and therefore are not included in the risk assessment, include: perinatal, reproductive, and central nervous system impacts.

No changes were made in response to these comments. References for all studies are provided at the end of the document.

The League of Women Voters of Dallas and one individual commented that particulate matter (PM) causes adverse health effects and haze and that the TCEQ has an obligation to reduce PM pollution in the DFW area. The League of Women Voters of Dallas submitted a 2011 article regarding the Clean Air Promise Campaign to inform and engage Americans on the issue of clean air, asking them to protect the health of children and families by supporting clean air policies that public health experts have recommended.

This DFW AD SIP revision is intended to demonstrate attainment of the 2008 eight-hour ozone NAAQS. Comments related to PM pollution are outside the scope of this DFW AD SIP revision; however, the EPA issued final area designations on December 18, 2014 for the 2012 primary annual fine particulate matter ($PM_{2.5}$) NAAQS, designating all areas of Texas, including the DFW area, as unclassifiable/attainment. Further, the DFW area is designated attainment for all PM NAAQS. No changes were made in response to these comments.

Oil & Gas Health Effects

One individual commented that the TCEQ should do more to protect human health and the environment from oil and gas activities and not allow itself to be influenced by politics. The Greater Fort Worth Sierra Club expressed concern regarding the long-term health effects of ozone and emissions from natural gas sites in the DFW area.

An individual commented that poor air quality and fracking causes sore throats; bloody noses; burning eyes; and breathing problems, especially in children with asthma. One individual commented that drilling and fracking close to city limits cause people to get cancer. One

individual commented that fracking causes cancer, teen depression, rashes, nosebleeds, and asthma. Another individual commented that drilling and fracking in residential areas causes allergies, pneumonia, migraines, nausea, cancer, asthma, and nosebleeds in children.

An individual expressed concern about gas emissions and their effect on our youth's lungs and reproductive organs each time they breathe the Arlington air when they are directly downwind while at Six Flags, Ranger Stadium, or AT&T Stadium. An individual commented that public quantitative health research needs to be done in North Texas on chemical releases from the gas drilling activities since the citizens are suffering health risks associated from this activity.

The TCEQ has conducted extensive air monitoring for chemicals associated with oil and gas operations in the DFW area, and staff has not monitored any off-site, short-term concentrations that would be expected to cause adverse health effects after short-term exposure. Additionally, staff has not monitored any concentrations at stationary monitors that would be expected to cause adverse health effects after long-term (i.e., lifetime) exposure. In some instances, staff has measured short-term concentrations of some chemicals that would be expected to cause odors, consistent with citizen odor complaints and staff investigator reports. No changes were made in response to these comments.

To help address concerns about potential health risks (including cancer) from long-term exposure to emissions from oil and gas operations, The stationary VOC monitoring network in the DFW nonattainment area has increased from eight VOC monitors in 2009 to 25 monitors in December 2014, mostly at the direction of Senate Bill 527 of the 82nd Legislative Session. The bill directed the TCEQ to work with a non-profit organization to expand and maintain air quality monitors in North Texas. These monitors were specifically sited to evaluate long-term ambient air quality in populated areas impacted by oil and gas activity.

The TCEQ uses long-term air monitoring comparison values (AMCV) to help determine the potential for chronic adverse health effects to occur from long-term exposure to monitored concentrations of chemicals in air. Long-term AMCVs are protective of cancer and non-cancer health effects as well as adverse effects on vegetation. Based on long-term air monitoring data collected to date in the Barnett Shale area, the TCEQ would not expect an increased risk of cancer to result from long-term exposure to the monitored concentrations.

Air monitoring data and associated toxicological evaluations addressing oil and gas-related air quality issues in the DFW area are publicly available on the TCEQ's Barnett Shale Web page (https://www.tceq.texas.gov/airquality/barnettshale). Toxicological evaluations of Region 4 ambient air network monitoring data are publicly available on the TCEQ's Toxicology Division Web page (http://www.tceq.texas.gov/toxicology/regmemo/AirMain.html). No changes were made in response to these comments.

Economic Effects

DFW Regional Concerned Citizens commented that this DFW AD SIP revision does not move the area toward meeting the newer more strict attainment standards, and thus impacts our

economic growth, our citizens' health, and the public infrastructure funding. The Sierra Club and Downwinders commented that the inability of the DFW area to achieve clean air impacts the local and regional economy. The commenters added that evidence is strong that ozone reduces yields for economically important local crops.

Lone Star Chapter of Sierra Club commented that industry avoids expanding to areas designated nonattainment and that this DFW AD SIP revision supports industry and not the public health. Two individuals commented that many people will leave Texas due to poor air quality. One individual commented that businesses and families will not invest in an area with poor air quality.

The Sierra Club and Downwinders commented that increased economic activity will adversely impact ozone levels.

The TCEQ strives to protect the state's human and natural resources consistent with sustainable economic development. The DFW area has made considerable improvement in air quality while steadily increasing in population and gross metropolitan product.

For example, between 2000 and 2014, the eight-hour ozone design value has trended downward 21 ppb. The number of days in the DFW area where the daily eight-hour ozone peak exceeded 84 ppb has also decreased from 36 to 3 over the same period. According to data from *U.S. Metro Economies Reports* prepared for the United States Conference of Mayors,[1,2] from 2000 to 2013 (the most recent year for which data were available), the DFW metropolitan area's economy has grown from $223 billion to $440 billion and the population has grown approximately 31%. No changes were made in response to these comments.

Inadequacies of the SIP

The DFW Regional Concerned Citizens commented that the proposed DFW AD SIP revision is inadequate, does not meet the criteria of the FCAA, and does not constitute sufficient progress toward bringing the DFW area into compliance with the new proposed standard currently being considered by the EPA. Representative Lon Burnam commented that this plan is inadequate and illegal and the TCEQ is not doing its job to clean the air. The Lone Star Chapter of the Sierra Club commented that the DFW AD SIP revision is inadequate and contained no changes. The Sierra Club and Downwinders urged the TCEQ to take the necessary steps to bring the area into attainment as expeditiously as practicable. 56 individuals commented that the plan is inadequate.

Public Citizen commented that this area has never complied with nor met the goals of the SIP. Downwinders and 52 individuals noted that previous ozone deadlines have not been met and recommended that the EPA reject the plan and take other actions as necessary. Public Citizen also commented that the TCEQ is not doing its job to reduce air pollution to a safe level. The

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1 IHS Global Insight (USA), Inc. (2010). *U.S. Metro Economies: GMP and Employment 2013-2015*. Prepared for The United States Conference of Mayors and The Council on Metro Economies and the New American City.

2 DRI-WEFA, Inc. (2001). *U.S. Metro Economies: The Engines of America's Growth*. Prepared for The United States Conference of Mayors.

Sierra Club, Downwinders, and one individual commented that given the State's history of attainment failure and the propensity for failure with this DFW AD SIP revision, the final numbers do not reflect any margin of error.

The Greater Fort Worth Sierra Club, the SEED Coalition, and two individuals commented that the 75 ppb ozone standard will not protect public health. The Health and Wellness Alliance commented that the current 75 ppb goal by 2018 is insufficient due to current scientific evidence in support of a lower standard. The SEED Coalition asserted that the standard should be 60 ppb and the Greater Fort Worth Sierra Club and one individual noted that this plan should aim to achieve at least 65 ppb to better protect human health. The Health and Wellness Alliance, Downwinders, and 52 individuals commented that this plan should aim at achieving ozone levels closer to 70 ppb in anticipation of the lower standard. One individual requested a clean air plan that will work and one individual requested a plan that will encourage lower future ozone levels.

Sections 108 and 109 of the FCAA govern the establishment, review, and revision, as appropriate, of the NAAQS. The FCAA requires the EPA to periodically review the NAAQS to determine whether or not existing standards are adequate to protect public health and welfare. The TCEQ has no authority under the FCAA concerning the evaluation and/or setting of the NAAQS. Comments regarding NAAQS levels are beyond the scope of this DFW AD SIP revision.

On December 17, 2014, the EPA proposed to lower the 2008 eight-hour ozone NAAQS. However, the purpose of this DFW AD SIP revision is to demonstrate attainment of the 2008 eight-hour ozone NAAQS, in accordance with FCAA requirements. The 2008 eight-hour ozone NAAQS is set at 75 ppb and states are required to submit plans to the EPA addressing attainment of the current standard. If the EPA lowers the current eight-hour ozone standard and the DFW area is designated nonattainment for the revised standard, the TCEQ will develop a SIP revision to address attainment of the revised standard for the DFW area.

Since the early 1990s, when the DFW area was designated nonattainment for the one-hour ozone standard, much has been done to bring the area into attainment with federal air quality standards. By 2006, ambient monitoring data reflected attainment of the one-hour ozone standard, which was acknowledged by the EPA on October 16, 2008, when the EPA published its final determination that the DFW area had attained the one-hour ozone standard, based on verified 2004 through 2006 monitoring data and was further supported by 2007 through 2008 monitoring data. The DFW area did not attain the 1997 eight-hour ozone standard by its original attainment date, June 15, 2010 by a narrow margin (2 ppb). However, the DFW area is now monitoring attainment of the 1997 eight-hour ozone standard, since its 2014 design value is 81 ppb. No changes were made in response to these comments.

<u>Comments Concerning the TCEQ</u>

One individual commented that the public pays taxes, elects officials, sends letters, and appears at hearings, all to stop polluters and requested that the TCEQ do its job. One individual commented that the public deserves and expects better protection of human health and the environment and one individual commented that the TCEQ should make decisions based on

environmental quality. One individual commented that the public deserved and expected better from environmental agencies.

An individual commented the public is "doomed to suffer" if its air is left to the TCEQ since those making money from dirty air seem to have bought everyone that has the power to do something to clean up the air, and that no TCEQ board member was present at the public hearing.

The TCEQ disagrees with these comments. The DFW area has seen considerable improvement in air quality since the time of the area's initial nonattainment designation under the one-hour ozone standard. In 2008, the EPA issued a determination that the DFW four-county one-hour ozone nonattainment area had attained the one-hour NAAQS based on certified 2004 through 2006 monitoring data and was further supported by 2007 through 2008 monitoring data. In addition, the eight-hour ozone design values in the DFW area have been trending downward since 2000 and the area is now monitoring attainment of the 1997 eight-hour NAAQS based on certified 2012 through 2014 monitoring data with a design value of 81 ppb.

The TCEQ does not agree that it has failed in carrying out its duties. The TCEQ takes its responsibilities to Texas citizens very seriously and endeavors to protect the public interest in every action it takes, including those intended to reduce air pollution. The TCEQ strives to protect Texas' human and natural resources, including those in the DFW area, consistent with sustainable economic development, as required by state and federal laws. The TCEQ is committed to working with area stakeholders to attain the 2008 eight-hour ozone standard as expeditiously as practicable in accordance with EPA rules and guidance and the FCAA. No changes were made in response to these comments.

The League of Women Voters of Dallas commented that the commission has the power to set and enforce standards stricter than those required by the federal government, and that the Texas Legislature should make funding available to enable the TCEQ to research, plan, and enforce regulations necessary to protect the public's health and the environment. The League of Women Voters also commented that it supports legislation to allow local and regional governments to set and enforce standards stricter than those of the state and encourages citizen involvement in rulemaking and enforcement.

Comments regarding legislative support for local and regional governments or legislative funding priorities are outside the scope of the commission's authority. The commission notes that the legislature appropriates significant funding to the TCEQ to research, plan, and enforce regulations necessary to protect public health and welfare. Under state law, neither the commissioners nor TCEQ staff may lobby the legislature for any particular purpose or program, and may only provide information to fulfill legislative mandates or to assist members of the legislature in legislative development or other duties. Additionally, the commission, through this DFW AD SIP revision and corresponding regulations, has provided its analysis of the control strategies appropriate to protect public health and welfare in regard to the ozone NAAQS for the DFW area. No changes were made in response to these comments.

CONTROL STRATEGY COMMENTS

The City of Mesquite supported the continued addition of *Appendix H: Local Initiatives submitted by the North Central Texas Council of Governments* as part of the DFW AD SIP revision targeted at reducing ozone-forming emissions in the region.

The TCEQ appreciates the support and is committed to working with local entities and interested parties to keep them updated on SIP developments and informed about technical issues related to air quality. No changes were made in response to this comment.

The EPA commented to the TCEQ that the EPA appreciates the list of local initiatives completed by the North Central Texas Council of Governments (NCTCOG) and requested a list of the local initiatives that will be completed by March 1, 2017 be included.

The NCTCOG has already begun to address development of a list of local initiatives that will be completed by March 1, 2017. The list reflecting a 2017 attainment year will be submitted to the TCEQ for the development of a future DFW AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area. No changes were made in response to this comment.

The EPA commented that the contingency plan should be revised to reflect the 2017 attainment year.

The contingency plan in Chapter 4: *Control Strategies and Required Elements*, Section 4.9: *Contingency Plan* of this DFW AD SIP revision was revised to reflect the 2017 attainment year. The required emissions reductions for contingency are now for 2018 instead of 2019, and all contingency requirements continue to be met.

The EPA commented that because the contingency plan relies on on-road fleet turnover to achieve the necessary emissions reductions, the TCEQ should include a Motor Vehicle Emissions Budget (MVEB) for the contingency year as required by the proposed Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements Rule (78 FR 34178).

The requirement of an MVEB for the contingency year if on-road fleet turnover emissions reductions are relied upon was not included in the final Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements Rule (2008 ozone standard SIP requirements rule) published on March 6, 2015 (80 FR 12264). No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the contingency measures detailed in the DFW AD SIP revision, primarily state mobile source measures and emissions reductions achieved through incentive programs, fail to meet the criteria for enforceability and are therefore not creditable as emissions reductions for contingency purposes. The commenters further claimed that the mobile source control measures included as contingency measures are not included in the DFW AD SIP revision, and are not enforceable by the EPA or through independent citizen action.

The TCEQ disagrees with this comment. The contingency measures for both the reasonable further progress (RFP) and AD SIP revisions are the Federal Motor Vehicle Control Program, the state inspection and maintenance program, the East Texas Low Reid Vapor Pressure Gasoline Program, the Texas Low Emission Diesel Program, federal non-road mobile new vehicle certification standards, non-road federal reformulated gasoline, and the non-road Texas Low Emission Diesel Program.

All of these programs are enforceable, quantifiable, permanent, and surplus. The reductions from these controls are creditable toward RFP and contingency requirements per the EPA's final 2008 ozone standard SIP requirements rule. Voluntary or incentive-based programs are not used as contingency measures for either RFP milestone years or the attainment year. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that Texas consumers and taxpayers bear the cost of NO_X emissions reductions and that it would be more equitable to require selective catalytic reduction (SCR) on coal-fired electric generating units (EGU) and cement kilns. The commenters point to the Diesel Emissions Reduction Incentive (DERI) and Texas Clean Fleet programs as examples of control measures that the TCEQ could use that are reasonable even though the costs of these programs relative to the emissions reductions achieved is much greater than that of "reasonably available control technology," like SCR.

The DERI and Texas Clean Fleet are legislatively established and funded programs that are administered by the TCEQ. While the TCEQ believes that incentive programs such as these provide beneficial emissions reductions in the DFW area and other areas in the state, the agency makes no claim that these programs meet the criteria for either RACT or RACM. As such, these programs are described in Chapter 5: *Weight of Evidence* along with other existing measures for which emission reductions are not included in the future case modeling results, but are nevertheless expected to achieve emissions reductions.

The TCEQ did evaluate SCR on both EGUs and cement kilns in the RACM analysis for this DFW AD SIP revision. As detailed in Appendix G: *Reasonably Available Control Measures Analysis*, based on the information currently available, the TCEQ does not consider SCR systems on Portland cement kilns to be adequately demonstrated with regard to technological or economic feasibility and, therefore, it is not RACM for the existing Ellis County cement kilns. The TCEQ also researched SCR for EGUs outside the nonattainment area, and found that there are substantial costs associated with this control measure, insufficient time available to implement controls, and limited ozone reduction benefit to the DFW area. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of this DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Therefore, the TCEQ has determined that imposing additional controls on these attainment county EGUs is not justified. No changes were made in response to this comment.

Texas Emissions Reduction Plan (TERP)

One individual expressed concern that the TERP was not included as a measurable emissions reduction program in the DFW AD SIP revision. The individual commented that citizens work hard and are paying for the TERP and that the program has now spent a half billion dollars and reduced emissions by 22 tons per day (tpd).

The TCEQ appreciates the support given to the TERP incentive programs and agrees that substantial effort and money has gone into making the TERP successful in achieving reductions in NO_X emissions. The TCEQ understands the desire to include the TERP as a control measure that can be considered in the emissions modeling. The TCEQ considers TERP an important component in the WoE of this DFW AD SIP revision demonstrating that the DFW ozone nonattainment area is expected to attain the standard on or before 2018. No changes were made in response to these comments.

An individual commented that the State of Texas doesn't encourage the use of electric cars and has not set up enough electric charging stations around the metroplex. The commenter further stated that private companies, including NRG Energy, Inc. (NRG), are doing a good job setting up charging stations.

The TCEQ does not agree with the conclusion that the state is not encouraging the use of electric cars. Under the TERP Alternative Fueling Facilities Program (AFFP), the TCEQ recently awarded $318,958 for electric charging stations in two locations in Harris County and three locations in the DFW area. An additional $577,205 was awarded to a project for a facility providing both compressed natural gas and electric charging in Brazoria County.

In addition, the commission encourages the use of electric vehicles through the Light-Duty Motor Vehicle Purchase or Lease Incentive Program. Through February 9, 2015, the TCEQ provided $2,233,750 in rebates for the purchase or lease of 1,019 electric-drive cars. No changes were made in response to these comments.

Stationary Sources

East Texas Electric Generating Units (EGU)

The Dallas County Medical Society and the Texas Medical Society commented that the commission should require three East Texas coal-fired power plants to either install and operate SCR or convert to natural gas to reduce NO_X emissions and meet current EPA standards to protect their North Texas patients, as previously suggested in their August 2013 petition for rulemaking. The commission denied the petition in October 2013 because the concerns of the petition would be addressed during the upcoming SIP process. The Dallas County Medical Society and the Texas Medical Society commented that the denial of the petition could be viewed as a “delay tactic” since the proposed DFW AD SIP revision did not address their expressed concerns and contained no measures to reduce NO_X emissions from the three plants. The Dallas County Medical Society and the Texas Medical Society further commented that SCR technology is cost effective and feasible for application in these plants.

As indicated in the commission's October 2013 denial of the Dallas County Medical Society petition for rulemaking, the commission did evaluate in this DFW AD SIP revision sources of NO_X emissions located in the DFW area and the potential necessity for emissions reductions to attain the 2008 eight-hour ozone NAAQS as part of this DFW AD SIP revision. As part of the RACM analysis conducted for this DFW AD SIP revision, the commission considered the potential impact of increasing the stringency of the existing East and Central Texas EGU rules. The commission has previously implemented controls in attainment counties in East and Central Texas to address NO_X emissions and ozone transport from EGUs, including the three East Texas coal-fired power plants that were the subject of the Dallas County Medical Society petition. The total capital costs of achieving SCR control on the eight affected units are estimated to be $1,878,585,000.

Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Given the substantial costs associated with this control measure, the insufficient time available to implement controls in time to advance attainment, the limited ozone reduction benefit to the DFW area from these sources outside the DFW area, and the current modeling results indicating that the DFW area will demonstrate attainment, the TCEQ has determined that imposing additional controls on these attainment county EGUs is not justified at this time. This decision reflects the data gathered during the year between the denial of the Dallas County Medical Society and Texas Medical Society petition and the proposal of this DFW AD SIP revision. Additionally, as discussed in this DFW AD SIP revision, the 76 ppb future design value for the Denton Airport South monitor is based on the "all days" attainment test recommended by the EPA modeling guidance from April 2007. Application of the "top 10 days" attainment test recommended by the draft EPA modeling guidance from December 2014 results in a 2018 future design value of 75 ppb at the Denton Airport South monitor, with the values for all other monitors ranging from 62-74 ppb, demonstrating attainment of the ozone standard.

Also, as discussed elsewhere in this response to comments regarding the June 2006 Environ study on East Texas EGU controls, the impact of the suggested NO_X controls on East Texas EGUs is not expected to have a substantive impact on Denton Airport South monitor in the DFW area.

At the time of the petition request, the TCEQ did not have final modeling for the projected 2018 design value. The commission's action in denying the petition did delay the decision regarding potential further control of the referenced power plants until sufficient data was available to assess if such controls were necessary to demonstrate attainment. Considering the SIP modeling and the RACM analysis, the commission has determined that the controls requested in the Dallas County Medical Society and Texas Medical Society petition are not necessary to demonstrate attainment of the 2008 eight-hour ozone NAAQS by the 2018 attainment deadline. No changes were made in response to this comment.

The SEED Coalition commented that coal-fired power plants in East Texas should have installed SCR 20 to 30 years ago to control emissions. In addition, the SEED Coalition, Downwinders, and 52 individuals commented that SCR technology is in place in other parts of the U.S. and in other parts of the world. Downwinders and 52 individuals further commented that SCR should be required for East Texas coal plants that impact DFW air quality to reduce smog pollution.

As discussed elsewhere in this response to comments, as part of the RACM analysis conducted for this DFW AD SIP revision, the TCEQ evaluated sources of NO_X emissions located in and around the DFW area and the potential necessity for emissions reductions to attain the 2008 eight-hour ozone NAAQS. The TCEQ considered the potential impact of increasing the stringency of the existing East and Central Texas EGU rules. In the past, the commission adopted controls in attainment counties in East and Central Texas to address ozone transport from coal-fired power plants and other sources of NO_X emissions as a result of modeling indicating NO_X emission reductions being needed to demonstrate attainment of the NAAQS. Although these previous rules did not specifically require an SCR level of control for these units, they were controlled appropriately in accord with federal and state laws.

Although SCR is technologically feasible and is used on some coal-fired power plants in Texas and in other parts of the U.S. and world, this alone does not qualify SCR-level control on East Texas coal-fired power plants as RACM for this attainment demonstration. As discussed elsewhere in this response to comments and in Appendix G of this DFW AD SIP revision, RACM is evaluated based on multiple criteria. Furthermore, although the EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment, such as the requirements adopted for East Texas EGUs, states are not required to exercise this option under the FCAA. Despite this, the TCEQ did consider additional NO_X controls on East Texas EGUs in the RACM analysis. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Given the substantial costs associated with this control measure, the insufficient time available to implement controls in time to advance attainment, the limited ozone reduction benefit to the DFW area from these sources outside the DFW area, and the current modeling results indicating that the DFW area will demonstrate attainment, the commission determined that imposing additional controls on these attainment county EGUs is not justified at this time and is not RACM. Additionally, as discussed elsewhere in this response to comments regarding the June 2006 Environ study on East Texas EGU controls, the impact of the suggested NO_X controls on East Texas EGUs is not expected to have a substantive impact on Denton Airport South monitor in the DFW area.

The TCEQ appreciates stakeholder technical input relating to control strategy development and may be able to use valid information for future air quality planning purposes. No changes were made in response to these comments.

The Sierra Club and Downwinders commented that East Texas coal-fired power plants are the largest sources of NO_X outside the DFW area, significantly contributing to the DFW area's continued nonattainment of the ozone NAAQS. Both also commented that at least 47% of the U.S. active coal-fired EGUs larger than 150 megawatts (MW) are equipped with SCR. The commenters indicated that well-maintained SCR systems regularly ensure NO_X emission reductions of at least 90%, resulting in emission limits of 0.05 pounds per million British thermal units (lb/MMBtu) or lower, such that a limit of 0.07 lb/MMBtu is consistently available on 30-day averages. The commenters also indicated that coal-fired power plant boilers in Texas equipped with SCR historically have achieved 30-day periods with average NO_X emission rates lower than 0.08 lb/MMBtu, as assumed by the source-apportioned modeling conducted by Environ in June 2006.

The Sierra Club and Downwinders further stated that the commission must reevaluate SCR as RACM for coal-fired EGUs outside the DFW nonattainment area even if the commission is not legally obligated to consider RACM for sources outside the nonattainment area. The commenters stated that a RACM determination of no higher than 0.07 lb/MMBtu for coal-fired power plant boilers in Texas was well-supported by actual historical operating experience, thus showing emission limits with SCR operation were both technologically and economically feasible. Downwinders and 52 individuals commented that for coal-fired power plants, SCR is commercially available technology. Downwinders and 40 individuals commented that SCR is readily available and that studies have shown this technology could cut ozone levels in the DFW area significantly.

The Sierra Club and Downwinders commented that the commission's failure to conduct a proper case-by-case analysis of SCR control on East Texas EGUs resulted in an under-estimation of emissions reductions and an over-estimation of the costs associated with SCR. The commenters asserted that such a case-by-case analysis of these sources would show SCR is RACM for East Texas coal-fired EGUs. Public Citizen commented that on a dollar-per-dollar basis, not only was reducing air pollution from power plants cheap compared to other control strategies, but also that SCR was a cost-affordable way to make significant reductions from power plants.

The Sierra Club and Downwinders indicated that, just as the EPA indicated in the Cross-State Air Pollution Rule that 24 to 30 months was sufficient time for affected sources to install SCR, two years is a sufficient amount of time for East Texas EGUs to implement and operate SCR.

For a state's RACM analysis, the EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment; however, the state does not have to exercise this option under the FCAA. Accordingly, and consistent with the EPA's technical RACM guidance, the commission researched the potential impact of increasing the stringency of the existing East and Central Texas EGU rules and East Texas combustion rules for sources of NO_X located outside the DFW nonattainment area.

To assess both the technical and economic feasibility of SCR control technology to further reduce NO_X emissions from East Texas coal-fired power plants, the

commission considered information from various sources. The commission evaluated EGU emissions and process rate data for reporting year 2012 from the EPA's Air Markets Program Database. The commission also evaluated available literature cost data for SCR control on coal-fired power plants from Sargent and Lundy and the Edison Electric Institute. Cost information was based on either 2008 or 2009 U.S. dollars.

However, at this time, the TCEQ disagrees with the commenters' assertions that the suggested control strategies for EGUs should be included in this DFW AD SIP revision. The commission determined that imposing additional controls, such as SCR, on EGUs in East Texas attainment counties is not justified at this time. The commission based this decision on the limited ozone reduction benefit to the DFW area from these sources outside the DFW area, the substantial costs associated with this control measure, the insufficient time available to implement SCR before the attainment date, and because the current modeling results indicate that the DFW area will demonstrate attainment. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Additionally, as discussed elsewhere in this response to comment regarding the June 2006 Environ study on East Texas EGU controls, the impact of the suggested NO_X controls on East Texas EGUs is not expected to have a substantive impact on Denton Airport South monitor in the DFW area.

The TCEQ has previously implemented controls in attainment counties in East and Central Texas to address NO_X emissions and ozone transport from stationary sources outside the DFW area, including East Texas coal-fired power plants at a time when these measures were determined to meet RACM criteria. These measures were included as part of the DFW AD SIP revision for the 1997 eight-hour ozone NAAQS adopted in April 2000 (Project No. 1999-055-SIP-AI).

The TCEQ notes that Texas Health and Safety Code, §382.017, prohibits the commission from adopting rules that require specific types of control equipment or manufacturing processes unless required by federal law or regulation. No changes were made in response to these comments.

The Sierra Club, Downwinders, and one individual commented that before dismissing SCR on coal-fired EGUs, the commission should have quantified the ozone improvements for the DFW area and compared the cost of SCR versus the cost of implementation of more stringent federal programs borne by the public.

The cost associated with the implementation of federal programs is beyond the scope of this DFW AD SIP revision and was not considered during the commission's concurrent rulemakings. The TCEQ did not identify any coal-fired EGUs within the DFW nonattainment area in the 2012 Point Source Emissions Inventory. Because these sources are located outside of the DFW nonattainment area, the ozone impact in the DFW area of these potential NO_X reductions is not expected to be sufficient to advance attainment of the 2008 eight-hour ozone

NAAQS, based on the photochemical modeling analysis documented in this DFW AD SIP revision. No changes were made in response to this comment.

Cement Kilns

The EPA, Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club, and 52 individuals requested that the DFW AD SIP revision include a RACM requirement for lower NO_X limits on cement kilns through use of SCR control technology. The EPA described the commission's estimated 4.6 tpd of NO_X reductions achieved from lowering the cement kiln source cap as a significant reduction and requested evidence of modeling or analyses conducted that led to the decision to not implement it as a RACM strategy.

The EPA, Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club, and 52 individuals argued that SCR systems are technologically feasible for cement kilns. Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club and 52 individuals noted that there are six operating SCR installations on cement kilns in Europe, one in the U.S., and a proposed permit to install SCR technology on one of the Holcim kilns in Ellis County. Downwinders and the Sierra Club commented that published reports of European kilns demonstrated an 80% to 90% NO_X reduction and 75% to 99% reduction of VOC emissions.

The EPA, Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club, and 52 individuals stated that the 2006 TCEQ Cement Kiln Study final report (Contract No. 582-04-65589) concluded that SCR technology was "commercially available." Downwinders and Sierra Club commented that recent SCR installations had solved the operational problems noted in the Cement Kiln Study and listed in the proposed RACM analysis, including catalyst poisoning and plugging due to high levels of dust, operating at the proper temperature, and problems due to sulfur compound formation.

The EPA, Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club, and 52 individuals stated that SCR systems are economically feasible for cement kilns because the Cement Kiln Study indicated that SCR systems on Ellis County kilns would have costs that are less than NO_X reduction costs for strategies used by the commission and other state environmental regulatory agencies for SIP purposes.

The EPA, Downwinders, the SEED Coalition, the Greater Fort Worth Sierra Club, the Lone Star Sierra Club, the national Sierra Club, and 52 individuals stated that the commission must evaluate SCR operational experience from all cement kilns and that based on the existing and planned installations, SCR is a proven effective and reasonably available technology. Downwinders and the Sierra Club asserted that two years is a sufficient amount of time to install SCR systems on cement kilns and such systems could be operational by summer 2017.

The TCEQ disagrees that the suggested control strategies need to be included in this DFW AD SIP revision. Based on the EPA's most currently accepted RACM guidance, the TCEQ evaluated the existing cement kilns in the DFW area and concluded that implementing RACM for this emission source category is not justified at this time. There are technological and economic feasibility issues

associated with the commenters' suggested SCR technology, as discussed in Appendix G of this DFW AD SIP revision.

Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. The modeling includes the current cement kiln source cap amount of 17.6 tpd of NO_X. No changes were made in response to these comments.

Energy Efficiency

The Lone Star Sierra Club and Public Citizen requested that the DFW AD SIP revision include energy efficiency due to enforced building codes, utility energy efficiency, and solar power, as enforceable emission reduction commitments.

The TCEQ supports energy efficiency and renewable energy programs and recognizes the air quality benefits of these programs. The Texas legislature has implemented many energy efficiency and renewable energy programs, including mandates for installation of new capacity of wind and other renewable energy generation. Texas is a leader in energy efficiency programs and especially in renewable energy such as wind energy. Installation of new wind generation facilities has greatly exceeded the milestones mandated by the legislature.

The TCEQ is aware of the EPA's updated guidance document for incorporating energy efficiency and renewable energy measures in the SIP. TCEQ staff has reviewed the draft guidance document entitled *Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State Implementation Plans/Tribal Implementation Plans*, (EPA-456/D-12-001a), and provided comments to the EPA. The TCEQ's current policy is to acknowledge the benefits of energy efficiency, renewable energy, and similar measures as WoE in SIP revisions.

In previous SIP revisions, the TCEQ has claimed specific SIP credit reductions for legislatively-mandated energy efficiency measures. Associating a specific amount of emissions reductions for ozone nonattainment areas from energy efficiency or renewable energy as SIP creditable reductions raises technical and legal issues considering the EPA's requirements for claiming such SIP credit. As outlined in the EPA's 2012 guidance[3], any SIP creditable emission reductions claimed for energy efficiency or renewable energy must meet the four standard criteria: enforceable, quantifiable, permanent, and surplus. Ensuring that SIP creditable reductions within a specific nonattainment area resulting from energy efficiency and renewable energy are permanent and surplus can be particularly problematic. The TCEQ relies on projections from the Electric Reliability Council of Texas (ERCOT) to model future expected operation of electrical generating utilities. Energy efficiency and renewable energy are accounted for in the SIP modeling to

[3] Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State Implementation Plans/Tribal Implementation Plans (http://epa.gov/airquality/eere/pdfs/EEREmanual.pdf)

the extent that these measures are accounted for in ERCOT's projections. If the TCEQ claimed additional reductions, this could result in double counting potential reductions. Furthermore, whether the emission reductions from energy efficiency and renewable energy occur at certain power plants within a specified nonattainment area is dependent on many factors in the electrical grid system. The Energy Systems Laboratory (http://www-esl.tamu.edu/terp/reports) at the Texas Engineering Experiment Station at Texas A&M University System uses the EPA's eGRID model to predict where emission reductions from energy efficiency and renewable energy programs, such as wind generation, will occur. However, electrical grid operations are subject to changes, such as shifts in transmission and distribution as well as units coming out of mothballed status to meet a reliability need. If changes in the electric grid system resulted in a shift in projected emission reductions outside of a nonattainment area that were relied upon as SIP creditable reductions, the state would face a shortfall in the SIP. The TCEQ does not dispute that energy efficiency and renewable energy programs work, or that such programs provide emissions reductions and air quality benefits. The TCEQ's concern is in being able to reliably predict for the future where those benefits will be realized to a degree that the commission can satisfy all of the EPA's criteria for SIP creditable reductions.

Based on current EPA guidance for claiming SIP credit for energy efficiency and renewable energy measures, the TCEQ considers the WoE discussion to be the most appropriate way at this time to acknowledge the benefits of energy efficiency and renewable energy measures in the DFW AD SIP revision. The commission may reconsider the current policy regarding how energy efficiency and renewable energy measures are accounted for in the SIP in future SIP development. Additional discussion regarding the various energy efficiency and renewable energy programs in Texas is included in Chapter 5, Section 5.4: *Qualitative Corroborative Analysis* of this DFW AD SIP revision. No changes were made in response to this comment.

Solar Energy

DFW Regional Concerned Citizens and three individuals commented that solar power was available, desired by the public, and would reduce NO_X emissions from fossil fuel-fired electricity generation. These commenters asserted that solar energy could provide a significant amount of cost-effective energy for transportation, residential, and commercial uses, especially for oil and gas production and transmission sites. The commenters requested that the commission be a leader in supporting solar energy, including recommending legislation to increase use of solar power in Texas. An individual also commented that the TCEQ should make a recommendation to the legislature to remove all restrictions against solar power.

Under state law, neither commissioners nor TCEQ staff may lobby the legislature for any particular purpose or program. The commission supports renewable energy generation and recognizes that it is and will continue to be an important part of the electricity generation profile in Texas and will help to meet electricity demand from all sectors of society. No changes were made in response to this comment.

An individual noted the potential emissions reductions if compressor engines were required to convert to electrical power, provided that a significant fraction used solar-powered electricity.

Based upon available information, compressor engines and other large electric motors require three-phase alternating current as a power source. Solar panels typically generate direct current and require specialized equipment to convert direct current to three-phase alternating current. Due in part to this and other limitations, current commercial solar power applications appear to be limited to powering small motors, which would typically not meet the requirements for compressing natural gas. **No changes were made in response to this comment.**

Compressor Electrification

Downwinders, Public Citizen, DFW Regional Concerned Citizens, and 52 individuals requested a requirement that compressors pressurizing natural gas be driven by electric motors, not fossil fuel-fired engines. One individual also suggested a requirement that all hydrocarbon drilling rigs be driven by electric motors rather than diesel fuel-fired engines. The commenters contended that the commission's decision not to require electrification of natural gas-fired compressors as a RACM strategy was not based on available studies or other supporting information.

Downwinders and the Sierra Club commented that electric motors driving natural gas compressors are both technologically and economically feasible; are required or encouraged by multiple Texas municipalities; and have higher reliability. The commenters further stated that this control strategy leads to greater operational efficiency; emits no NO_X; requires less extensive permitting; and has lower maintenance costs. Based on this economic and technological feasibility, the commenters requested a RACT or RACM strategy to reduce 90% of the NO_X emissions from compressor drivers on natural gas pipelines in the DFW area by either controlling natural gas-fired engines or by changing the engines to electric motors. The commenters suggested that the strategy emulate the ground support equipment electrification strategy implemented in the DFW area.

Downwinders and the Sierra Club commented that the commission's RACM analysis for compressor drivers was insufficient on four grounds. First, the commenters disagreed with the commission's reasoning that an engine replacement strategy could not be implemented because it would require a particular method to control or abate air pollution. The commenters stated that the commission previously justified adoption of emission standards for engines in the Houston-Galveston-Brazoria (HGB) ozone nonattainment area by assuming electrification of some large existing engines to achieve an 80% NO_X reduction across the compressor fleet. Second, the commenters indicated that the commission did not tally the number of compressors that would require electric service upgrades, or the extent of each upgrade. Third, the commenters indicated that the commission's analysis of increased electricity demand and associated NO_X emissions was insufficient, including the potential for expected future generation or increased future renewable energy to meet the demand. Lastly, the commenters stated that the commission did not provide an estimate of the total cost of engine electrification or a justification explaining why the commission considered the cost per ton of NO_X reduced to be prohibitively large.

The commission disagrees that the suggested control strategies should be included in this DFW AD SIP revision. During the planning phase of this DFW AD SIP revision, TCEQ staff evaluated the use of electric motors to drive natural gas compressors. TCEQ staff concluded that the potential RACM strategy is

economically infeasible and cannot be implemented by the compliance deadline. Additionally, modeling results based on the April 2007 EPA modeling guidance, which includes compressor engine and drilling rig NO_X emissions, project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. No additional NO_X controls are necessary at this time.

Commenters suggested a requirement for either total use of electric motors, or a 90% NO_X reduction from replacement of most of the engines with electric motors. According to Texas Health and Safety Code, §382.017(f)(3), unless required by federal law or regulation, the commission may not specify the type, design, method of installation, or type of construction of a manufacturing process or other kind of equipment. Therefore, the commission cannot require complete electrification of compressors or drilling rigs as the commenters suggest because that would be specifying the equipment type or design.

The commission acknowledges that it has previously adopted regulations in the DFW area to reduce NO_X by 90% from ground support equipment at certain airports and also to reduce NO_X by 80% from compressor engines in the HGB area and that both rules assumed partial electrification in combination with add-on controls and modifications of existing engines. However, both of these rules were adopted as RACM and designed to provide NO_X reductions needed to demonstrate attainment of the one-hour ozone NAAQS. The ground support equipment rules have since been repealed and replaced with individual agreements.

The TCEQ is aware of several electric motor-driven drilling rigs and large compressors in the DFW area and recognizes that powering compressors and drilling rigs with electric motors supplied by grid electricity is technologically feasible. The TCEQ acknowledges that this mode of operation results in greater system efficiency and lower overall NOX emissions. However, published articles indicate logistical concerns with this strategy, as described in Appendix G, Section 4.2.2: *Engines*, of this DFW AD SIP revision. Concerns include: the need for additional equipment beyond the electric motor at the compressor station, potential electric service upgrades, and potential replacement of the compressor, all of which need to be considered in addition to the cost of the electric motor itself. Published information also indicates that delivery time for necessary equipment and time required to install additional equipment at all affected sites renders a strategy of complete replacement unreasonable to accomplish by the regulatory deadline. The TCEQ is commencing an area source emissions inventory improvement study to quantify current use of electric-powered compressor engines.

In the past, when the TCEQ has provided fiscal analysis of proposed emission reduction strategies, staff used data from EPA alternative control techniques (ACT) documents to estimate costs of engine modifications and controls and data submitted to the commission for a property tax abatement request. For this analysis, TCEQ staff used these data sources, EPA Natural Gas Star information,

and electric motor and driver supplier cost data to conclude that the cost of this strategy was not justified at this time. Because this strategy is not considered RACM at this time, TCEQ staff did not include all calculated cost information or calculated NO_X reductions and offsetting electric generator NO_X emissions increases in the DFW AD SIP revision proposal.

The EPA has previously approved the commission's 30 TAC Chapter 117 rules addressing RACT for engines and the commission contends that these rules continue to satisfy RACT for this source category. The only amendments to these rules required as part of this DFW AD SIP revision are to include RACT emission specifications for major source engines in Wise County (Rule Project Number 2013-049-117-AI). No changes were made in response to these comments.

Engines

The EPA commented that previous NO_X control requirements for natural gas-fired compressor engines in the DFW nine-county 1997 eight-hour ozone nonattainment area and in East Texas counties relied on non-selective catalytic reduction catalytic convertors. The EPA commented that these catalytic convertors typically require periodic changes of catalysts to maintain NO_X control levels. The EPA questioned whether Texas performed any follow-up on the affected sources to confirm that proper maintenance occurred to ensure NO_X controls still met the applicable NO_X requirements.

To date, while the TCEQ has not initiated a targeted review of affected sources to confirm whether proper maintenance is occurring to ensure that NOx controls still meet the NOx control requirements, like the EPA, the TCEQ conducts investigation activities of affected sources where the required maintenance would be one of the issues that is reviewed and determines if an enforcement action is warranted. Source owners or operators of affected units subject to the DFW industrial rules are required to conduct testing every two years or within 15,000 hours of engine operation after the previous emission test and perform quarterly emission checks to ensure continued compliance with the NO_X emission specifications. Affected source owners and operators are also required to report in writing to the TCEQ executive director on a semiannual basis any excess emissions and the air-fuel ratio monitoring system performance. This includes the quarterly emission checks; the biennial emission testing required for demonstration of emissions compliance; and the specific identification of each period of excess emissions that occurs during startups, shutdowns, and malfunctions of the engine or emission control system, the nature and cause of any malfunction (if known), and the corrective action taken or preventative measures adopted. Owners and operators are also required to maintain records on-site for a period of at least five years.

Source owners or operators of affected units subject to the East Texas Combustion rules are required to conduct testing every two years or within 15,000 hours of engine operation after the previous emission test and perform quarterly emission checks to ensure continued compliance with the NO_X emission specifications. Owners and operators are also required to maintain records on-site for a period of at least five years. These records also include information relating to the catalytic converter, air-fuel ratio controller, or other emissions-related control system maintenance, including the date and nature of corrective actions taken. The

commission considers the current quarterly emissions checks, periodic testing, recordkeeping, and reporting requirements for engines subject to the Chapter 117 requirements to be sufficient to ensure proper operation and maintenance of catalyst controls. No changes were made in response to these comments.

Oil and Natural Gas Production

The Lone Star Sierra Club and one individual commented that the DFW AD SIP revision needed to include control measures on existing oil and natural gas production and processing equipment. Specifically, the commenters requested reduced emission completions on both natural gas and oil wells, low or non-emitting pneumatic devices on wellhead processing equipment and pipelines, compressor maintenance requirements, and improved leak detection including the use of optical gas imaging and gas sensors.

The EPA has developed new source performance standard (NSPS), 40 Code of Federal Regulations Part 60, Subpart OOOO, for natural gas wells. It requires, among other things, reduced emission completion methods, low or no-bleed pneumatic devices on wellhead processing equipment and pipelines, and periodic compressor maintenance. Subpart OOOO applies to all new natural gas wells. The EPA has indicated that it is considering adding similar controls to oil wells, but the impact to the DFW area is not expected to be significant due to the low fraction of wells targeting crude oil.

The control suggestions made by the commenters would not be RACT because the controls specified would not reduce VOC from a piece of equipment capable of emitting over the applicable VOC major source threshold in the DFW area. The EPA has also not released a control techniques guideline (CTG) or ACT document covering these pieces of equipment that would require RACT consideration.

The requested strategies are also not RACM because they would reduce VOC and photochemical modeling indicates VOC reductions will not advance attainment. No changes were made in response to this comment.

The Lone Star Sierra Club and one individual suggested that the commission adopt rules similar to the State of Colorado for oil and natural gas production, transmission, and processing, with a special emphasis on reducing venting and flaring of hydrocarbons and VOC from the largest sources, condensate tanks, and pneumatic devices.

Concurrent with this DFW AD SIP revision, the commission is adopting rulemaking (Rule Project Number 2013-048-115-AI) to update existing control requirements for VOC sources in the DFW area to implement RACT. The rule changes in Chapter 115, Subchapter B, Division 1, Storage of VOC, will implement RACT for storage tanks storing condensate with the potential to emit VOC of at least the applicable major source threshold for all counties in the DFW 2008 eight-hour ozone nonattainment area. Specifically, the rules will require proper maintenance of equipment and additional inspections of tank openings. As part of the RACT evaluation for this rulemaking, staff reviewed available information from many different sources, including the recent rule changes in Colorado and the EPA's NSPS for condensate storage tanks. The commission is amending Division 1, Storage of VOC, but declines to add controls on pneumatic devices.

There is no existing CTG that establishes presumptive RACT for pneumatic devices used in the oil and natural gas industry. In addition, the rule proposal did not include any controls for pneumatics so affected parties would not be afforded the opportunity to provide comment on potential controls. The requested strategies are also not RACM because they would reduce VOC and photochemical modeling indicates VOC reductions will not advance attainment. No changes were made in response to this comment.

The Lone Star Sierra Club and one individual requested that the DFW AD SIP revision include control requirements for all stages of flowback following fracking of natural gas and oil wells. The commenters suggested requiring closed flowback tanks that route vapors to vapor recovery units. Another individual commented that green completions should be required by rule.

The commission disagrees that green completions or associated flowback VOC emissions should be addressed in this DFW AD SIP revision. The EPA has addressed both green completions and associated flowback VOC emissions in NSPS, 40 Code of Federal Regulations (CFR) Part 60, Subpart OOOO, for natural gas wells. Since the proposal of this DFW AD SIP revision, the EPA has revised Subpart OOOO to clarify that owners or operators must control all flowback VOC by 95% during what it calls the "separation flowback stage."

The EPA evaluated closed flowback tanks with controls and found them to be infeasible during the initial flowback stage. During this stage, the material produced by the well is characterized by high volumetric flow water containing sand, fracturing fluids, and debris from the formation with very little gas being brought to the surface. During the initial flowback stage, there is insufficient volume and consistency of flow to enable recovery of the gas by separation. Therefore, there is no practical way to route the gas stream to a pressurized tank as the commenter suggested.

Once the flowback material becomes more consistent in rate and composition later in the process, the EPA requires 95% control by any means, including vapor recovery units, flares, and other devices.

Since Subpart OOOO applies to all new natural gas wells and all refractured existing natural gas wells, it covers all future flowback situations from natural gas wells in the DFW area. The EPA has indicated that it is considering adding similar controls to oil wells, but this is expected to have little impact to the DFW area due to the low fraction of new wells targeting crude oil.

No changes were made in response to this comment.

General Reasonably Available Control Technology (RACT) Demonstration and Reasonably Available Control Measure (RACM) Demonstration

The Sierra Club and Downwinders acknowledged that the state may limit RACT to existing sources in the area, but that RACM has no geographical limitations and should be applied to any source regardless of whether the source is within the designated area.

Downwinders and the Sierra Club indicated that the EPA has made clear that restrictive available control measures are required for all sources contributing to the nonattainment situation even if it requires significant sacrifice, contrary to the commission's assertion that RACT or RACM is optional for contributing sources.

The TCEQ notes that although the commenter characterizes the requirement as "restrictive" available controls, the statute actually requires "reasonably" available control technology and measures.

The TCEQ disagrees that the EPA requires every source in a nonattainment area to comply with RACT. RACT is required for major sources of VOC and NO_X emissions and emission source categories addressed in a CTG document. The TCEQ continues to rely on the most currently accepted EPA definition to fulfill its RACT obligations under the FCAA, basing its RACT determinations on analyses of "the lowest emissions limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility."

The EPA's 2008 ozone standard SIP requirements rule follows the EPA's existing policy with respect to area-wide average emission rates, which recognizes that states may demonstrate that the weighted average NO_X emission rate from all sources in the nonattainment area subject to RACT meets NO_X RACT requirements. In the preamble to the rule, the EPA states that, "The EPA believes that the statute, as interpreted by the court in *Natural Resources Defense Council (*NRDC) *v. EPA*, provides a state with the option of demonstrating that its program achieves RACT level reductions by showing emission reductions greater than or equal to reductions that would be achieved through a source-specific application of RACT in the nonattainment area...In sum, nothing in the CAA or in *NRDC v. EPA* requires that 'each and every source' in the area employ RACT or achieve RACT-level reductions. Consistent with previous guidance, the EPA continues to believe that RACT can be met on average by a group of sources within a nonattainment area rather than at each individual source."

Recent action taken by the EPA (80 FR 16291, March 27, 2015) to approve the state's VOC and NOx RACT regulations in Chapters 115 and 117, respectively, indicates the EPA's support of the commission's reliance upon this definition and the technical support upon which the commission based its RACT regulations.

The TCEQ also disagrees that RACM should be applied to every source, regardless of whether the source is in a nonattainment area or not. The FCAA requires RACM only for sources in nonattainment areas, under Section 172, but as discussed elsewhere in this RTC, the EPA has indicated that states may consider measures for sources outside an attainment area, as appropriate. Additionally, because RACM are control strategies that are implemented to provide for and advance attainment of the ozone NAAQS, RACM can be determined to not be necessary at all in the event no additional emissions reductions are needed, such as with this DFW AD SIP revision. The TCEQ acknowledges its obligation to make RACT and RACM determinations based on technical analyses during each AD SIP revision,

although not all analyses support adopting new controls to satisfy RACT or RACM. No changes were made in response to these comments.

The Sierra Club and Downwinders provided comment regarding the evaluation criteria and legal standards the state must rely on to complete its RACT and RACM analyses. The Sierra Club, Downwinders, Dallas County Medical Society, and 52 individuals commented that the proposed DFW AD SIP revision does not implement RACT and RACM in accordance with the FCAA requirements.

The commenters claimed that because the TCEQ's RACM analysis cannot be deemed "reasoned decision-making" it cannot be approved by the EPA. Downwinders and 52 individuals further commented that there are existing technologies that are readily available to reduce pollution in the DFW area. In addition, one individual expressed disappointment with the current air quality conditions of the DFW area and questioned why Texas doesn't take steps to make improvements.

The TCEQ conducts both RACT and RACM analyses in accordance with currently accepted EPA guidance and with FCAA requirements and disagrees that the RACM analysis is unreasonable. For this DFW AD SIP revision, the TCEQ assessed available technologies and ideas including those submitted by stakeholders. The technical assessments and the evidence supporting regulatory action taken by the commission are provided in Appendix F: *Reasonably Available Control Technology Analysis* and Appendix G of this DFW AD SIP revision. As discussed in these appendices, the TCEQ's RACT and RACM analyses consider several factors and are based on reasoned decision-making.

The EPA's guidance provides states the option to either make a demonstration that RACT is in place with existing control requirements and that additional controls are not necessary; make a negative declaration; or adopt new requirements implementing RACT for major sources of NO_X and other FCAA-specified sources of VOC, including major sources. Consistent with this guidance, the TCEQ determined that for certain NO_X and VOC emission source categories, additional regulations are needed to assure RACT is in place. These additional regulations comprise the rulemakings concurrent with this DFW AD SIP revision (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI). For all other emission source categories not addressed in these rulemakings, the current RACT regulations or negative declarations provided continue to satisfy VOC and NO_X RACT.

Although not obligated under the FCAA, the TCEQ recognizes that the EPA allows states the option to consider control measures outside the ozone nonattainment area that can be shown to advance attainment, and meet the remaining determining criteria. The EPA's interpretation of RACM in the April 16, 1992 publication of the *Federal Register*, states §172(c)(1) "imposes a duty on all nonattainment areas to consider all available control measures and to adopt and implement such measures as are reasonably available for implementation in the area." The EPA continues to support this interpretation, as evidenced in the EPA's 2008 ozone standard SIP requirements rule, that a state should consider all available measures, including those outside the nonattainment area, but that a

state must only adopt measures for an area if those measures are technologically and economically feasible and will advance attainment of the NAAQS.

Consistent with this currently accepted EPA RACM guidance, the TCEQ provides its analysis of potential control measures and its determination that there are none that met the criteria to be considered RACM, partially due to the current modeling results indicating that the DFW area will demonstrate attainment. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Based on these considerations, the TCEQ determined that imposing additional controls as RACM is not justified at this time. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that just as in 2011, the commission's claim that RACT and RACM are unnecessary because it has modeled attainment of the NAAQS is wrong and that the commission must meaningfully evaluate RACT and RACM controls.

The TCEQ disagrees with the commenter's claim that the TCEQ did not meaningfully evaluate RACT and RACM during the 2011 DFW AD SIP revision. The 2011 SIP revision provided both the RACT and RACM analyses in Appendices F and G, respectively, as well as corresponding rulemaking implementing RACT for various CTG source categories and storage tanks (Rule Project Nos. 2010-016-115-EN and 2010-025-115-EN). The 2011 DFW AD SIP revision, however, did not include implementing RACM because the modeling showed that the DFW nonattainment area would attain the 1997 eight-hour ozone NAAQS without additional control measures. As explained elsewhere in this response to comments section, implementing RACM is not a requisite component of the SIP revision without adequate supporting justification. No changes were made in response to this comment.

The Sierra Club and Downwinders urged the commission to consider RACT or RACM for coal combustion and cement kilns. In addition, the Lone Star Sierra Club, Greater Fort Worth Sierra Club, and two individuals further commented that RACT must be developed for sources such as East Texas coal plants, industrial boilers, steel mills, cement kilns, and the Barnett shale gas facilities; the Lone Star Sierra Club and one individual suggested requiring SCR as the means of control. Additionally, the Sierra Club and Downwinders commented that SCR is RACT for cement kilns because it is technologically and economically feasible, as demonstrated through the pending Holcim permit in Midlothian and the existing cement kiln with SCR in Joppa, Illinois. One individual and the Lone Star Sierra Club referenced a technical presentation given to the NCTCOG that indicated targeted, optimized control strategies on point sources during early morning hours would significantly lower ozone formation in the afternoons.

As described in Appendix G of this DFW AD SIP revision, based on the EPA's existing RACM guidance, the commission evaluated sources of NO_X emissions located in the DFW area and the potential necessity for emissions reductions to attain the 2008 eight-hour ozone NAAQS as part of this DFW AD SIP revision. For

both coal combustion and cement kilns, the commission concluded that implementing RACM is not justified at this time.

The TCEQ disagrees with the commenters that RACT controls must be considered for coal-fired electric generating units. RACT obligations under the FCAA apply to existing sources within the nonattainment area; the commission did not identify any coal-fired electric generating units in the 2012 Point Source Emissions Inventory located within the 10-county DFW nonattainment area. The TCEQ maintains that, at this time, RACT is either proposed concurrently with this DFW AD SIP revision (Rule Project No. 2013-049-115-AI) or is currently in place for all emission source categories identified in the 2012 EI data. Because the current modeling current modeling results indicate that the DFW area will demonstrate attainment, RACM is not necessary. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Additional information regarding both the commission's RACT and RACM analyses are located in Appendix F and Appendix G, respectively, of this DFW AD SIP revision. Further, the commission does not agree that SCR is NOx RACT for cement kilns, nor does the pending Holcim permit, for which SCR is not being installed for NOx control, prove that SCR is NOx RACT.

The TCEQ appreciates stakeholder technical input relating to control strategy development and may be able to use valid information for future air quality planning purposes. No changes were made in response to these comments.

The SEED Coalition commented that best available control technology (BACT) and lowest achievable emission rate (LAER) standard, classifications which are more stringent than RACT, should be considered for this DFW AD SIP revision and that the associated costs are irrelevant. Another individual commented a reasonable standard is more akin to a California-level standard.

BACT and LAER are permitting requirements that apply to new sources and modified sources meeting certain criteria and are implemented in the DFW nonattainment area through the TCEQ's air permitting process. BACT and LAER fulfill different FCAA obligations for programs outside of those included in this DFW AD SIP revision. For these reasons, these standards are not contemplated as part of this plan. The FCAA requires RACT to be in place to assure that major sources of NOx emissions and FCAA-specified sources of VOC emissions, including major sources, are controlled to a reasonable extent, but not necessarily to BACT and LAER levels.

The EPA considers economic and technological feasibility when determining the lowest emission limitation a source is capable of meeting. Because economic feasibility is an integral component in determining RACT, the state must evaluate and consider fiscal impacts associated with potential control options. This information along with the technical feasibility component is relied upon to justify

the state's final RACT determination. No changes were made in response to these comments.

Solar and the TPA opposed the January 1, 2017 compliance deadline and suggested a phased-in compliance schedule to allow industry the time to develop and implement technology upgrades necessary to comply with proposed RACT standards.

An alternative compliance schedule, such as a phased-in compliance schedule suggested by the commenter, is unnecessary at this time, especially given that the affected Wise County turbines are not expected to require retrofits. The EPA's implementation rule for the 2008 eight-hour ozone NAAQS specifies the January 1, 2017 date as the compliance deadline for implementation of RACT requirements. The commission retains in the rule the compliance deadline of January 1, 2017 for affected units. No changes are made in response to this comment.

RACT Demonstration

The EPA commented that it supports the inclusion of major sources of VOC located in Wise County to become subject to the requirements in 30 TAC Chapter 115. The EPA also expressed support of the commission's clearly identified sections, which pertain to control of ammonia and carbon monoxide emissions. Ammonia and carbon monoxide emissions are not ozone precursors and are therefore not necessary components of the Texas ozone SIP. The EPA also expressed support of the commission's inclusion of major sources of NO_X located in Wise County to become subject to the requirements of Chapter 117.

The TCEQ appreciates the EPA's support. No changes were made in response to these comments.

The EPA commented that it cannot approve the proposed compliance schedule that states that, upon publishing notice in the *Texas Register*, Wise County is no longer nonattainment for the 2008 eight-hour ozone NAAQS, the rule applicability for sources in Wise County remains as it was prior to this rulemaking. The EPA indicated it cannot approve this provision because it does not contain "a replicable procedure" and to accomplish changing the applicability for sources in Wise County, the state would need to undergo rulemaking and submit a subsequent SIP revision. The EPA commented that Appendix B of the attainment demonstration analysis quantified NOx and VOC reductions from the rules proposed for sources in Wise County. The EPA stated that any SIP revision removing these proposed rules would need to include updated modeling so that emission reduction credit from these strategies would not be taken improperly.

The commission disagrees that a replicable procedure is necessary to change the applicability of RACT rules in Wise County in the event the ozone nonattainment designation for Wise County is no longer legally effective. If the ozone nonattainment designation is no longer legally effective, then there is no underlying legal basis or support for the RACT requirement to apply in Wise County. The inclusion of Wise County in the DFW ozone nonattainment area is currently in litigation, awaiting a decision from the D.C. Circuit Court. A final decision from the court that vacates the ozone nonattainment designation for Wise County would mean that the EPA would no longer have the authority to require or

enforce RACT requirements in an area that is not legally designated nonattainment for ozone.

Only in the absence of a legally valid ozone nonattainment designation would the commission be able to act under this rule provision, and such action would merely provide notice that it would no longer be legally required to comply with provisions that are no longer legally valid. Further action from the EPA would not be required if a final court decision vacates the ozone nonattainment designation of Wise County; therefore, no §110(l) demonstration could be required to remove a requirement that would no longer be legally required. Furthermore, the 2018 future year attainment demonstration modeling documented in the 2015 DFW AD SIP revision does not include NOx and VOC reductions from any rules proposed in the concurrent rulemakings (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI) for Wise County. The EI portions of both Chapter 3: *Photochemical Modeling* and Appendix B: *Emissions Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Standard* of this DFW AD SIP revision do not discuss or quantify any control strategies specific to Wise County. Since no emission reductions from these rulemakings were included in the 2018 future case modeling for Wise County, additional scenarios would not be required for attainment demonstration purposes.

To ensure that the rule language clearly establishes this standard, the commission is replacing the proposed language "Wise County is no longer designated nonattainment for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard" with "the Wise County nonattainment designation for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard is no longer legally effective" in the compliance schedules in the concurrent Chapter 115 and Chapter 117 RACT rulemakings (Rule Project Nos. 2013-048-115-AI and 2013-049-117-AI).

The Lone Star Sierra Club and one individual requested that vapor recovery units be required on VOC major source condensate tanks.

The adopted rule changes in Chapter 115, Subchapter B, Division 1, will extend control requirements to Wise County to implement RACT for storage tanks storing condensate with the potential to emit VOC of at least the applicable major source threshold for all counties in the DFW 2008 eight-hour ozone nonattainment area. The adopted rules require 95% control of VOC from condensate storage tanks in Wise County, as is required in the other nine DFW ozone nonattainment counties, but do not specify use of vapor recovery units because Texas Health and Safety Code, §382.017, prohibits the commission from adopting rules that require specific types of control equipment unless required by federal law or regulation. No changes were made in response to this comment.

The Sierra Club and Downwinders stated that advancing timelines is not a factor to consider when implementing RACT and that nothing in the FCAA or the EPA's guidance supports rejecting RACT because it cannot be installed and operational in sufficient time to advance attainment. The Sierra Club and Downwinders commented that precluding measures that cannot be installed before 2017 discourages the use of the most effective measures for reducing NO_X, delays attainment of the NAAQS, and affords Texas an excuse to do nothing.

Although advancing attainment is not a factor considered during a RACT analysis, the EPA prescribes implementation deadlines by which sources must be in compliance with RACT requirements. In the EPA's 2008 ozone standard SIP requirements rule, similar to previous implementation rules, the RACT compliance date is a fixed date based on the effective date of area designations. For the RACT portion of AD SIP revisions, the EPA established the implementation deadline as January 1st of the 5th year after the effective date of designation, or January 1, 2017. No changes were made in response to these comments.

The EPA requested that the commission either lower the Ellis County cement kiln source cap or set lower rate-based emission limits that reflect RACT for each dry kiln. Downwinders and the Sierra Club commented that the FCAA requires case-by-case RACT determinations for each of the cement kilns in Ellis County to determine technologically and economically feasible controls. The EPA argued that the 2007 source cap equation used production and emissions from wet kilns that have been supplanted by dry kiln use with intrinsically lower emissions, thus giving the dry kilns an effectively less stringent allowed emission rate that no longer satisfies RACT.

The TCEQ disagrees that the existing cement kiln NO_X rules no longer satisfy RACT. The EPA has previously approved the current Ellis County ozone season NO_X source cap as meeting the FCAA RACT requirements for these sources (74 FR 1927, January 14, 2009), which is consistent with the EPA's policy with respect to area-wide average emission rates. These existing sources have complied with the cap in part by replacing higher-emitting wet kilns with dry kilns. The cement kiln RACT rules were written and approved with a provision that emissions from new construction must fit under the cap and that all ongoing operations would continue to be bound by the cap based on 2003 to 2005 production. Therefore, RACT continues to be met on average by this group of sources under the current cap. Further evaluation of RACT for these cement kilns on an "each and every source" basis to establish new limits based on the replacement of wet kilns is not necessary, and the currently approved NO_X source cap continues to represent RACT for these sources.

The EPA's 2008 ozone standard SIP requirements rule follows the EPA's existing policy with respect to area-wide average emission rates, which recognizes that states may demonstrate that the weighted average NO_X emission rate from all sources in the nonattainment area subject to RACT meets NO_X RACT requirements. In the preamble to the rule, the EPA states that, "The EPA believes that the statute, as interpreted by the court in *NRDC v. EPA*, provides a state with the option of demonstrating that its program achieves RACT level reductions by showing emission reductions greater than or equal to reductions that would be achieved through a source-specific application of RACT in the nonattainment area...In sum, nothing in the CAA or in *NRDC v. EPA* requires that 'each and every source' in the area employ RACT or achieve RACT-level reductions. Consistent with previous guidance, the EPA continues to believe that RACT can be met on average by a group of sources within a nonattainment area rather than at each individual source." No changes were made in response to these comments.

The TPA disagreed with the commission's analysis that 0.50 grams per horsepower-hour (g/hp-hr) represents RACT for gas-fired rich-burn engines. One TPA member determined that six gas-

fired rich-burn engines from its fleet, already controlled by catalyst, could not meet the proposed NO_X level even with additional catalyst. For a particular 1,680 hp engine, an emission control system conversion kit would cost $90,000 ($540,000 in total) for the engine to meet 0.50 g/hp-hr. The member estimated the cost per ton of NO_X reduced for this one engine to be $11,100. The TPA therefore requested the commission establish 1.0 g/hp-hr as NO_X RACT for Waukesha engines.

The commission disagrees that an emission limit of 0.50 g/hp-hr is not representative of RACT for gas-fired rich-burn engines. The commission estimated the total costs for nonselective catalytic reduction (NSCR) catalyst retrofits for gas-fired rich-burn engines in Wise County based on some rich-burn engines needing entire catalyst system retrofits and some engines already equipped with catalyst systems only needing additional catalyst elements. The $30/hp estimate used by the commission for capital costs for new NSCR systems (39 TexReg 10351) is an overall estimate, and capital costs for an individual engine may be higher than this estimate. The $90,000 capital cost estimate provided by the TPA would equate to approximately $54/hp. While higher than the commission's estimate, the commission still considers the TPA's cost estimate for NSCR on rich-burn engines to be economically feasible. The TPA's estimated cost effectiveness of $11,100 per ton appears to be based on only first year capital costs and is not annualized. Capital costs associated with control requirements are typically annualized over a period of time when calculating cost effectiveness on a dollar per ton basis. Calculating cost effectiveness based on first-year capital costs and a single year of emission reductions inflates the dollar per ton estimate. The cost effectiveness estimate used by the commission in the RACT and fiscal analyses for this rulemaking included annual operating and maintenance costs and annualized capital costs over the first five years the rules are in effect. The first-year cost effectiveness estimate by the TPA cannot be compared to the commission's cost effectiveness estimates without being converted to the same basis.

Furthermore, the TPA's cost per ton estimate of $11,100 is also based on a NO_X reduction from 1.0 g/hp-hr to 0.50 g/hp-hr, when it should be from 2.0 g/hp-hr to 0.50 g/hp-hr. Site-specific data of annual NO_X emissions and operating hours reported to the 2012 Point Source Emissions Inventory indicate the 1,680 hp engine operated at a performance level of 2.0 g/hp-hr. Based on the TPA's cost information of the conversion kit, annualized over five years, the commission estimates the cost per ton for the 1,680 hp engine to be $1,027. This figure includes the $90,000 capital cost for the conversion kit, a capital cost of $2,500 for one totalizing fuel flow meter, annual maintenance costs of $3,000 for catalyst washing and O_2 or NO_X sensor replacement, annual average costs of $2,525 for compliance testing, and an emission reduction of approximately 23.4 tons per year. The commission notes that this estimate of $1,027 per ton for NSCR systems using the TPA capital costs is lower than the overall average of $1,563 per ton the commission cited for all affected units, including rich-burn engines, in the proposed rulemaking (39 TexReg 10350). The commission maintains that the NO_X emission specification of 0.50 g/hp-hr represents RACT for gas-fired rich burn engines. No changes are made in response to this comment.

Solar and the TPA suggested that the commission maintain the 4,500 hp level as the threshold for units subject to the NO_X standards and adopt emission levels in 40 Code of Federal Regulations (CFR) Part 60, Subpart KKKK, the current New Source Performance Standard (NSPS) for industrial combustion turbines, for modified and reconstructed industrial turbines. Solar and the TPA commented that the proposed emission values are stricter than 40 CFR Part 60, Subpart KKKK levels for modified and reconstructed units, and 40 CFR Part 60, Subpart KKKK contains emission standards for modified and reconstructed units were set at emission levels existing units were capable of meeting. For modified and reconstructed units with a heat input less than or equal to 50 MMBtu/hr, 40 CFR Part 60, Subpart KKKK contains an emission standard of 150 ppm. The proposed RACT requirements set a NO_X limit of 122 ppm for similarly sized industrial turbines, i.e., turbines rated less than 4,500 hp. For two affected units in Wise County, Solar commented that a dry low-NO_X retrofit is available but at significant capital cost. The other two affected units in Wise County will require uprating to a higher power rating and retrofitting with dry low-NO_X technology; this will impose significant capital costs. For these two units, Solar commented the results of the uprate and retrofit will potentially require corresponding compressor or other equipment upgrading, replacement, or modification; may trigger additional new source review permitting and/or Federal Energy Regulatory Commission permitting issues; and may result in the site running at a lower, less efficient load.

The TPA and Solar also disagreed with the commission's analysis that no capital costs due to retrofits or combustion modifications were expected for industrial gas-fired turbines in Wise County to meet the proposed NO_X emission specifications. Solar and the TPA estimated the compliance cost to be as high as $2 million to $4 million for each of the four affected Solar industrial turbines to comply with the RACT rulemaking. One TPA member determined that two industrial gas-fired turbines from its fleet would require retrofit technology estimated to cost between $1.5 million to $4 million per turbine. The member estimated the cost per ton for emissions reductions to be $38,800. The TPA contended this would approach a complete source replacement, contrary to RACT requirements. Solar contended that a source-specific RACT cost estimate is imperative to assess the cost effectiveness of the proposed RACT rulemaking on each affected unit in Wise County. Similarly, the TPA commented that consideration on a case-by-case basis of the specific technological and economic circumstances of an individual unit is the best way to ensure emission limits are complied with while accounting for exceptional circumstances that may arise in particular cases. The TPA endorsed and incorporated fully Solar's comments.

The commission acknowledges the emission limits proposed as RACT in the rulemaking are stricter than current 40 CFR Part 60, Subpart KKKK levels for modified and reconstructed units with a heat input less than or equal to 50 MMBtu/hr located in Wise County. However, the referenced NSPS rules are national rules whereas the NO_X RACT rules that the commission is adopting for the DFW 2008 eight-hour ozone nonattainment area are specific to the facilities in that area. Furthermore, RACT requirements can be, and are in some circumstances, more stringent than NSPS or National Emission Standards for Hazardous Air Pollutants rules. The commission declines to make the suggested change to create an exemption threshold based on unit size and adopt an emission standard of 150 ppm, or approximately 0.55 lb/MMBtu. However, based on supplemental data and information provided by, and comments received from, owners or operators of these units in Wise County, the commission has determined that some of the affected turbines in Wise County in the proposed mid-

size category, 4,500 hp and greater but less than 10,000 hp, may not be able to meet the proposed 0.20 lb/MMBtu NO_X emission specification without making significant modifications or retrofits at substantial costs. The commission determined at proposal that these costs did not represent RACT for these turbines in Wise County. The commission's proposed emission standards were based on existing emissions data for the units, but the commission's assessment of the ongoing emissions performance based on this data for the midsize category of turbines may have been too conservative. This resulted in the emissions standard being lower than what would be consistent with the commission's determination of RACT for industrial turbines in Wise County. Information provided by the TPA supplemented and clarified the 2012 Point Source Emissions Inventory data, upon which the commission proposed the NO_X RACT standards for industrial turbines in Wise County, and it indicated unit performance variability among the various turbine model ratings.

Therefore, the commission is removing the unit size category for units with a hp rating of less than 4,500 hp and the unit size category for units with a hp rating of 4,500 hp or greater but less than 10,000 hp. The commission is replacing these two unit size categories with a unit size category for units with a hp rating of less than 10,000 hp, and the corresponding NO_X emission limit is 0.45 lb/MMBtu, or approximately 122 ppm. Based on the supplemental information provided by source owners or operators of affected units, the commission determines that 0.45 lb/MMBtu for units rated less than 10,000 hp is an appropriate RACT control level considering current performance levels of existing units in Wise County. This control level is also consistent with the commission's determination of RACT for industrial turbines in Wise County made at proposal. Furthermore, based on unit specific information, the commission expects that no NO_X control technology retrofits will be necessary to comply with the RACT rule requirements for any of the affected industrial combustion turbines in Wise County. Therefore, the commission expects no fiscal impacts associated with controls for units in Wise County to comply with the adopted RACT emission standards. Based on the revised NO_X emission specifications, no affected sources are anticipated to undergo retrofits of any kind in order to meet the emission limits for industrial gas-fired turbines in Wise County.

The TPA commented that the proposed 500 parts per million by volume (ppmv) leak definition for valves at natural gas processing plants in Wise County is not RACT because it is not economically feasible and suggested regulatory alternatives. The TPA estimated that at one affected natural gas processing plant in Wise County, 494 valves would be affected by the 500 ppmv leak definition and that 75% of these valves would need repair and 25% of theses valves would need replacing. Using an average cost of $25,000 per valve to replace and $1,000 per valve to repair, the TPA estimated the plant to incur a total compliance cost of $3.45 million. The TPA indicated that the number of components requiring replacement or repair is even higher at another natural gas processing plant in Wise County.

The TPA claimed that the commission’s estimate of repair costs is too low. Specifically, the TPA disagreed with the commission’s assumption that on-site personnel would conduct monitoring, questioned the commission’s assumption of two annual valve repairs per site, and noted an inconsistency in how the commission described repair costs in the fiscal note.

The TPA recommended allowing the two affected natural gas processing plants in Wise County to monitor valves with their current permit-based 10,000 ppmv leak definition. The TPA requested a limited exemption if a Wise County natural gas plant could demonstrate that leak detection and repair of valves with a 500 ppmv leak definition would be economically infeasible. The suggested exemption would expire if the valve became subject to 40 CFR Part 60 Subpart OOOO. The TPA supported its recommendation because DFW area ozone formation is not dependent on Wise County VOC emissions and only two facilities are affected.

The commission disagrees that the fugitive emission control rules in Chapter 115, Subchapter D, Division 3, are not RACT for natural gas processing plants in Wise County. The 500 ppmv leak definition is already established as RACT for the other nine counties of the DFW 2008 eight-hour ozone nonattainment area, as well as the HGB 1997 eight-hour ozone nonattainment area. The commenter did not provide data demonstrating that unique technological and economic circumstances exist for the natural gas processing plants in Wise County that warrant a leak definition different than the current 500 ppmv RACT-level leak definition to which natural gas processing plants in the other nonattainment counties and areas are subject. The commission determined, and contends, that these rule requirements are just as technologically and economically feasible for the applicable facilities in Wise County as the requirements are for facilities already subject to the rules. The commission's staff based the fiscal analysis, including the repair cost of $150 per valve, on EPA Natural Gas Star documents and articles published in *Oil and Gas Journal*. The commission continues to expect that Wise County natural gas processing plants will not incur additional expenses for monitoring valves with a 500 ppmv leak definition, whether they are monitored by on-site personnel or a contractor, since these valves are already monitored on the same schedule as those with a 10,000 ppmv leak definition. The commission also expects that the percentage of valves at a natural gas plant leaking more than 500 ppmv should be far lower than the 100% characterized in the comment.

The costs for replacing valves was not considered because the commission anticipates that valves would be designed and maintained to leak less than 500 ppmv. There may be an initial cost to replace leaking valves but adequate information was not provided to justify $25,000 per replaced valve as an appropriate replacement cost. No changes are made in response to this comment.

RACM Demonstration

The Sierra Club and Downwinders commented that given the commission will not, and admits that it will not attain the 2008 eight-hour ozone standard by 2018, reliance on an "arbitrary" 2017 cutoff date for RACM is unreasonable. The commenters also stated that nothing in the EPA's interpretation or the FCAA suggests that a measure fails to qualify as RACM if it cannot be installed and in operation an entire year before the attainment date, but that the control measure should only be capable of advancing attainment.

The TCEQ disagrees that it has admitted that it cannot and will not attain by 2018. Modeling results based on the April 2007 EPA modeling guidance project the future ozone design value to be 76 ppb. Use of the newer EPA draft guidance projects this 2018 future ozone design value to be 75 ppb. These 2018 design values

and the WoE analysis included in Chapter 5 of the DFW AD SIP revision demonstrate attainment of the 2008 eight-hour ozone NAAQS. Additionally, as discussed in this DFW AD SIP revision, the 76 ppb future design value for the Denton Airport South monitor is based on the "all days" attainment test recommended by the EPA modeling guidance from April 2007. Application of the "top 10 days" attainment test recommended by the draft EPA modeling guidance from December 2014 results in a 2018 future design value of 75 ppb at the Denton Airport South monitor, with the values for all other monitors ranging from 62-74 ppb, demonstrating attainment of the ozone standard.

The 2017 cutoff date the commenters refer to is the date by which control measures considered to be RACM would need to be implemented as part of this DFW AD SIP revision in order to advance the December 31, 2018 attainment date by at least one year to December 31, 2017. The TCEQ relied on the EPA's interpretation of RACM criteria, including whether the control measure can advance the attainment date by at least one year (74 FR 2945, January 16, 2009) to evaluate whether each control measure constituted RACM. Advancing the attainment date to December 31, 2017 would require controls to be installed and in operation no later than March 1, 2017, allowing time to realize the emissions reduction benefit from implementing the control measures. The TCEQ anticipates that without requiring operation of a control a year prior to attainment, the full benefit/effect of a control measure would not be realized in monitoring data and may not, in reality, actually advance attainment of the NAAQS by at least a year. If a control measure does not meet this criteria point, it is not a valid RACM control.

As explained in Appendix G of this DFW AD SIP revision, the implementation deadlines for RACM are established by the EPA's interpretation of FCAA, §172(c)(1) that states incorporate into their SIP all RACM that would advance a region's attainment date after determination that such measures are reasonably available for implementation in light of local circumstances (57 FR 13498). This interpretation was subsequently upheld by several courts. No changes were made in response to these comments.

TECHNICAL ANALYSIS

Future Attainment Year

The EPA referenced a December 23, 2014 U.S. Court of Appeals ruling that concluded the end of year attainment dates required by the EPA for the 2008 eight-hour ozone standard "were not consistent with Congressional intent...Therefore, the EPA intends to promulgate rulemaking to revise the attainment dates to a timeframe consistent with the courts' decision...the attainment year ozone season for the DFW nonattainment area will likely be 2017 rather than 2018." The EPA stated that the TCEQ should "revise the applicable elements of the attainment demonstration submittal to reflect the earlier attainment date" and that a "SIP requirements rule will be finalized soon addressing the Court's decision regarding the attainment date." The EPA requested that the AD MVEB be revised to reflect the earlier attainment date, and that the attainment analysis be supplemented "to show that the area will attain by 2017."

The D.C. Circuit did not make its ruling until December 23, 2014 and the TCEQ did not receive this comment from the EPA until February 11, 2015. The TCEQ approved proposal of this DFW AD SIP revision on December 10, 2014. The

complex information gathering and photochemical modeling assessments required by the EPA to submit an AD do not permit the TCEQ to merely change the attainment year and provide an analysis within such a short time. The proposed DFW AD SIP revision was developed based on the EPA's May 21, 2012 implementation rule for the 2008 eight-hour ozone NAAQS (77 FR 30160), which set 2018 as the attainment year for areas classified as moderate. The TCEQ began AD SIP revision development work in 2012 when this rule was published and designations under the 2008 eight-hour ozone standard were made by the EPA. The deadline to submit AD SIP revisions for areas classified as moderate for the 2008 eight-hour ozone NAAQS is July 20, 2015, which EPA has not altered.

Due to the timing of the court's ruling and the EPA's subsequent rulemaking action, it was not possible to complete all work necessary for this DFW AD SIP revision to demonstrate attainment in 2017 and still meet the July 20, 2015 submission deadline. Therefore, this DFW AD SIP revision includes the work completed to date to demonstrate that the DFW nonattainment area will attain the 2008 eight-hour ozone NAAQS by 2018 as proposed, and to demonstrate progress toward attainment by the new 2017 attainment year. The DFW AD SIP revision also commits to develop a new AD SIP revision for the DFW 2008 eight-hour ozone nonattainment area as long as 2017 remains the attainment year. The new DFW AD SIP revision would include the following analyses to reflect the 2017 attainment year: a modeled AD, a RACM analysis, and an MVEB. Because significant additional analysis was not needed to complete the contingency plan for attainment, Chapter 4, Section 4.9 was revised to reflect a 2017 attainment year.

Draft Modeling Guidance

The EPA recommended that the TCEQ continue to perform the attainment test calculations in accordance with both the April 2007 final guidance for the 1997 eight-hour ozone standard and the December 2014 draft guidance for the 2008 eight-hour ozone standard.

The TCEQ agrees with this recommendation and will include calculations of future ozone design values in accordance with both guidance documents until the version for the 2008 eight-hour ozone standard is finalized. The guidance dated April 2007 recommends calculation of the future design values based on all episode days per monitor modeled in the baseline above a specific threshold, such as 75 parts per ppb. The newer draft guidance released December 3, 2014 recommends calculation of the future design values based on the 10 days in the baseline episode per monitor with the highest modeled design values. All of the modeling work documented in the proposed DFW AD SIP revision was done prior to the release of the new draft guidance by the EPA. In a supplement released on January 12, 2015, the TCEQ included tables for the future design values based on the older "all days" test and the newer "top 10 days" test. Chapter 3, Section 3.7.2: *Future Baseline Modeling* of this DFW AD SIP revision includes 2018 ozone design value results for both attainment tests.

The EPA requested that further analysis and documentation be provided evaluating the specific days used in the attainment test. Specifically, the evaluation of modeling performance and meteorology/transport should be provided for each day included in the design value calculation

per monitor. Each day should also be evaluated to ensure consistency with the conceptual model description for the area. The EPA also states that more than 10 days may be needed in the calculation of design values for each monitor.

The current draft modeling guidance from December 2014 describes the "top 10 days" test in detail, but does not specify any of these additional requirements. Preparing detailed analyses for the top 10 days for all 19 monitors is a significant work effort that cannot be completed in time for adoption of this DFW AD SIP revision. If these provisions are recommended in the final version of the modeling guidance for the 2008 eight-hour ozone standard, the TCEQ will work with the EPA to determine how to most efficiently perform these analyses and to appropriately determine if and when a specific monitor will need more than 10 days in the attainment test calculation. Therefore, this detailed analysis for the top 10 days for all 19 monitors was not performed at this time. No changes were made in response to this comment.

Model Performance

The EPA commented that the modeling is performing reasonably well, but has some concerns with performance related to transported ozone and ozone precursors. The EPA noted that on a number of days, the model overestimates ozone at upwind monitors in the DFW nonattainment area, and infers that ozone over-prediction at upwind monitors farther away is influencing model performance in the DFW nonattainment area, taking particular note of nighttime over-prediction of ozone at rural monitors. The EPA further speculated that this issue may lead to the model being more responsive to regional background changes than to local changes.

The TCEQ is aware of the performance issues at upwind monitors, and has determined that the cause of this phenomenon is at least partially attributable to the model predicting higher levels of ozone blowing onshore from the Gulf of Mexico than are actually measured. The TCEQ has used a contractor project to implement halogen chemistry over ocean waters into recent modeling activities and to also explore improving the accuracy of boundary conditions over the Gulf of Mexico and Atlantic Ocean. These approaches are currently being evaluated and may be implemented in future modeling if appropriate. This modeling will provide a platform for assessing the model's responsiveness to changes to both background and local ozone precursors. No changes were made at this time in response to this comment.

The EPA commented that it has concerns that the model is overly sensitive to low-level NO_X reductions and has some concerns about NO_X predictions in the DFW nonattainment area. The EPA suspected the model's vertical mixing of pollutants emitted at ground-level is too vigorous, based on a comparison of observed and modeled nitrogen dioxide (NO_2) concentrations throughout the modeling domain. The EPA suggested that applying a vertical diffusivity (Kv) "patch" to the standard Weather Research and Forecasting (WRF) model output as it is being converted to Comprehensive Air Quality Models with Extensions (CAMx) input may be causing surface emissions to mix up too rapidly, thus artificially lowering surface concentrations and ultimately making the model too sensitive to NO_X emissions.

The Kv patch, which increases mixing through the first 100 meters in the vertical dimension, is routinely used in modeling to account for enhanced nocturnal

mixing in urban areas due to heat island and increased mechanical mixing in those areas. However, since the minimum Kv value at the surface is land-use weighted, and in rural areas this minimum Kv is a fraction of the urban value, the neighboring vertical cell layers will also generally exhibit lower values than in urban areas. Most importantly, this feature is completely marginal during the daylight hours when all mixing is significantly greater than at nighttime. Therefore, this contribution to any NO_X sensitivity is likely to be of much less consequence than other factors.

A review of modeled versus observed NO_X concentrations in eastern Texas does show that some, but not all, rural sites' NO_X concentrations are under-predicted by the model. Any tendency towards under-prediction in rural areas may be due more to local effects than to any product of the Kv patch or other modeling artifact. While performance evaluation of precursor concentrations is valuable, the commensurability of the model and observations must be considered. The model predicts average concentrations over a 4 kilometer (km) by 4 km grid cell, while a monitor only measures concentrations at one location. If a monitor is near a source such as a major roadway within the same cell, it will likely record concentrations higher than the modeled average concentration, and vice-versa for a monitor on the opposite side of a cell from a large source. Even in rural areas, monitors are often sited relatively close to roads, since physically moving the monitoring trailer requires vehicular access, so a rural monitor often may over represent NO_X levels when compared to the entire modeling grid cell in which the monitor resides. No changes were made in response to this comment.

The EPA acknowledged the issue of incommensurability in the case of the Hinton Street monitor and its proximity to the Interstate 35 corridor, but the EPA statement that "modeled values would likely be higher for both the bilinear interpolation values and the 3x3 array values" is ambiguous since it is unclear what the "values would likely be higher" than.

Modeled vertical mixing within a few hundred meters of the surface has traditionally been difficult to verify because most air quality data are collected at ground level or by aircraft flying several hundred meters or more above the surface. The Deriving Information on Surface conditions from COlumn and VERtically resolved observations for Air Quality (DISCOVER-AQ) study led by National Aeronautics and Space Administration was conducted in September 2013 in the Houston area. DISCOVER-AQ collected a rich set of data that can be used to better characterize vertical mixing, and the TCEQ is actively supporting analyses that promise to improve modeled treatment of vertical mixing in the near future. No changes were made at this time in response to this comment.

The EPA expressed concern over model performance in the August-September 2006 episode, specifically general over-prediction of maximum daily eight-hour average (MDA8) ozone concentrations of over 10 ppb, under-prediction of NO_X concentrations at the Kaufman monitor upwind of the main urban areas, slight over-prediction of NO_X concentrations at the Hinton Street monitor, over-prediction of ozone at the Fort Worth Northwest monitor coupled with under-prediction of NO_X at high measured concentrations and over-prediction of isoprene, and over-prediction of highly reactive VOC (HRVOC) species at both the Hinton Street and Fort Worth Northwest monitors.

The TCEQ is aware of these concerns and addresses many of them specifically in Appendix C: *Photochemical Modeling for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Ozone Standard* of this DFW AD SIP revision. The overall performance for the June 2006 episode is better than the August-September 2006 episode. The TCEQ has attempted to identify specific causes of the difference in performance between the episodes. Part of the difference may simply be that June had more high ozone days than did August-September in 2006, and regulatory models tend to be optimized to perform better for days important for regulatory purposes. At the Hinton Street monitor, the modeled concentrations of isoprene are reasonably close to the observations, but modeled concentrations of anthropogenic VOC are too high. Meanwhile, at the Fort Worth Northwest monitor, modeled concentrations of anthropogenic VOC are much closer to the observations than at the Hinton Street monitor, but modeled isoprene concentrations are several times as high as the observed values. The differences may be indicative of issues with the model, but also may simply be the result of incommensurability of the model and observational data as discussed previously. Finally, the new draft modeling guidance states that "Where feasible, it is recommended that days with model biases greater than ±20% percent be examined to make sure that they can be appropriately used in calculating the expected response." Modeled MDA8 ozone concentrations on most high-ozone days, even in the August-September 2006 period, are within ±20% of the observed values. In accordance with the draft guidance, the TCEQ plans in future AD SIP revisions to not perform relative response factor (RRF) calculations on episode days with bias greater than ±20%. No changes were made in response to this comment.

<u>Background Ozone Levels</u>

The EPA commented that the source apportionment modeling indicated lower contributions from outside of Texas than the upwind monitoring analysis that Texas included. The EPA noted that upwind monitor analyses can overestimate background contributions since most monitors are not in a location that precisely separates upwind and downwind contributions. The EPA stated that the non-Texas ozone contribution on high transport days was usually less than 50 ppb, and often 40-45 ppb or less. The EPA concluded that Texas sources contribute approximately half of the ozone formed in the DFW nonattainment area.

The TCEQ acknowledges that the assessment of background ozone is different between modeling and upwind monitor analyses. Both approaches are imperfect tools for assessing background ozone levels, and it would be surprising if they matched. Out of necessity, modeling analyses are confined to a base and/or future year for which extensive modeling files exist. In contrast, monitoring data cannot be used to estimate future background levels, but several years of historical monitoring data can be analyzed. Table 3-47: *2018 Ozone DV_F Denton, Parker, and Kaufman Aggregate Summary* of this DFW AD SIP revision shows source apportionment results for the 2018 future year with the non-Texas contribution ranging from 43 ppb at the "low" Kaufman monitor to 45 ppb at the "high" Denton Airport South monitor. The Texas contribution is then shown to total 20 ppb at Kaufman and 32 ppb at Denton Airport South. The TCEQ disagrees with the EPA's conclusion that Texas sources contribute approximately half of the ozone formed in the DFW nonattainment area, because these results show the relative Texas

contribution at 32% for Kaufman and at 42% for Denton Airport South, which implies that the non-Texas contribution is at 68% for Kaufman and 58% for Denton Airport South.

For the historical years of 2001 through 2014, the TCEQ analyzed monitoring data for each eight-hour ozone exceedance day to conclude that the mean non-Texas background contribution for each year ranges from 60-70%. This range correlates very well with the 58-68% results shown for the Kaufman and Denton Airport South monitors, which are the most upwind and downwind monitors within the DFW nonattainment area, respectively. The monitoring analysis showed that mean background ozone on exceedance days appears to range during 2001 through 2014 from roughly 49 to 61 ppb. The 2001 through 2014 monitoring analysis also shows that the background ozone levels during an entire season may average in the range of 40 ppb, but that this could increase by 10-20 ppb to 50-60 ppb on any given exceedance day. Both the monitoring and the TCEQ's modeling analyses indicate that all DFW exceedance days are accompanied by high non-Texas background levels, and that this background contributes the majority of peak ozone. No changes were made in response to this comment.

<u>Episode Selection</u>

The EPA commented that June 2006 is a "good episode and representative of the type of days from the conceptual model that drive the early summer exceedances in the DFW area." The EPA also stated that the inclusion of the August-September 2006 episode was "a step in the right direction," but that the late summer 2006 episode days were "not typical" and "actually light on ozone exceedances compared to the conceptual model." The EPA states that the episode days driving the future design values may be more heavily weighted toward the June 2006 rather than August-September 2006 episode.

The TCEQ agrees that the 33-day June 2006 episode is good and representative of the types of days that occur during early summer ozone exceedances in the DFW nonattainment area. The TCEQ also agrees that the inclusion of the 34-day August-September 2006 episode is an improvement over previous modeling work. The June 2006 episode was chosen over the August-September 2006 episode in the previous eight-hour ozone SIP revision from 2011 because it tended to have overall improved performance and representation. Even though the August-September 2006 episode is not as optimal in this respect as June 2006, the TCEQ believes it would be more representative to include it rather than exclude it. Table 3-1: *DFW 75 ppb Ozone Exceedance Days by Month from 2006 through 2012* of this DFW AD SIP revision shows that the August-September 2006 period had 13 ozone exceedance days. Based on the summary of exceedance days by month provided in Table 3-1, the TCEQ disagrees with the EPA's statement that this portion of the episode is light on exceedance days in comparison to the conceptual model.

The TCEQ also disagrees with the EPA's suggestion that the future design value calculations have insufficient representation from the later summer period. Table 3-40: *2006 Baseline Design Value Summary for the Attainment Test* of this DFW AD SIP revision shows that 36 days of the combined 67-day episode were used in the attainment test calculation for the Denton Airport South monitor. Seventeen of these days were from the June 2006 period, while 19 were from the August-

September 2006 period. If the "top 10 days" test is used, there are five from each period. The full set of modeling output files used to make these determinations for each monitor are available via the TCEQ Air Quality Modeling Web page (https://www.tceq.texas.gov/airquality/airmod/data/tx2006). No changes were made in response to this comment.

The SEED Coalition commented that the AD uses outdated computer modeling. Several individuals, the Sierra Club, and Downwinders commented that the AD relies on an outdated 2006 episode that was already used in DFW nonattainment area SIP revisions submitted in 2007 and 2011. The Sierra Club and Downwinders also stated that the 2006 episode is not consistent with the requirement of the draft modeling guidance that the EPA released in December 2014. The Sierra Club and Downwinders stated that the episode should model representative time periods and meteorological conditions when peak ozone levels are monitored. Several individuals, the Sierra Club, and Downwinders further commented that 2011 should have been chosen because it was a year with exceptional drought conditions and high monitored ozone levels. Several individuals, the Sierra Club, and Downwinders stated that the TCEQ failed to account for climate change effects in the episode selection process even though these are required by the draft December 2014 modeling guidance.

The 2006 episode was not used in two previous SIP revisions. It was used in the DFW AD SIP revision that was adopted on December 7, 2011, but was not used in the DFW AD SIP revision adopted in May 2007. This SIP revision also added a 34-day episode from August 13-September 15, 2006, which results in a combined 67-day episode.

Episode selection is covered in Chapter 3, Section 3.3: *Episode Selection* of this DFW AD SIP revision. A representative episode for the DFW nonattainment area would need to include the bi-modal peaks that historically occur in ozone exceedances during both June and August-September, as shown in Figure 3-2: *DFW Eight-Hour Ozone Exceedance Days by Month from 1991 through 2012* of this DFW AD SIP revision. The TCEQ demonstrates that the only acceptable candidates identified for such representation are 2006 and 2012. Table 3-1 shows how the years from 2007 through 2011 had far fewer exceedance days in June compared with August-September. For example, there were only four exceedance days in June 2011 but 26 in August-September. This is a skewed distribution that is not representative of the historical ozone exceedance patterns in the DFW nonattainment area. 2012 has been identified as an acceptable candidate episode, and Chapter 3, Section 3.3.2: *DFW Ozone Episode Selection Process* indicates that the TCEQ has begun development work on this episode.

Table 3-1 also shows that 2006 had more ozone exceedance days than the 2011 episode suggested by the commenters. According to the Palmer Drought Severity Index (PDSI), the north central Texas area was in extreme drought for all months from June through September during both 2006 and 2011. Prior to 2006, the north central Texas area had only been categorized in extreme drought for all four of these successive months in six different years spanning from 1909 through 1956.

The December 2014 modeling guidance was not used by the TCEQ in the episode selection process for this DFW AD SIP revision because it was not available when the TCEQ was required to begin SIP development. The episode selection review began in 2012 when the EPA made nonattainment designations under the 2008 eight-hour ozone standard. This process was documented in the draft modeling protocol that was submitted to the EPA in August 2013. All of the technical work included in this DFW AD SIP revision had to be completed by June 2014 in order to be included in the December 2014 proposal. Chapter 3, Section 3.3.1: *EPA Guidance on Episode Selection* of this DFW AD SIP revision states "When development work commenced for this AD SIP revision in 2012, the EPA's former modeling guidance for the 1997 eight-hour ozone standard of 84 ppb was in effect. The episode selection work for this attainment analysis was done in accordance with this former guidance."

The updated draft modeling guidance references climate change issues in Section 2.6.2: *Assessing Impacts of Future Year Meteorology*. However, the EPA does not provide any instruction on how meteorological modeling inputs are to be adjusted to predict these future levels. Out of necessity, ozone episodes are from the past and meteorological measurements are used to drive the model accordingly. Furthermore, the EPA states the following in the draft guidance: "Given the relatively short time span between base and future year meteorology in most SIP demonstrations, the EPA does not recommend that air agencies explicitly account for long-term climate change in attainment demonstrations." No changes were made in response to this comment.

<u>Emissions Banking and Trading</u>

The EPA noted that the discussion of ERCs and DERCs in Appendix B: *Emissions Modeling for the DFW AD SIP Revision for the 2008 Eight-Hour Ozone Standard* of the proposal indicated that there are 363 tons per year (tpy) of NO_X ERCs and over 6,000 tons of NO_X DERCs. The EPA requested clarification of how the 17 NO_X tpd figure was developed for modeling sensitivity purposes. The EPA also requested documentation on how the NO_X and VOC emissions for ERCs and DERCs were spatially allocated in the model. The EPA requested clarification regarding emergency use of DERCs beyond the flow control limit.

The rulemaking in 30 TAC Chapter 101, Subchapter H, Division 4 (Rule Project Number 2014-007-101-AI) adopted concurrently with this DFW AD SIP revision replaces the previous annually calculated NO_X DERC limit in §101.379(c) with a fixed limit of 17.0 tpd of NO_X DERCs. This limit applies only to NO_X DERCs generated and used in the nine-county DFW 1997 eight-hour ozone nonattainment area. The 17.0 tpd limit was selected based on the 2013 NO_X DERC limit of 16.9 tpd, which was the second highest limit that had been set at the time the modeling sensitivity was conducted. In addition, the 17.0 tpd limit is consistent with the 16.3 tpd average of all of the NO_X DERC limits established from 2009 through 2015. The limit is one and a half times greater than the largest request to use DERCs submitted from 2009 through 2015, and more than 11 times greater than any actual DERC use from 2009 through 2014. Adoption of the fixed limit does not affect the exemption for ERCOT-declared emergencies, which was established in 2013 because the effects on air emissions from an electrical grid emergency and

potential blackout could be more significant than the use of DERCs above the limit. To date the exemption has not been used.

Section 3.7.4.2: *Discrete Emissions Reduction Credit (DERC) Sensitivity* of the adopted DFW AD SIP revision presents the model-predicted results of adding 17.0 tpd of NO_X DERCs in the 2018 future case to the non-cement kiln non-EGU point sources located throughout the DFW nonattainment area. Section 3.7.4.2 discusses how these 17.0 tpd of NO_X emissions were allocated based on the proportional contributions from these point source facilities to the 22.99 NO_X tpd total projected for 2018. The 17.0 NO_X tpd limit on DERC use is consistent with attainment and maintenance of the 1997 and 2008 eight-hour ozone NAAQS because the modeling sensitivity conducted shows that the adopted limit will not cause any monitor to exceed the 73-78 ppb weight of evidence range for the 75 ppb standard. Section 3.7.4.2 of the adopted DFW AD SIP revisions provides additional detail regarding the modeled ozone impacts of the 17.0 NO_X tpd DERC limit.

The TCEQ acknowledges that the wording in Table 2-15: *Banked Emissions as of June 2013* and Table 2-16: *Texas Non-EGU "No-Rules" Growth Summary* in Appendix B might cause the reader to infer that the entries of Table 2-15 are actually the emissions that were modeled. The TCEQ has corrected the table entries and improved the wording in Appendix B to match the wording in Section 3.7.4.2 of the adopted DFW AD SIP revision.

The TCEQ concludes that the 17.0 NO_X tpd value in the "Total Modelable NO_X Bank (tpd)" column of Table 2-15 is incorrect. The correct entry should be 16.5 NO_X tpd, which is the sum of the DFW NO_X ERCs and DERCs and is the maximum amount (worst case) of NO_X credits that could be applied to the future case. The EPA identified the ERCs and DERCs in the "DFW Registry" row of that table when, in fact, the modelable banked emissions are always less than the registry total, as provided in the last row of Table 2-15 (see explanation in the paragraphs following Table 2-15 on page 47 of Appendix B). As described in the paragraphs above Table 2-15 on page 47 of Appendix B, the "Total Modelable NO_X Bank" is the absolute maximum that would be modeled if there were no other limitations applied. As documented, there is no reason to expect that the entire bank would be used prior to the required ozone attainment date in 2018, and in fact, there is no history of more than 1.5 NO_X tpd usage of the DFW DERCs in any one year, and the bank would be used only for potential growth in the DFW nonattainment area. This is another example of modeling potential worst case, when in practice, DERCs have never been used for growth (expansions, new units, etc.)– only for compliance with applicable TCEQ rules and permit limits.

Section 2.3.3.1.2: *NAA non-EGU Projections and Control Implementation* of Appendix B explains that the growth projected by the Eastern Research Group, Inc. (ERG) analysis was actually the limiting factor. As shown in Table 2-16, the ERG projection factors predict 2018 DFW NO_X to be reduced by 0.55 tpd from the 2012 projection year. This is also made more clear in the DERC sensitivity modeling as documented in Section 3.7.4.2 of the adopted DFW AD SIP revision. The modeling did not address any additional DERC use that may or may not occur due to the exemption for ERCOT-declared emergencies, which as stated above, to

date have never been used. Changes for the purposes of clarification were made to Appendix B in response to this comment.

<u>On-Road Emissions Inventory</u>

An individual commented that the TCEQ is waiting on the gasoline fuel controls to take effect in 2017. The Sierra Club and Downwinders commented that the AD "relies almost entirely on implementation of the unenforceable, future low-sulfur motor vehicle emission standards that are not scheduled to become effective until 2017, at the earliest." The Sierra Club and Downwinders further stated that the TCEQ estimates of on-road emissions "will account for an unprecedented 57% reduction" in NO_X emissions by 2018. The Sierra Club and Downwinders stated that "federal fuel measures are unenforceable by TCEQ and...will not be fully implemented until 2025, TCEQ cannot reasonably rely on those measures to demonstrate attainment by 2018." The Sierra Club and Downwinders stated the EPA now estimates that these federal mandates will result in 2018 emission reductions of 9.98 NO_X tpd and 2.39 VOC tpd per day within the DFW nonattainment area.

The TCEQ disagrees with this assessment. The standards for fuels and vehicles are separate, but both are enforceable by the federal government. The commenters incorrectly suggest that the TCEQ should not be accounting for reductions from these measures because it is the federal government that regulates them instead of the state. The state is required to use the EPA's latest version of the on-road model at the time that inventory work is done, and these models incorporate the benefits of various federal measures for fuels and vehicles that will be in place for the specific calendar year modeled.

The EPA finalized rulemaking in March 2014 for more stringent vehicle emission and fuel standards. The vehicle emission standards required for manufacturers are referred to as Tier 3 and are phased-in between the 2017 through 2025 model years. There is a separate standard for gasoline refiners that requires 10 parts per million (ppm) sulfur instead of the 30 ppm level currently required. This takes effect starting in the 2017 calendar year, and will have an immediate emission reduction benefit from emissions from vehicles currently being used, referred to as "in-use vehicles."

Chapter 3, Section 3.7.4.1: *Tier 3 Standards Sensitivity* of the proposed DFW AD SIP revision references the research conducted by the EPA about the emission reductions that will result from in-use vehicles operating on 10 ppm sulfur gasoline instead of 30 ppm. The report is referenced in Chapter 3, Section 3.8.2: *Modeling References* and is entitled *The Effects of Ultra-Low Sulfur Gasoline on Emissions from Tier 2 Vehicles in the In-Use Fleet.* The commenter suggests that the benefits of 9.98 NO_X tpd and 2.39 VOC tpd were estimated by the EPA, but Chapter 3, Section 3.7.4.1 clearly states that these benefits were estimated by the TCEQ using the EPA's MOVEST3NPRM model.

In Chapter 3, Section 3.5.4.2 of this DFW AD SIP revision, the 2006 and 2018 on-road emission estimates are compared. Using the latest available vehicle activity and emission rate information applicable to these years, DFW nonattainment area on-road NO_X emission estimates are shown to drop by 58% from 284.27 tpd to 119.69 tpd. This is a result of the ongoing fleet turnover effect where older higher-

emitting vehicles are constantly removed from the fleet while newer lower-emitting vehicles are introduced. The net reduction over time in the fleet average emission rate is greater than the net increase in miles traveled, thus resulting in substantial emission reductions. The commenter suggests that a 57% reduction in NO_X in the 12-year period from 2006 through 2018 is "unprecedented," but offers no alternative on-road emission figures for these years. Fuller descriptions of the on-road inventory development process are available in Appendix B and on the TCEQ on-road mobile FTP directory (ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/). No changes were made in response to this comment.

Oil and Gas Emissions Inventory

The Sierra Club and Downwinders commented that TCEQ staff, during an August 2014 presentation, attributed a full 1 ppb reduction in future modeled ozone at the Denton Airport South monitor solely to changes in oil and gas emission estimates. The Sierra Club and Downwinders stated that the monitors with future design values close to the 75 ppb standard are historically the worst-performing monitors in the DFW nonattainment area, the ones setting the ozone design values now and in the future, and that these are greatly impacted by oil and gas pollution. The Sierra Club and Downwinders cited a University of North Texas study that divided the DFW nonattainment area monitors into western "fracking" ones and eastern "non-fracking" ones. The study concluded that the higher ozone levels recorded at the western fracking monitors were due to emissions from oil and gas sources.

During an August 2014 presentation held at the NCTCOG offices in Arlington, TCEQ staff did not say that changes in 2018 oil and gas emission estimates were entirely responsible for a 1 ppb change in modeled ozone at the Denton Airport South monitor. Slide 7 from the November 5, 2013 presentation shows that the 2018 future design value modeled at the time was 77.09 ppb for the Denton Airport South monitor. Slide 9 from the August 12, 2014 presentation shows that the 2018 future design value being modeled was 76.67 ppb. The net reduction is 0.42 ppb and not a full 1 ppb. The TCEQ intentionally reports modeled design values out to two decimal places so that these types of effects can be properly reported. After rounding to one decimal place and truncating in accordance with the EPA modeling guidance, the 77.09 ppb becomes 77 ppb, and the 76.67 ppb becomes 76 ppb. These presentations are available both on the TCEQ's DFW Photochemical Modeling Technical Committee Web page (https://www.tceq.texas.gov/airquality/airmod/committee/pmtc_dfw.html) and through the NCTCOG Air Quality Technical Committee Web page (http://www.nctcog.org/trans/committees/AQTC/).

The commenters incorrectly attribute this truncated 1 ppb change exclusively to oil and gas emission impacts. Under the EPA's modeling guidance, the modeled design value would only have to change 0.01 ppb from 76.94 ppb to 76.95 ppb to result in rounded and truncated differences of 76 ppb and 77 ppb, respectively. In this hypothetical example, it is incorrect to conclude that emission changes having resulted in a 0.01 ppb ozone difference are really a 1 ppb impact.

The TCEQ did revise its 2018 emission projections for many of the anthropogenic source categories between November 2013 and August 2014. These are reported on

slide 36 of the November 2013 presentation and slide 9 of the August 2014 presentation. The TCEQ was initially projecting oil and gas production NO_X emissions for 2018 to be 12.20 tpd, but the newer information resulted in a drop of 5.05 tpd down to 7.15 tpd. The TCEQ was initially projecting oil and gas drilling NO_X emissions for 2018 to be 5.83 tpd, but the newer information resulted in a drop of 3.01 tpd down to 2.82 tpd. The combined reduction for both of these categories is an 8.06 NO_X tpd reduction from 18.03 tpd to 9.97 tpd. These presentations are available both on the TCEQ's DFW Photochemical Modeling Technical Committee Web page (https://www.tceq.texas.gov/airquality/airmod/committee/pmtc_dfw.html) and through the NCTCOG Air Quality Technical Committee Web page (http://www.nctcog.org/trans/committees/AQTC/).

The best estimate of the amount of ozone attributed to the Denton Airport South monitor from oil and gas production and drilling emissions is presented in the source apportionment results within Table 3-46: *2018 Ozone DV_F Denton, Parker, and Kaufman Contributions* of this DFW AD SIP revision. These two combined categories are shown to be responsible for 0.40 ppb of the 76.72 ppb design value for 2018. The four major anthropogenic source categories within the DFW nonattainment area are reported to be on-road (8.66 ppb), non-road (3.39 ppb), off-road (2.96 ppb), and area (2.77 ppb). Table 3-47 shows how the 76.72 ppb design value for the Denton Airport South monitor is broken out into contributions from DFW (20.27 ppb), non-DFW Texas (11.67 ppb), non-Texas (18.59 ppb), biogenic sources (4.40 ppb), and boundary/initial conditions (21.79 ppb).

The University of North Texas study oversimplified its analysis by simply breaking out monitors into "fracking" and "non-fracking" categories without appropriately accounting for the dominant wind direction in the analysis. For each calendar year, the monitor(s) establishing the design value are listed in the table below. All of the listed monitors are located in the northwest corner of the DFW metroplex. The Barnett Shale boom in drilling activity occurred from 2005 through 2008, which resulted in a subsequent natural gas production peak in 2012. Oil and gas activity was relatively low from 2000 through 2004, yet the peak design values were still being set by ozone monitors located northwest of the urban core. Therefore, it is incorrect to attribute oil and gas emissions as the primary factor influencing peak ozone values being monitored at these locations. As discussed previously with respect to source apportionment, the TCEQ is not suggesting that emissions from oil and gas activity have no impact on ozone levels recorded at these monitors. No changes were made in response to this comment.

Table 1: DFW Area Peak Eight-Hour Ozone Design Values from 2000 through 2014

Calendar Year	DFW Area Ozone Monitor Establishing the Design Value	Ozone Design Value (ppb)
2000	Denton Airport South	102
2001	Denton Airport South	101
2002	Denton Airport South	99

Calendar Year	DFW Area Ozone Monitor Establishing the Design Value	Ozone Design Value (ppb)
2003	Grapevine Fairway / Keller	100
2004	Grapevine Fairway / Keller	98
2005	Eagle Mountain Lake / Fort Worth Northwest / Keller	95
2006	Eagle Mountain Lake	96
2007	Eagle Mountain Lake	95
2008	Denton Airport South	91
2009	Eagle Mountain Lake / Keller	86
2010	Keller	86
2011	Keller	90
2012	Keller	87
2013	Denton Airport South	87
2014	Denton Airport South	81

The Sierra Club and Downwinders commented that the TCEQ arbitrarily assumed production levels would remain constant from 2013 through 2018, but then applied emission rates from 2018 retroactively. The Sierra Club and Downwinders also stated that the TCEQ cannot assume drilling levels will remain constant through 2018. The Sierra Club and Downwinders commented that by applying 2018 emission rates to wells and facilities built and operating before 2018, the TCEQ is constructing a "best case scenario that is already being betrayed by the real world." The Sierra Club and Downwinders points out that there were 940 wells drilled in 2013 versus 1,004 wells drilled in 2014.

The comment does not accurately characterize the manner in which drilling rig emissions were estimated by the TCEQ. The TCEQ is not arbitrarily assuming that production levels will remain constant. When inventory development on this DFW AD SIP revision was performed during 2014, the 2013 drilling information was the latest full year for which information was available from the RRC. Chapter 3, Section 3.5.4.4: *Area Sources* of this DFW AD SIP revision describes how the magnitude of feet drilled in 2013 for three different categories was multiplied by 2018 drilling rig emission rates to arrive at the estimates of 2.82 NO_X tpd and 0.21 VOC tpd for this category.

The figures referenced by the commenters of 940 for 2013 and 1,004 for 2014 refer to the number of drilling permits issued by the RRC for the entire Barnett Shale area, which encompasses more than the 10-county DFW nonattainment area. Also, the issuance of a drilling permit within a given calendar year does not automatically mean that a well was drilled within that same year. This is why comprehensive data sets from the RRC are used to determine the total feet drilled within a calendar year. Even though the number of drilling permits issued is not used to estimate drilling emissions, the general trend over time is useful to review and is available for 2000 through 2014 on the RRC Barnett Shale Information Web page (http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/barnett-shale-information/). During the pre-boom years of 2002 through 2004, the number of drilling permits issued hovered between 900 and 1,200. Due to high natural gas

prices from 2005 through 2008, the number of these permits issued climbed to 4,065 in 2008 alone. Due to the lower natural gas prices that have occurred starting in 2009, the number of permits issued has been back to the pre-boom levels hovering between 900 and 1,200 from 2012 through 2014. At this time there is no reason to believe that drilling levels will start increasing to the degree seen from 2005 through 2008. Therefore, it is appropriate to take the latest full year of drilling activity and hold it constant per county when projecting forward to 2018. This same approach was used for counties in the Eagle Ford Shale area where the relatively high 2013 drilling levels were held constant for the purposes of projecting to 2018. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ's "no growth" assumption about oil and gas activity is wrong. The commenters stated there is growth in oil production and associated production equipment in 2014, and that the bell-shaped Hubbert peak theory that estimates a drop off in production starting in 2011 is incorrect. The commenters further stated that if the number of new wells increases, the level of production will also likely increase. The commenters also stated that even though production has leveled off, 2014 production was roughly the same as 2010. The commenters referred to data from the U.S. Energy Information Administration (EIA) about production levels within the Barnett Shale. The commenters concluded that it is unreasonable to assume that all the pre-2018 wells will have 2018 emission rates, as the TCEQ does in the DFW AD SIP revision.

The comment does not accurately characterize the manner in which oil and gas production emissions are estimated. For the drilling category, fleet-average emission rates for 2018 were applied to 2013 activity levels. Emission estimates of oil and gas production are based on rates for individual types of equipment that, unlike drill rigs, are not associated with specific fleet turnover effects that show an emission rate decrease over time. For example, the single largest source of NO_X for natural gas production is from compressor engines needed for transport. In Chapter 3, Section 3.5.4.4 of this DFW AD SIP revision, 0.61 NO_X grams per horsepower-hour (gm/hp-hr) is referenced as the emission rate used in calculating total compressor engine emissions as a function of natural gas production. This emission rate of 0.61 NO_X gm/hp-hr applies to natural gas produced from all wells operating in 2018, whether they were drilled in 2018 or earlier.

The commenters made several statements regarding growth in oil and gas production. In one sentence, the commenters state that there is "growth in oil production and associated production equipment in 2014" but then later states "even though production has leveled off, 2014 production was roughly the same as 2010."

According to the latest data from the RRC Barnett Shale Information page (http://www.rrc.state.tx.us/oil-gas/major-oil-gas-formations/barnett-shale-information/), natural gas production in the Barnett Shale peaked during 2011 and 2012, and has begun to decline, with the 2013 production level 7% lower than 2012, and the 2014 production level 15% lower than 2012. According to the latest available RRC data, the 2014 daily average production level of 4,877 million cubic feet (MMcf) per day is closer to the 4,921 MMcf value for 2009 rather than the 5,159 MMcf value for 2010.

The historical production curve reported by the RRC from 2000 through 2014 follows the bell-shaped Hubbert peak theory very closely with steady increase from 2000 to peaks in 2011 and 2012, followed by a decline. As new data become available from the RRC, the TCEQ will continue to revise these projections. No changes were made in response to this comment.

The SEED Coalition and the Greater Fort Worth Sierra Club commented that the AD SIP revision underestimates emissions from Barnett Shale production. Greater Fort Worth Sierra Club stated that NO_X and VOC emissions from compressor engines are increasing, and should be better reflected in the TCEQ's modeling. The Sierra Club and Downwinders commented that the TCEQ underestimates 2018 oil and gas production levels by taking the latest available RRC data from 2013 and forecasting based on the Hubbert peak theory. The Sierra Club and Downwinders stated the oil and gas industry forecasts emissions based on the number of wells in operation and the number of facilities to exploit those wells, compressors, tanks, pipelines, dehydrators, separators, and associated equipment. The Sierra Club and Downwinders also commented that the number of wells in the Barnett Shale is expected to increase and that the TCEQ is only counting new wells in its estimates of oil and gas pollution. The Sierra Club and Downwinders reference a Rand Corporation study from 2013. The Sierra Club and Downwinders also quoted an industry representative regarding annual production yields after each well is drilled. The Sierra Club and Downwinders also referenced a 2013 University of Texas at Austin (UT-Austin) study that forecasted continued development of the Barnett Shale out to 2030, and quoted from a press release about the study. The Sierra Club and Downwinders stated that this UT-Austin study predicts the Barnett Shale will not reach its production peak until 2018, and it estimates that a majority of the wells will have a 25-year life span.

The TCEQ agrees with the Rand Corporation study conclusion that long-term production emissions associated with each well are higher than the short-term drilling emissions for that well. However, the TCEQ uses different methodologies for estimating drilling and production emissions, and reports the drilling and production emission categories separately within the DFW AD SIP revision to document these distinctions. Table 3-28: *2013 Oil and Gas Drilling Activity for the 10-County DFW Area* and Table 3-29: *2018 Oil and Gas Drilling Rig Emissions for 10-County DFW Area* of this DFW AD SIP revision summarize 2018 drilling emissions estimation. 2018 oil and gas production emissions estimation is summarized in Table 3-30: *Barnett Shale Emission Projection Factors from 2013 to 2018*, Table 3-31: *2018 Oil and Gas Production Emissions for 10-County DFW Area*, and Table 3-32: *2018 Point Source Oil and Gas Emissions for 10-County DFW Area*.

The TCEQ has funded 15 oil and gas EI improvement studies since 2007, with 12 of those being completed from 2010 through 2014. They are all available on the TCEQ Air Quality Research and Contract Reports Emissions Inventory Web page (http://www.tceq.texas.gov/airquality/airmod/project/pj_report_ei.html). Many of these reports focus on improving the estimation of emissions from various oil and gas drilling and production equipment. The TCEQ uses the latest available production activity data from the RRC both to estimate and to spatially allocate compressor engine emissions.

The comment that emissions should be estimated simply on the number of wells in operation is incorrect. This could only be true if natural gas wells annually produced the same amount of gas on average over an indefinite period of time. During 2014, the RRC reported a total well count "snapshot" throughout the Barnett Shale of roughly 17,500. If all of these wells had been drilled in 2013, the 2014 production levels would be extremely high. If all of these wells had been drilled 20 years earlier in 1994, the 2014 production levels would be extremely low. Emission levels from equipment such as compressors are directly dependent on the amount of gas produced/compressed, and not on the number of wells. The latest available RRC data show Barnett Shale natural gas production declining since 2012, which indicates that NO_X and VOC compressor engine emissions associated with production will also decline.

The UT-Austin study previously referenced concluded that it takes roughly five years to extract 50% of the estimated ultimate recovery of Barnett Shale natural gas wells. It then takes another 20 years to extract the remaining 50%. These conclusions detailed in the study are in agreement with the industry representative referenced by the commenter that said "production stays very level after initial declines in the first few years." The commenter provides no documentation or data set to support the assertion that the oil and gas industry forecasts emission levels.

The commenters state that the UT-Austin study showed Barnett Shale natural gas production peaking in 2018. However, the commenters did not mention that this was the result of a sensitivity analysis where the Henry Hub spot price for natural gas was assumed to remain constant over several years at $10 per million British thermal units. According to the EIA, the summer of 2008 was the last time the Henry Hub spot price was at or above the $10 level. It declined to as low as $3 in September 2009 and has hovered between $3 and $5 since then. The UT-Austin study performed a total of four price sensitivity analyses for Henry Hub spot prices at levels of $3, $4, $6, and $10. The $3 scenario has a production peak around 2012 and this matches the historical production peak being reported by the RRC.

The TCEQ stands behind its use of the Hubbert peak theory approach for predicting future production. All of the sensitivity analyses shown in the UT-Austin study show some form of the bell-shaped Hubbert curve, with production steadily rising to a peak year, and then falling off over time. The TCEQ believes that the UT-Austin study did a very good job of predicting Barnett Shale production for a Henry Hub spot price of $3 based on the 2010 drilling and 2011 production data that were available at the time the work was done. The study specifically says that a "model update that will include all wells drilled through 2012 and their production through mid-2013 will be run in 2014." When this update is available, the TCEQ will review it.

The TCEQ used the full year of 2013 drilling and production data as the basis for projecting to 2018. When the full year of 2014 drilling and production data are available from the RRC, the TCEQ will use it instead for projection purposes for future SIP revisions. The TCEQ concurs with the results of studies suggesting that

Barnett Shale production will likely continue out to 2030 and perhaps beyond. However, the future attainment year modeled for this DFW AD SIP revision is 2018, and the TCEQ has used the latest available information for projecting to it. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ is underestimating oil and gas emission from the Haynesville Shale. The Sierra Club and Downwinders stated that the four counties of Falls, Leon, Limestone, and Robertson have a large number of permitted compressor stations that emit as much or more NO_X tons than electric utilities located within these counties. The Sierra Club and Downwinders state that the TCEQ has never released any estimates for the magnitude of NO_X and VOC emitted from these sources in its 2018 modeling efforts.

The TCEQ disagrees with the comment. Section 2.3: *2018 Future Year Point Source Modeling Emissions Development* of Appendix B of this DFW AD SIP revision includes a thorough discussion of the 2018 point source EI development work that was done for all 254 Texas counties. The full set of modeling files and inputs for these point source data sets are available on the TCEQ FTP site (ftp://amdaftp.tceq.texas.gov/pub/TX/ei/2006/fy2018/point/). A summary of the 2018 emission estimates for the 13 point source facilities within these four counties is presented below. Please note that Falls County currently has no large point sources.

Table 2: 2018 Point Source Emission Estimates for Fall, Leon, Limestone, and Robertson Counties

RN Code	County Name	Standard Industrial Classification Description	NO_X (tpd)	VOC (tpd)
RN100542927	Limestone	Electric Services	43.04	0.96
RN100216191	Robertson	Electric Services	14.31	0.23
RN100226570	Robertson	Electric Services	5.34	0.02
RN102979473	Limestone	Crude Petroleum and Natural Gas	0.22	0.51
RN104137146	Limestone	Crude Petroleum and Natural Gas	0.10	0.05
RN100929645	Robertson	Crude Petroleum and Natural Gas	0.05	0.01
RN104898978	Robertson	Natural Gas Liquids	0.26	0.21
RN100542646	Limestone	Natural Gas Transmission	<0.01	<0.01
RN101700060	Limestone	Natural Gas Transmission	0.39	0.28
RN101627792	Robertson	Petroleum Bulk Stations and Terminals	<0.01	0.07
RN100215672	Limestone	Minerals and Earths	0.03	0.00
RN100211093	Leon	Blast Furnaces and Steel Mills	0.58	0.22
RN102039575	Robertson	Transportation Services	0.01	0.09
Total			64.34	2.66

The 2018 non-point oil and gas production emission estimates for all Texas counties are available on the TCEQ FTP site (ftp://amdaftp.tceq.texas.gov/pub/Oil_Gas_EI/2018/). A summary of these emission estimates for these four counties is provided in the table below.

Table 3: 2018 Oil and Gas Production Estimates for Falls, Leon, Limestone, and Robertson Counties

County Name	NO_X (tpd)	VOC (tpd)
Falls	0.01	0.12
Leon	4.07	9.99
Limestone	3.37	4.00
Robertson	6.51	13.07
Total	13.96	27.18

Figures presented in the above tables have been aggregated into four-county totals by categories for electric services and oil and gas activities during 2018. As shown, all electric utility emissions are estimated to be 62.69 NO_X tpd and 1.22 VOC tpd, while all oil and gas emissions are estimated to be 14.99 NO_X tpd and 28.31 VOC tpd. No changes were made in response to this comment.

Table 4: 2018 Summary of Electric Services and Oil and Gas Production Emissions for Falls, Leon, Limestone, and Robertson Counties

Source Type Description	NO_X (tpd)	VOC (tpd)
Electric Services – Point	62.69	1.22
Oil and Gas – Point	1.03	1.13
Oil and Gas - Non-Point	13.96	27.18
Oil and Gas – Total	14.99	28.31

The Sierra Club and Downwinders commented that the TCEQ radically changed its own forecasts of 2018 Barnett Shale air pollution based on new Barnett Shale production figures from the RRC. The Sierra Club and Downwinders stated that the TCEQ reported these estimates in January 2014 to be 39 NO_X tpd and 58 VOC tpd. The Sierra Club and Downwinders further stated that TCEQ reported these estimates in January 2015 to be 16.5 NO_X tpd and 50 VOC tpd. The Sierra Club and Downwinders stated that these significant changes in the 2018 projections indicate high uncertainty in the AD analysis.

The TCEQ has updated the emission estimates to reflect the latest available data in order to have the most accurate DFW AD SIP revision. On slide 4 of a January 2014 presentation given by the TCEQ (https://www.tceq.texas.gov/assets/public/implementation/air/am/committees/pmt_dfw/20140131/20140131-DFW-Ozone-Emissions-Inventory-Kite.pdf), the 2018 oil and gas total (from both drilling and production) is reported to be 18.04 NO_X tpd and 43.69 VOC tpd. In Table 12: *2006 and 2018 DFW Area Anthropogenic Emissions Summary* of the technical supplement to the proposed DFW AD SIP revision released in January 2015, the TCEQ reported revised 2018 emission projections for these categories to be 11.13 NO_X tpd and 24.45 VOC tpd. The net change in the NO_X emissions projection is 6.91 NO_X tpd.

The TCEQ has publicly stated that the 2018 projections would change based on the availability of new information. For VOC emissions, the net change in projection

from January 2014 to January 2015 is 19.24 VOC tpd. The reduction in VOC was due primarily to a change in the methodology for estimating condensate storage tank emissions. An emissions estimation change of 19.24 VOC tpd versus 8 VOC tpd will have little impact on modeled ozone formation from this category because the reactivity levels of this type of VOC are low compared with those for the abundant and highly reactive biogenic category. Since changes in NO_X have so much more of an effect on ozone formation in the DFW nonattainment area, it would be misleading to combine NO_X and VOC of low reactivity together for emission comparison purposes. No changes were made in response to this comment.

The Sierra Club and Downwinders referenced a July 2012 study: Olaguer (2012): *The potential near-source ozone impacts of upstream oil and gas industry emissions*, Journal of the Air & Waste Management Association, 62:8, 966-977. The commenters stated that the study concludes the following: "Routine emissions from a single gas compressor station or large flare can raise ozone levels by 3 ppb as far as five miles downwind, and sometimes by 10 ppb or more as far as 10 miles downwind." The commenters provided excerpts from the study stating that "aggregations of oil and gas sites may act in concert so that they contribute several parts per billion to 8-hr ozone during actual exceedances" and that "major metropolitan areas in or near shale formations will be hard pressed to demonstrate future attainment of the federal ozone standard, unless significant controls are placed on emissions from increased oil and gas exploration and production."

The comment's use of the first quote summarized above is not referenced from the study itself. In January 2013, the TCEQ provided formal comments in the form of a letter to the editor of the *Journal of the Air & Waste Management Association* in response to this study (Brymer, David, (2013), Letter to the Editor, *Journal of the Air & Waste Management Association*, 63:2, 125-126). In this letter to the editor, the TCEQ explains that the 2012 Olaguer study has numerous shortcomings. For example, the author of the study states that significant controls should be placed on oil and gas exploration and production, ignoring that the TCEQ had already done so in 2007 when it required a low emission rate for all stationary engines above 50 horsepower in the DFW nonattainment area as part of the Chapter 117 rules. By not acknowledging the existence of these rules, the author modeled a much higher unregulated NO_X emission rate, thus increasing overall NO_X emissions for the scenario by a factor of 10.

The most notable flaw in the 2012 Olaguer study, however, was artificially collocating a large and highly reactive propylene flare with the NO_X emissions from a compressor engine.

This flare, described as receiving natural gas in the abstract, was modeled as receiving a significant amount of propylene (an HRVOC that can increase ozone production efficiency). No evidence or citation was presented to substantiate the addition of propylene to the modeled flare's input stream at a natural gas facility. HRVOCs are rarely present in upstream oil and gas operations according to TCEQ study data.

The author's addition of propylene to an oil and gas service flare appears highly unrealistic, even for an emissions event.

The TCEQ's letter concluded that because of noted flaws, the results of the study cannot be considered reliable (Brymer, 2013). No changes were made in response to these comments.

An individual commented that oil and gas operations are the dominant sources of VOC precursors for ozone formed in the winter.

The TCEQ disagrees with the statement that oil and gas operations are the dominant source of VOC precursors during winter or any other time of year in the DFW nonattainment area. The DFW AD SIP revision clearly shows that area source emissions are the dominant category for anthropogenic VOC precursors within the DFW nonattainment area. This is shown within this DFW AD SIP revision in Table ES-1: *Summary of 2006 Baseline and 2018 Future Year Anthropogenic Modeling Emissions for DFW*, Table 3-19: *2006 Summer Baseline Anthropogenic Emissions for 10-County DFW*, Table 3-33: *2018 Future Case Anthropogenic Emissions for 10-County DFW*, and Table 3-34: *2006 Baseline and 2018 Future Modeling Emissions for DFW Area*. Development of area source emission estimates is discussed in Chapter 3, Sections 3.5.2.3: *Area Sources* for 2006 and 3.5.4.4: *Area Sources* for 2018. No changes were made in response to this comment.

<u>Ozone Impacts of Cement Kiln NO_X Emissions</u>

The Sierra Club and Downwinders stated that the concentration of the three cement kilns in the Midlothian area effectively forms a "super plume" upwind of the DFW metropolitan area during ozone season. The commenters referenced three studies demonstrating that Midlothian cement plant pollution significantly affects DFW ozone levels:

- An August 2005 Environ study funded by the TCEQ entitled *Accounting for the Impacts of Variable Cement Kiln Emission Rates on Ozone Formation in the Dallas/Fort-Worth Area*. The Sierra Club and Downwinders included a plot from Figure 3-5: *Daily maximum 8-hour ozone for the 2012 baseline using CAMx 4.31 and a2 emissions and differences from the 2009 baseline* of that study for the "worst case" scenario for all three cement kilns at full operation resulting in a 1-11 ppb ozone increase throughout various Texas counties.
- A June 2006 Environ report entitled *DFW APCA Run for 2009 with East Texas EGU Controls*. Using a baseline of 28 NO_X tpd for the three cement kilns, this study performed sensitivity tests by dropping the NO_X emissions by 10 tpd to 18 tpd, and by 20 tpd to 8 tpd. The Sierra Club and Downwinders emphasized that the highest modeled ozone reductions from these sensitivity tests were in Tarrant County.
- A University of Texas at Arlington (UT-Arlington) analysis presented at the NCTCOG offices in November 2013. This UT-Arlington study applied a 90% cement kiln NO_X reduction from 6 AM to 12 PM on the August 16 episode day from a 1999 episode. The Sierra Club and Downwinders included a table from slide 30 of the presentation showing that a 2.04 ppb ozone reduction was modeled from 7:00 PM to midnight compared with the previous episode day of August 15 for the Denton Airport South monitor for the 2009 future year. The

Sierra Club and Downwinders commented that this 2.04 ppb ozone reduction could be achieved for the 2018 future design value currently being modeled by the TCEQ at the Denton Airport South monitor.

The TCEQ disagrees with this comment. The ozone episode modeled for all three referenced studies spanned 10 days from August 13-22, 1999, and 2009 was the future year modeled in the analyses. The episode for this DFW AD SIP revision is more recent and spans 67 days during 2006, covering all of June and parts of both August and September. As shown in Table 3-37: *Summary of Ozone Modeling Platform Changes* of this DFW AD SIP revision, the TCEQ now has a much more updated modeling configuration that is an improved predictor of future ozone for the DFW nonattainment area.

Table 3-1: *NO_X emissions by source region and emission category on August 17* on page 7 of the August 2005 Environ study shows Ellis County point source NO_X at 45 tpd, most of which is from cement kilns. Environ modeled five scenarios, multiplying the mean emission rate by adjustment factors ranging from 0.538 to 1.462. The chart referenced by the commenter is the "worst case" where 65.8 NO_X tpd total was modeled for the three kilns, which is almost four times the current cement kiln cap of 17.64 NO_X tpd modeled in this DFW AD SIP revision. These sensitivity tests were run in 2005 and 2006 to help determine the appropriate level of control for cement kilns in the DFW nonattainment area. The subsequent cement kiln rule caps issued in 2007 were the results of these efforts.

The June 2006 Environ study started with a cement kiln baseline of 28 NO_X tpd, and considered two reduction scenarios for the 2009 future year: a 10 tpd reduction for a control level of 18 NO_X tpd, and a 20 tpd reduction for a control level of 8 NO_X tpd. The ozone impacts of these scenarios were reported in Table 4-12: *2009 future design values with high and low-end cement kiln controls and differences from the 2009 a1 baseline* on page 4-27 of the report. The maximum eight-hour ozone design value reductions of 0.46-1.02 ppb were predicted in Arlington roughly 17 miles downwind of Midlothian. The Denton Airport South monitor, which is located roughly 52 miles downwind of Midlothian, saw impacts of 0.03-0.07 ppb from these reduction scenarios. The 18 NO_X tpd control scenario is roughly equivalent to the current 17.64 NO_X tpd cap limits currently modeled for 2018.

Table 3-46: *2018 Ozone DV_F Denton, Parker, and Kaufman Contributions* of this DFW AD SIP revision includes 2018 ozone source apportionment results for eight different source category groups within the DFW nonattainment area. At the Denton Airport South monitor, cement kilns at 17.64 NO_X tpd are shown to be the smallest local contributor to the future design value at 0.21 ppb, while the on-road sector is shown to be the highest contributor at 8.66 ppb with 119.69 NO_X tpd of emissions. Ozone source apportionment analyses were done for all monitors. Of the 19 monitors operating in DFW during the 2006 episode, the monitor with the highest 2018 cement kiln contribution to the future design value was Arlington Municipal Airport at 0.58 ppb. Chapter 3, Section 3.7.2 of this DFW AD SIP revision shows that the Arlington Municipal Airport monitor, which is located 13

miles downwind of Midlothian, has a 2018 future design value of 69 ppb for the "all days" attainment test and 68 ppb for the "top 10 day" attainment test.

As of December 2014, the Arlington Municipal Airport monitor has a design value right at 75 ppb and is currently in compliance with the standard. This 75 ppb level is based on a three-year average of fourth-high readings of 92 ppb, 68 ppb, and 65 ppb from 2012, 2013, and 2014, respectively. Although studies done several years ago modeled very high NO_X levels for cement kilns and thus showed relatively higher ozone impacts, the 17.64 NO_X tpd cap contributes only 0.21 ppb of ozone at the Denton Airport South monitor, which is currently the highest ozone design value monitor for the DFW nonattainment area. Compared with the others, the Arlington Municipal Airport ozone monitor is more sensitive to cement kiln NO_X emissions but is currently in compliance with the 75 ppb standard.

The purpose of the UT-Arlington study referenced by the commenter was to show that the temporal distribution of NO_X emissions can have a significant impact on ozone formation. The TCEQ agrees with this principle because it is a fundamental aspect of ozone chemistry. The results of a 2.04 ppb ozone reduction modeled at the Denton Airport South monitor are taken out of context. The table excerpted stated that this reduction is from 7:00 PM to midnight compared with the previous day. Peak ozone levels at specific monitors, whether monitored or modeled, can change much more than 2 ppb from one day to the next. Furthermore, the 7:00 PM to midnight diurnal period does not drive the daily maximum eight-hour ozone values monitored. Since the presence of solar radiation is necessary for ozone formation, peak eight-hour ozone levels on exceedance days are typically monitored and modeled from mid-day through mid-afternoon. Since monitored ozone values are already quite low from 7:00 PM to midnight, it is erroneous to conclude that an extra 2.04 ppb of ozone reduction during this period will impact a modeled future design value for this DFW AD SIP revision. The Environ sensitivity work with the same August 1999 episode and a 2009 future case showed that reducing cement kiln NO_X by 20 tpd (from 28 tpd down to 8 tpd) resulted in a 0.07 ppb eight-hour ozone design value reduction at Denton Airport South. The source apportionment work reported in the DFW AD SIP revision for 2018 shows a 0.21 ppb contribution from 17.64 NO_X tpd emitted by the cement kilns. No changes were made in response to this comment.

<u>Ozone Impacts of EGU NO_X Emissions</u>

Public Citizen commented that a 2.4 ppb ozone reduction in the future design value at the Denton Airport South monitor could be achieved by application of SCR on coal-fired power plants to the south and east of DFW. The League of Women Voters of Dallas and Greater Fort Worth Sierra Club commented that the dominant wind direction from the southeast brings polluted air from coal-fired power plants in east Texas. One individual and the Greater Fort Worth Sierra Club commented that requiring SCR on East Texas coal-fired power plants would have a measureable impact on the air pollution in North Texas. The Sierra Club and Downwinders stated that NO_X emissions from Texas coal-fired EGUs contribute to ozone nonattainment in the DFW nonattainment area and that application of SCR controls would significantly reduce NO_X emissions, resulting in dramatically reduced ozone levels within DFW. The Sierra Club and Downwinders referenced a June 2006 Environ study funded by the TCEQ

entitled *DFW APCA Run for 2009 with East Texas EGU Controls* in which SCR NO_X controls on nine EGUs in eastern Texas showed ozone design value reductions of 1.0 and 1.5 ppb at the Arlington and Midlothian monitors, respectively. The remaining DFW area monitors showed reductions from 0.5 to 0.8 ppb from this analysis.

The ozone episode modeled for this study spanned 10 days from August 13-22, 1999, and 2009 was the future year modeled in the analyses. The episode for this DFW AD SIP revision is more recent and spans 67 days during 2006, covering all of June and parts of both August and September. As shown in Table 3-37 of this DFW AD SIP revision, the TCEQ now has a much more updated modeling configuration that is an improved predictor of future air quality for DFW. The southeasterly winds are dominant during DFW ozone seasons, and this updated 2006 episode reflects that.

Based on 2014 monitoring data, the regulatory design values at the Midlothian and Arlington Municipal Airport monitors are 71 ppb and 75 ppb, respectively, using the fourth-high values from 2012, 2013, and 2014. Since these monitors are already attaining the 75 ppb standard, additional reductions of 1-1.5 ppb from NO_X controls on EGUs in eastern Texas are not needed to help these monitors demonstrate attainment.

Table 3-46 of this DFW AD SIP revision contains 2018 ozone source apportionment results for the 67-day episode from 2006. At the Denton Airport South monitor, the 12 EGU facilities within the DFW nonattainment area are shown to account for 0.41 ppb of the 76.72 ppb design value for 2018. The non-DFW Texas EGUs are shown to account for 2.64 ppb of the 2018 future design value. This latter non-DFW group consists of 125 EGU facilities located throughout the 244 non-DFW Texas counties, and are modeled at a total of 474.27 NO_X tpd for 2018 in accordance with the Clean Air Interstate Rule Phase II caps discussed in Chapter 3, Section 3.5.4.1: *Point Sources* of this DFW AD SIP revision. The June 2006 Environ analysis showed that the Denton Airport South monitor received a 0.6 ppb reduction in its 2009 design value from application of the SCR NO_X controls on nine east Texas EGUs. If this figure still applied, the Denton Airport South design value for 2018 would be reduced from 76.72 ppb to 76.12 ppb, which still rounds to one digit and then truncates to the 76 ppb future design value referenced in this DFW AD SIP revision. No changes were made in response to this comment.

Modeling of Catastrophic Accidents

An individual commented that the TCEQ's modeling should account for catastrophic accidents that can and will occur. The commenter noted specific examples such as broken gas pipelines, explosive storage tanks, earthquakes, car/rail collisions, and car/truck collisions. The individual also stated that the TCEQ's modeling does not account for the synergistic effects of NO_X and VOC reacting to form ozone. An individual stated that the pollution from General Motors mixes with the gas wells and the cement kiln plants pluming this way, and no one is looking at that in the ozone SIP.

The TCEQ disagrees that its ozone modeling does not account for the interaction between NO_X and VOC. This is precisely what photochemical models are designed

to do, and the TCEQ currently uses the latest version of the CAMx for this purpose. The NO_X and VOC emission inputs for CAMx from various sources are spatially and temporally allocated throughout the entire modeling domain, which encompasses most of North America. The VOC emissions from each source are matched to appropriate reactivity values for forming ozone. The meteorological inputs to CAMx account for the appropriate hourly wind speed and wind direction.

Ozone formation typically occurs downwind of where NO_X and VOC precursors are emitted, so this pollutant has to be modeled on a regional basis versus a micro-scale one. Since ozone exceedances tend to occur over several days and weeks, the episodes for modeling them must match these longer periods of time. The types of accidents mentioned by the commenter can only be appropriately modeled at a micro-level geographic scale within very short periods of time. Inclusion of such accidents in large-scale multi-week ozone modeling is not practical because each hour of each episode day would need to include some type of accident within each of the several thousand grid cells contained in the modeling domain. Such an approach is unrealistic for future year modeling because the dates, times, and locations of accidents are unknown. These events can only be modeled in historical years if this information is known, along with the magnitude of additional NO_X and reactive VOC emissions that resulted from the event. No changes were made in response to this comment.

WEIGHT OF EVIDENCE (WOE) COMMENTS

General Weight of Evidence

The EPA stated that the WoE components raise some concern about whether the DFW nonattainment area will be able to attain the 2008 eight-hour ozone standard of 75 ppb in 2018.

The TCEQ disagrees that the DFW nonattainment area will not attain the 2008 eight-hour ozone standard of 75 ppb in 2018, or possibly earlier. The most essential observed ozone precursor, NO_X, is trending downward, which suggests that the ozone design value will be below the 75 ppb NAAQS by 2018. Moreover, the modeling component of the WoE also strongly suggests that the NAAQS will be met. No changes were made in response to this comment.

The Sierra Club, Downwinders and forty-two individuals commented that future ozone design values for some of the DFW nonattainment area monitors are above 75 ppb in the analysis. The Sierra Club and Downwinders stated that this "close enough" approach for approval from the EPA is not satisfactory.

The 2007 EPA modeling guidance lists an 82-87 ppb WoE range for the attainment test, which equates to a range of 73-78 ppb for the 2008 eight-hour ozone standard of 75 ppb. In Chapter 3, Section 3.0: *Introduction* of this DFW AD SIP revision, this was the latest available guidance from the EPA when attainment modeling work was done for this AD analysis. All of the future design values modeled and presented in the documentation fall well below this 78 ppb threshold. The updated draft guidance issued by the EPA in December 2014 no longer specifies a numeric WoE range for future design values. Instead, Section 4.9.3: *Weight of Evidence Summary* on page 190 of this the draft guidance requires a "fully-evaluated, high-quality modeling analysis that projects future values that are close to the NAAQS."

This AD is meeting both the older requirement of modeling future design values at or below 78 ppb, and the new requirement that projected future design values be "close to the NAAQS." No changes were made in response to this comment.

Voluntary Measures

The Sierra Club and Downwinders commented that the WoE analysis improperly relies on unenforceable and uncertain measures. The Sierra Club and Downwinders stated that the TCEQ improperly assumes benefits from energy efficiency, renewable energy, and voluntary programs. The Sierra Club and Downwinders stated that the TCEQ is improperly assuming benefits for federal fuel and engine standards that will not be fully implemented until 2025, and that the TCEQ is also double-counting these benefits.

The TCEQ disagrees with this assessment and notes that the claims are inconsistent with the EPA guidance. Section 4.9.1.3: *Additional Emissions Controls/Reductions* on page 186 of the draft guidance specifically states that "there may be various emissions sources and/or controls that are difficult to represent in the modeling analysis and the effects of some emissions controls may be difficult to quantify." This section specifically lists energy efficiency and renewal energy measures as an example of items that can be included in a WoE analysis without quantification. Page 187 of the draft guidance specifically states that voluntary measures that are not enforceable should be listed in the AD SIP because "they can still lead to positive actions in the nonattainment area that can lead to lower emissions" and that they "should be documented to the fullest extent possible." The TCEQ mentions these voluntary measures in the WoE section, but does not quantify them, and is therefore not claiming specific benefits for them.

The commenter does not properly characterize how the benefits of fuel and vehicle emission standards are referenced in the DFW AD SIP revision. Chapter 3 of the proposed DFW AD SIP revision notes that the MOVES2010b model did not include the benefits of Tier 3 vehicles and 10 ppm "low sulfur" gasoline. Chapter 3, Section 3.7.4.1 of the proposed DFW AD SIP revision presents the results of an analysis that estimated the 2018 benefits that could be obtained from these federal rules, and showed that the reductions estimated by the TCEQ are consistent with those estimated by the EPA. Just because the Tier 3 vehicle standards are not fully phased-in until the 2025 model year does not mean that benefits from the tighter vehicle and fuel standards will not exist in the 2018 calendar year. The commenter indicates that these benefits are being double-counted just because they are referenced in different portions of the DFW AD SIP revision. Simply referencing the same benefit in both Chapter 3, Section 3.7.4.1 and Chapter 5, Section 5.5: *Conclusions* of the proposed DFW AD SIP revision does not mean it is being double-counted in the analysis. No changes were made in response to this comment.

Meteorological Trends

The EPA concluded that the WoE analysis is not overly supportive that the modeling is conservative. The EPA noted that the TCEQ has provided information on recent ozone trends to support its conclusion the area will attain by 2018. The EPA believes, however, that most of the recent years have been average or below normal in overall conduciveness for ozone formation. The EPA stated that temperatures have been high for some of these years, which does lead to

higher ozone, but wind speeds have also been higher than normal and this leads to lower ozone concentration with more dispersion. The EPA noted that 2011 was one of these types of years. The EPA believes that 2014 had very favorable meteorology and was one of the lowest ozone monitoring years in the Eastern half of the U.S. with a 2014 DFW nonattainment area regulatory design value of 81 ppb. The EPA's view is that 2014 was abnormal due to its lower than average temperature and frequency of frontal passages that led to reduced background buildup, and is thus not likely to be repeated.

The TCEQ disagrees with the EPA that the most recent years of 2012 through 2014 are less conducive to ozone formation. The TCEQ agrees that higher than average temperatures can lead to higher ozone; however, winds speeds were not faster than normal. In addition, the TCEQ does not believe that wind speed is the sole factor that determines ozone concentrations. The National Oceanic and Atmospheric Administration's National Climatic Data Center places the winds from the second half of the DFW ozone season for the years of 2011-2014 in the climatological normal range, with winds in 2014 slower than the climatological normal. Relying only on wind speeds would lead one to believe that ozone should have been high in 2014, which was not the case. Moreover, if meteorology remains normal (in the statistical sense), the 2014 ozone season is more likely to be repeated. Due to the downward trend of ozone precursors, an ozone season with normal meteorological conditions will in turn lead to lower ozone concentrations. No changes were made in response to this comment.

The Sierra Club and Downwinders stated that the TCEQ does not properly account for uncertainties in the meteorological trends analysis. The Sierra Club, Downwinders and forty-two individuals commented that the state relied on overly optimistic 2006 meteorology in its AD.

The TCEQ disagrees with this assessment. A full discussion of meteorological trends is provided in Section 3.6: *Meteorological Characterization and Trends* of Appendix D: *Conceptual Model for the DFW Attainment Demonstration SIP Revision for the 2008 Eight-Hour Standard*. The TCEQ also disagrees with the claim that 2006 represented an "overly optimistic" meteorological year for modeling purposes. As documented in Chapter 3, Section 3.3: *Episode Selection* of this DFW AD SIP revision, there were a total of 50 exceedance days of the 75 ppb standard in 2006, 18 of which occurred in June and 13 of which occurred in August/September. This is more exceedance days than occurred in any of the years from 2007 through 2012.

A geographical area is considered to be in extreme drought if its Palmer Drought Severity Index (PDSI) is in the range of -0.4 through -0.7. The DFW nonattainment area is included within the North Central Climate Division of Texas. In the 120 years from 1895 through 2014, there were eight years that this region experienced extreme drought during the four consecutive months of June, July, August, and September. Table 5: *PDSI Values for Extreme Drought Years in North Central Texas* summarizes these figures. As shown in Table 5: *PDSI Values for Extreme Drought Years in North Central Texas*, both 2006 and 2011 are included in this group of extreme drought for four consecutive summer months, and 1956 was the most recent year prior to 2006 that the same pattern occurred. No changes were made in response to this comment.

Table 5: PDSI Values for Extreme Drought Years in North Central Texas

Year	June	July	August	September
1909	-4.47	-5.16	-4.77	-5.10
1911	-5.97	-5.41	-4.68	-4.93
1918	-5.26	-5.78	-6.11	-5.57
1925	-6.03	-6.41	-6.40	-5.93
1952	-4.04	-4.45	-5.12	-5.29
1956	-5.30	-6.03	-6.31	-6.82
2006	-4.27	-4.84	-4.93	-4.58
2011	-4.36	-5.42	-5.80	-5.99

Emission Trends

The EPA commented that NO_X trends are flat in the western portion of the DFW nonattainment area, and that these monitors are impacted by oil and gas activity. Furthermore, the EPA believes that NO_X reductions from on-road and non-road sources in the urbanized area will not help these western monitors come into compliance.

The TCEQ disagrees with this conclusion. As documented in Chapter 5, Section 5.2.2.2: *Ambient NO_X Trends* of this DFW AD SIP revision, the greatest NO_X concentrations are at highly urbanized locations, such as the Hinton monitor, which are most sensitive to on-road emissions. The Parker County monitor is in a more rural location at the western edge of the DFW nonattainment area, so it is expected that the trend at the Parker County monitor would be relatively flat. Historical ozone data from before the oil and gas boom shows that the northwest monitors have always had the highest eight-hour ozone design values. However, these monitors have also had the largest decline in eight-hour ozone design values. The TCEQ also disagrees that ozone levels monitored in areas with significant oil and gas development are primarily impacted by oil and gas activity. An examination of the NO_X concentrations at the monitors located near oil and gas development show some of the lowest NO_X concentrations monitored throughout the DFW nonattainment area. No changes were made in response to this comment.

The Sierra Club and Downwinders stated that the TCEQ does not properly account for uncertainties in the emissions trends.

The TCEQ disagrees with this comment. Figure 5-10: *90th Percentile Daily Peak NO_X Concentrations in the DFW Area* of the DFW AD SIP revision includes monitored trends in NO_X concentrations at twelve monitors spanning from 1997 through 2013. All but the most western rural monitor in Parker County show downward trends in monitored NO_X, and those monitors within the urban core (such as Dallas Hinton and Redbird Airport) show the most pronounced NO_X reductions over time. These concentrations are corroborated within this DFW AD SIP revision by Figures 5-4: *Reported Point Source NO_X Emissions for the 10-County DFW Area* through 5-9: *Ozone Season (March through October) Daily Peak NO_X Trends in the DFW Area*. This series of figures presents long-term NO_X emission trends for on-road, non-road, point, and electrical generation (subset of

point) sources. If these downward emission trends were not occurring over the span of several years, all of the monitors would be showing flat NO_X concentration trends from 1997 through 2013. No changes were made in response to this comment.

Ozone Trends

The EPA commented that the 2013 regulatory design value for the DFW nonattainment area was 87 ppb, and states that it is unlikely that this value can drop down to 75 ppb within the five years necessary to show attainment in 2018. The EPA acknowledged that the regulatory design value dropped 6 ppb in the one-year span from 2013 to 2014, but considers this to be anomalous and not likely to be repeated in the future. The Sierra Club and Downwinders commented that the DFW AD SIP revision underestimates future ozone design values.

The TCEQ disagrees with the EPA's statement that a one-year drop in the eight-hour ozone design value of 6 ppb is not likely to occur again. The eight-hour ozone design value has dropped by 6 ppb or more in past years as well. The eight-hour ozone design value dropped 6 ppb from 2013 to 2014, and it dropped by 7 ppb from 2006 to 2007. In the successive five-year year time periods from 2004-to-2009, 2005-to-2010, 2006-to-2011, and 2007-to-2012, the design value dropped 11 ppb, 13 ppb, 12 ppb, and 11 ppb, respectively. The TCEQ modeling effort predicts attainment by 2018 and all observed trends for ozone and its precursors support this statement. No changes were made in response to this comment.

The EPA commented that extrapolating the ozone design value data provided by the TCEQ shows that the DFW nonattainment area will not meet the 2018 attainment date. The EPA also states that there are not enough NO_X reductions, including from the on-road source category, to attain the ozone standard. The Sierra Club and Downwinders commented that the DFW AD SIP revision misevaluates emission reductions necessary to demonstrate attainment. The EPA notes that the TCEQ provides a trend analysis in the DFW AD SIP revision that includes a roughly linear relationship to demonstrate the long-term trend in monitored ozone reductions. This equation indicates the eight-hour ozone design values have dropped at a rate of 1.1 ppb per year. The EPA modified the table to extrapolate the DFW eight-hour ozone design values in 2017 and 2018, and noted that the area will be in the 80-82 ppb design value range for these future years. The EPA concluded that, since the majority of NO_X reductions are from federal measures for on-road and non-road sources, it seems unreasonable to expect this rate of reduction to accelerate. Based on these monitoring data and emission inventory trends, the EPA states that it is difficult see how the area would reach attainment in 2018.

The TCEQ disagrees with the EPA's comment and misuse of extrapolating beyond the data limits in the linear regression. The linear regression fit-line helps the reader visualize the downward trend, but an extrapolation of these data to a future year should not be relied upon to demonstrate attainment. Because of current observed downward trends in ozone and ozone precursor data, and the more advanced modeling methods available with tools such as CAMx, the AD shows that the DFW nonattainment area will meet the 2018 ozone attainment date. The EPA's own photochemical modeling in support of the Tier 3 and 10 ppm sulfur rule projected 2018 future ozone design values for Denton County at 75 ppb and Tarrant County at 76 ppb. The TCEQ notes that the 2014 ozone design value is

already at 81 ppb, but the EPA comment indicates it will not drop to the 80-82 ppb level until 2017 and 2018. No changes were made in response to this comment.

The EPA noted that the TCEQ provided a large chapter on WoE using recent monitoring data as the principal form of evidence. The EPA stated that the monitoring data trends do not show the large drops in local ozone levels, and that this therefore raises a fundamental question about whether the photochemical modeling is working as an accurate tool for assessing attainment for the DFW nonattainment area in 2018.

The TCEQ disagrees with this statement because the evidence at monitoring sites does show strong downward trends, as discussed below in this response to comment and in Chapter 5, Section 5.2.1: *Ozone Design Value and Background Ozone Trends* in this DFW AD SIP revision. Furthermore, the EPA acknowledges in both the former and draft guidance documents that, by definition, models are simplistic approximations of complex phenomena. No changes were made in response to this comment.

Public Citizen commented that the air in the HGB nonattainment area is getting better than the air in the DFW nonattainment area because the business community in HGB got together and actually did something about air quality. The commenter states that the HGB nonattainment area began to do a number of measures suggested over time, and it is working.

Air quality in both the HGB and DFW nonattainment areas continues to improve. Both areas have seen ozone levels reduced 29% and 21%, respectively, during the last 15 years. The ozone design value is currently 81 ppb in the DFW nonattainment area and 80 ppb in the HGB area. Fifteen years ago, the eight-hour ozone design value was 120 ppb in the DFW nonattainment area and 112 ppb in the HGB nonattainment area. The business communities in each area have implemented control measures as required by federal, state and local regulations. Businesses in both areas have worked with their councils of government on voluntary pollution reduction strategies, which are documented in state plans. Unlike the DFW nonattainment area, the HGB nonattainment area is home to one of the largest industrial complexes in the U.S., and those facilities are subject to stringent pollution requirements. However, citizens in both areas participate in vehicle emissions testing programs designed to reduce pollution from motor vehicles. All of the measures in both areas are working to improve air quality. No changes were made in response to this comment.

The Texas Medical Association commented that ozone levels in the DFW nonattainment area have been increasing since 2007 and not decreasing. The Texas Medical Association noted that exceedances of the 75 ppb ozone standard have been occurring each summer. The League of Women Voters of Dallas commented that air quality in DFW got worse between July 2011 and July 2012. Several individuals commented that ozone levels have gotten worse since 2011, while other individuals commented that ozone levels have been flat for the last five years. One individual commented that air quality has significantly worsened due to the fracking and drilling occurring in the DFW nonattainment area.

The TCEQ acknowledges that the DFW nonattainment area has not yet reached attainment of the 75 ppb standard, and that exceedances of this standard have

occurred during each ozone season over the last several years. The TCEQ disagrees with the statements that ozone levels have been flat and/or increasing rather than decreasing since years such as 2007 and 2011. From 2011 through 2014, the peak eight-hour ozone design value for the DFW nonattainment area dropped from 90 ppb to 81 ppb. From 2007 through 2014, the peak eight-hour ozone design value dropped from 95 ppb to 81 ppb.

The TCEQ disagrees with the statement that air quality has worsened during the time that drilling and fracking has occurred. According to RRC data, the drilling "boom" in the Barnett Shale area started in 2005 and reached its peak in 2008, but that drilling has reverted back to pre-2005 levels from 2012 through 2014. At the end of the 2004 ozone season just prior to the start of the drilling boom, the DFW nonattainment area ozone design value was 98 ppb, but was 81 ppb at the end of 2014.

The TCEQ disagrees with the comment that air quality worsened between 2011 and 2012. As part of the general downward trend in monitored ozone levels, the DFW nonattainment area ozone design value dropped from 90 ppb in 2011 to 87 ppb in 2012. These data sets use the design values for the complete 2011 and 2012 ozone seasons, rather than intermediate ozone season values that would be needed for comparing the July 2011 and July 2012 ozone levels inferred by the commenter. No changes were made in response to this comment.

Motor Vehicle Emission Simulator (MOVES)

The City of Mesquite and the RTC, support the use of on-road mobile emission inventories based on MOVES2014 in this DFW AD SIP revision to fulfill the transportation conformity rule requirements.

The TCEQ appreciates the support and is committed to working with local entities and keeping interested parties updated on SIP developments and informed about technical issues related to air quality. No changes were made in response to this comment.

Emissions Inventory

Emissions from Oil and Gas Well Drilling

Public Citizen commented that the TCEQ did not reduce air pollution from fracking, which caused air pollution to increase in the DFW area. Two individuals commented that the TCEQ does not address or regulate the pollution from oil and gas drilling.

The TCEQ disagrees with the assertion that air pollution has increased in the DFW area. Overall, emissions from DFW-area anthropogenic sources have decreased from 2005 to 2011 despite the rapid growth in Barnett Shale oil and gas exploration and production activities during this time. Ozone levels decreased by 5 ppb over the same time period, 2005 to 2011.

Analyzing the anthropogenic EI from 2005 to 2011 for the 10-county DFW 2008 eight-hour ozone nonattainment area indicates that NO_X emissions have decreased by approximately 29,000 tons (16%) and VOC emissions have decreased

by approximately 80,000 tons (34%). The TCEQ ensures these estimates include emissions from oil and gas exploration and production activities, including drilling.

Concerning regulation of oil and gas drilling activities, oil and gas drillers and producers are subject to rules established to meet and maintain air quality standards in Texas. The commission enforces its rules through various means, such as monitoring, recordkeeping, testing, and reporting requirements. In addition, the TCEQ conducts investigations of companies in all areas of the state to determine compliance with the rules and regulations.

Regarding air pollution reductions for drilling rigs, these sources are considered non-road mobile sources due to their portability. The FCAA generally preempts state authority to adopt or enforce emissions standards for mobile sources. As a result, the commission cannot regulate drilling rig emissions in the same manner as stationary source emissions. No changes were made in response to these comments.

An individual provided information excerpted from a blog post (Arlington TX Barnett Shale Blogger, [https://barnettshalehell.wordpress.com/2014/03/26/gm-needs-1479-yrs-to-10-yrs-of-drilling-rig-barnett-shale-created-nox/]) discussing attempts to understand emissions specifics related to oil and gas drilling in the Barnett Shale area.

The TCEQ used a different method than the individual to estimate drilling rig engine emissions for this DFW AD SIP revision. The TCEQ estimated drilling rig engine emissions using the calculation methodology from the ERG report *Development of Texas Statewide Drilling Rigs Emissions Inventories for the Years 1990, 1993, 1996, and 1999 through 2040*, combined with drilling activity data from the RRC. For example, the calculation methodology from the ERG report was combined with actual 2011 drilling activity data from the RRC to develop the 2011 EI. No changes were made in response to this comment.

An individual commented that the TCEQ Barnett Shale Phase I and II EI did not include preproduction emissions such as drilling, fracking, and flowback.

The purpose of the Barnett Shale Phase I and Phase II Special Inventories was to obtain detailed inventory information for stationary sources associated with Barnett Shale oil and gas production, transmission, processing, and related activities. These sources are typically not required to report as point sources per 30 TAC 101.10. As noted by the individual, information on exploration and preproduction emission sources such as drilling rigs, hydraulic pump engines, or well completions was outside the scope of this special inventory. However, the TCEQ estimates these types of emissions as area source and non-road mobile emissions, and these emissions are included in this DFW AD SIP revision. No changes were made in response to this comment.

Oil and Gas Emissions Inventory Development

An individual commented that oil and gas operations have significant emissions, must be accounted for in this DFW AD SIP revision, and make a significant contribution to ozone. The

individual further commented that oil and gas operations are the dominant sources of VOC precursors for ozone formed in the winter.

The TCEQ did account for oil and gas operations in this DFW AD SIP revision. Multiple tables in both the Executive Summary and Chapter 3: *Photochemical Modeling* show 2018 emission estimates for oil and gas drilling and production at 11.13 NO_X tpd and 24.45 VOC tpd, which represent 4% and 5% of the total 2018 NO_X and VOC emissions, respectively, for the DFW nonattainment area. The TCEQ disagrees with the statement that oil and gas operations are the dominant source of VOC precursors during winter or any other time of year. The DFW AD SIP revision clearly shows that oil and gas operations are not the dominant source of VOC precursors in the DFW nonattainment area. The single largest contributor to 2018 VOC emissions is the portion of the area source category that excludes oil and gas operations. This segment is projected to emit 284.94 VOC tpd, which represents 62% of the total 460.72 VOC tpd estimated for the entire DFW nonattainment area in 2018. The single largest contributor to 2018 NO_X emissions is the on-road category at 119.69 NO_X tpd, which represents 41% of the total 292.17 NO_X tpd estimated for the entire DFW nonattainment area in 2018.

The TCEQ agrees that oil and gas operations contribute to the ozone formed in the DFW nonattainment area. The ozone source apportionment results in Table 3-46: *2018 Ozone DV_F Denton, Parker, and Kaufman Contributions* show that drilling and production of oil and gas operations contributes 0.40 ppb to the Denton Airport South monitor located far northwest, 0.79 ppb to the Parker County monitor located far west, and 0.02 ppb to the Kaufman County monitor located far southeast. The TCEQ acknowledges that some ozone is formed during winter months, but monitoring data show that these concentrations fall within the very low range of 10-50 ppb, which is well below the standard of 75 ppb. No changes were made in response to these comments.

An individual commented that oil and gas exploration and production emissions in the Barnett Shale are severely underrepresented and under-regulated. The Sierra Club and Downwinders commented an accurate oil and gas EI is necessary for DFW to attain the ozone standard.

The TCEQ disagrees that oil and gas exploration and production emissions are severely underrepresented in the DFW AD SIP revision. The TCEQ develops the EI in accordance with EPA reporting requirements and works closely with the EPA to ensure the inventory is accurate, updated, and comprehensive.

The EI reflects two decades of continuous improvement. The TCEQ has performed state-of-the-science studies to identify and quantify potentially under-reported emissions sources. These studies result in refined emissions factors, activity data, or emissions determination methods that are incorporated directly into the development of the appropriate inventory source category. As one example, a recent study refined upstream oil and gas industry storage tank emissions factors. More information on these studies can be found on the TCEQ's Air Quality Research and Contract Projects Web page (http://www.tceq.texas.gov/airquality/airmod/project/pj.html).

Area (nonpoint) EI estimates are developed using the best available data and emissions determination methods or models available at the time. For example, the area source oil and gas inventory uses the current production data and well statistics from the RRC to develop specific county-level estimates. As noted above, the TCEQ has invested significant resources in advancing area source inventory development methods. The methods the TCEQ uses to develop its area source oil and gas inventory serve as a model for other agencies. No changes were made in response to these comments.

The Sierra Club of Greater Fort Worth and an individual commented that the TCEQ must get an accurate count of the number of gas wells, compressor stations, and compressor engines in the DFW area. The Sierra Club and Downwinders commented that using a production-based approach to estimate compressor engine emissions underestimates ozone precursor emissions from these sources.

The TCEQ does use an accurate count of the number of gas wells in the DFW area when developing area source (nonpoint) oil and gas emissions estimates. The number of gas wells used to develop the oil and gas EI was obtained from the RRC. Publicly available well count information is available on the RRC's Well Distribution by County Web page (http://www.rrc.state.tx.us/oil-gas/research-and-statistics/well-information/well-distribution-by-county-well-counts/).

The TCEQ does not use the number of compressor stations or compressor engines in the DFW area when developing area source oil and gas compressor engine emissions estimates. Since the number of compressor stations and the number of compressor engines changes over time, and the operating conditions of each compressor engine (such as operating horsepower, number of hours operated, and engine load) can vary from year to year, knowing the number of compressor stations or the number of compressor engines alone would not provide enough information to develop accurate emissions estimates for these sources.

Instead, the TCEQ uses a compressor engine profile developed from a comprehensive DFW-specific compressor engine data set obtained from the Barnett Shale Phase II Special Inventory completed in 2011 combined with gas production data obtained from the RRC to estimate area source compressor engine emissions. No changes were made in response to these comments.

The Sierra Club and Downwinders stated that underestimating natural gas blowdown emissions would jeopardize attainment of the ozone standard.

Point source annual emissions include emissions from blowdown activities in accordance with TCEQ's Emissions Inventory Guidelines document and are included in both the attainment demonstration and reasonable further progress SIP revisions. Information on compressor engine blowdown emissions was not available to accurately estimate these emissions for the 2011 area source EI. This category has been identified as a potential area for further research for upcoming fiscal years.

Since natural gas is typically released to the atmosphere during blowdowns, a significant portion of these emissions are methane and ethane, which do not react readily to form ozone. No changes were made in response to this comment.

Natural Gas Compressor Engines

The Sierra Club and Downwinders commented that "untold thousands" of smaller compressors remained unidentified in a systematic manner.

The TCEQ disagrees with this comment. The TCEQ conducted a comprehensive inventory of nonpoint (area) oil and gas emissions sources in the Barnett Shale in 2011 to determine the location, number, and type of these sources. The TCEQ received special inventory data from companies that accounted for more than 99% of the 2009 production in the Barnett Shale formation. Specifically, data for 9,123 upstream leases/facilities and 519 midstream sites/facilities has been received. It should be noted that midstream sites/facilities process or transport gas from formations other than the Barnett Shale formation. Operations were reported in all 23 counties that comprise the core Barnett Shale area.

Smaller compressor engines, such as those added to help boost pressure at aging gas wells, are typically rated less than 360 horsepower. In Phase II of this special inventory, operators reported engine characteristics such as horsepower rating for 1,911 engines. Of these engines, 76% were rated less than 360 horsepower, indicating that a sizeable number of smaller compressor engines were inventoried. The TCEQ also collected emissions and location data from these engines, and used the provided data to refine its area source EI emissions estimation methodology for the source type. Since the commenter provided no support or otherwise identified the "untold thousands" of smaller compressors, the TCEQ has no information upon which to base changes in response to this comment.

An individual commented that gas compressor engines are usually fueled with gasoline or diesel, and that these engines are a significant source of ozone precursor emissions.

The TCEQ disagrees that gas compressor engines are typically fueled with gasoline or diesel; the vast majority of natural gas compressor engines used for pipeline transmission are fueled by natural gas in Texas and the DFW area. Comprehensive compressor engine data for the DFW and surrounding areas was obtained from the Barnett Shale Phase II Special Inventory completed in 2011. In this mandatory special inventory, three gasoline-fired compressor engines and three diesel-fired compressor engines were reported out of approximately 1,900 engines; the remaining engines (99%) were fueled by natural gas.

The commission has adopted rules to reduce emissions from natural-gas fired compressor engines. In May 2007, in addition to NO_X control requirements on many other sources, the commission adopted stringent NO_X control requirements in 30 TAC Chapter 117 for gaseous fuel-fired stationary reciprocating internal combustion engines which includes compressor engines used in oil and natural gas industry. These rules for the DFW area include Chapter 117, Subchapter B, Division 4 for major sources and Chapter 117, Subchapter D, Division 2 for minor sources. The compressor engine controls required to meet the Chapter 117

emission limits result in compressor engine NO_X emissions that are about 92% lower than those from typical uncontrolled compressor engines. No changes were made in response to this comment.

An individual commented that a recent study measured higher emissions from compressor engines than traditional emissions estimation methods.

The commenter did not provide a reference to a particular study. Based on the information provided, it is not possible to address the study mentioned by the commenter. No changes were made in response to this comment.

The Sierra Club and Downwinders commented that the TCEQ has never released information regarding compressor engine emissions from counties in the lower Haynesville Shale play.

The TCEQ disagrees with this comment. Annual emissions from large stationary sources including compressor stations and gas processing plants are reported to the TCEQ's point source EI. Site-level reported criteria pollutant emissions data are posted on the TCEQ's Point Source Emissions Inventory Web page (https://www.tceq.texas.gov/airquality/point-source-ei/psei.html). Currently, this Web page includes 2011 through 2013 annual criteria pollutant emissions for sites that reported point source emissions inventories.

The TCEQ develops emissions estimates for sites that fall below the point source EI reporting thresholds in its area source EI. The TCEQ reports the area source inventory triennially to the EPA; this data is available on the EPA's National Emissions Inventory Web page (http://www.epa.gov/ttnchie1/net/2011inventory.html).

The TCEQ is currently commencing an area source emissions inventory improvement study to quantify current use of electric-powered compressor engines.

Future Emissions Inventory Development Regarding Oil and Natural Gas Activity

Downwinders and 52 individuals commented that the TCEQ's projected oil and gas emissions omit increased reliance on lift compressors at older Barnett Shale wells, which underestimate future case ozone precursor emissions. The Sierra Club and Downwinders stated that TCEQ's future case oil and gas inventory does not include re-fracked wells and the corresponding increase in compressor emissions estimates.

Artificial lift compressors at oil wells are typically powered by electricity and electric compressors are not included in current or future emissions estimates. The TCEQ accounts for artificial lift compressors that use petroleum fuels for energy in its area source EI.

For gas wells, compression requirements may vary with many factors, including well age, as noted in the comment. New wells potentially do not require compression; as wells age and well pressures decrease, compression requirements can increase. The TCEQ's area source inventory accounts for increased

compression requirements as gas wells age through the activity data used to develop compressor engine emissions estimates.

The TCEQ has surveyed natural gas production companies and trade organizations to calculate the amount of compression required to transmit natural gas. These surveys have captured a wide range of data for wells of varying age, pressure, and production levels, as well as the horsepower rating of the associated compressor engines. This survey data is averaged on a regional basis to determine the compression factor for wells in the area. The compression factor, in turn, is incorporated into the county-level compressor engine emissions factor.

Therefore, compressor engine emissions estimates reflect the entire population of engines and the wells serviced, both old and new. More details on how this factor is developed can be found in the report *Characterization of Oil and Gas Production Equipment and Develop a Methodology to Estimate Statewide Emissions* (https://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5820784003FY1026-20101124-ergi-oilGasEmissionsInventory.pdf). No changes were made in response to these comments.

Downwinders and 52 individuals commented that the TCEQ estimates for future oil and gas emissions do not account for new markets for natural gas, such as new liquefied natural gas plants on the Texas Gulf Coast. The Sierra Club and Downwinders commented that the TCEQ underestimated oil production and its air quality impacts, and questioned the Hubbert model oil and gas production predictions since the number of Barnett Shale wells are increasing.

The TCEQ uses the most currently available EI information and the EPA-approved models and growth factors to estimate growth of oil and gas emissions. The growth factors include economic factors such as projected supply and demand. Gas production in the Barnett Shale peaked in 2012, began to decrease in 2013, and continued to decrease in 2014 according to historical reported production data from the Barnett Shale RRC Web page (http://www.rrc.state.tx.us/media/22204/barnettshale_totalnaturalgas_day.pdf).

This trend correlates well to the projected production curve from the 2012 study Forecasting Oil and Gas Activities, which the TCEQ used to estimate 2017 and 2018 area source oil and gas emissions. It also correlates well to actual drilling activity, which peaked in 2008. RRC data for 2014 indicate total drilling permits issued were about 25% of the 2008 level. With drilling levels declining, it is unlikely that the Barnett Shale production will increase. RRC data indicate that Barnett Shale peak production levels occurred in 2012, and production has continued to decline each year from 2012 through 2014.

The TCEQ will continue to develop updated emissions inventories using the most recent activity data available and any changes in production will be reflected in future emissions estimates. No changes were made in response to these comments.

Point Sources

An individual commented that the General Motors Arlington plant emitted 557 tons per year (tpy) of VOC (4,447 pounds per ozone season day [ppd]), 56 tpy (436 ppd) of NO_X, and 37 tpy (271 ppd) in 2011.

The TCEQ agrees with this comment. General Motors Arlington plant's emissions as stated by the commenter are within 1 tpy for annual emissions and 1 ppd for ozone season emissions reported to the TCEQ. No changes were made in response to this comment.

An individual commented that the natural gas operations located on or near General Motors Arlington plant do not report emissions to the TCEQ point source EI.

The TCEQ agrees that the oil and gas sources located near or on the General Motors Arlington plant do not report emissions to the TCEQ point source EI. However, these oil and gas sources are independently operated from the General Motors Arlington plant. Many stationary sources, including some oil and gas sources, do not meet the reporting requirements of 30 TAC 101.10. The TCEQ develops estimates for these sources and includes them in the area (nonpoint) source inventory. No changes were made in response to this comment.

COMPLIANCE AND ENFORCEMENT

Enforcement

Two individuals commented that action and enforcement are lacking. Another individual commented that there were too many violations overlooked. An individual expressed dissatisfaction with the TCEQ's inability to enforce and make rules and stated that the TCEQ should develop some "regulatory teeth."

The commission vigorously pursues enforcement against any person or business that is in non-compliance and whose violations meet the criteria for referral to enforcement as laid out in the commission's Enforcement Initiation Criteria. All penalties assessed are done so in accordance with the commission's Penalty Policy.

Citizens may contact the Region 4 office in Fort Worth at 817-588-5800 to report an environmental complaint and are encouraged to report conditions thought to contribute to adverse health and/or welfare effects. No changes were made in response to these comments.

Monitoring

An individual commented that the TCEQ relies on measurements that are heavily manipulated to favor industry, using old data to mask current trends in deteriorating air quality. The commenter also stated that monitors are placed to avoid picking up emissions from the highest sources of air pollution, and gas drilling compressors are completely ignored even though their use in the monitoring area has increased exponentially since 2006.

An individual commented that the General Motors plant in Arlington has their own gas well pad sites on their property and there are no monitors there.

The TCEQ monitors ambient air quality in the DFW area at over 40 sites for a variety of objectives, including evaluation of population exposure, background concentrations, upwind and downwind concentrations, and concentrations in areas that are expected to have the highest concentrations. These ambient monitoring sites include monitors that measure ozone, NO_2, particulate matter, sulfur dioxide, lead, carbon monoxide, and/or several species of VOC emissions. Many of these monitors operate continuously, providing ambient air quality data online and available to the public every hour.

The location of these monitoring sites is selected based on the specific monitoring objective of the site and following the siting criteria specified in EPA regulations located in 40 CFR Part 58. These criteria include the requirement for an unobstructed pathway for the air allowing the monitor to measure an unbiased sample from the surrounding area. The monitors cannot distinguish between industrial pollutant emissions and pollutant emissions from mobile or area wide sources. Monitors are operated in a manner consistent with the operations of the other regulatory monitors in the country and measurements are quality assured to ensure that they are representative of the surrounding ambient air quality.

Information about the sites and data from the monitors can be accessed using TCEQ's interactive geographical air monitoring data tool, GeoTAM (http://tceq4apmgwebp1.tceq.texas.gov/geotam3/). No changes were made in response to these comments.

Field Investigations

An individual commented that after calling in a complaint, the TCEQ took two to three days to come out to investigate gas wells and compressor sites. Additionally, the commenter noted that the TCEQ did not cite Eagleridge for known violations.

Complaints received by the agency are prioritized according to the individual characteristics of the event, and its potential impact on human health, safety, and the environment. The agency works to address complaints as soon as possible, within the assigned priority deadlines. Based on Regional management discretion, assigned priority for all complaint responses, except emergency response, could be postponed due to weather or weekend/holiday consideration. A complaint's prioritization is based on the information provided by the complainant. For the complaints made by the commenter to the TCEQ, all were investigated within the assigned prioritization deadline.

In regard to the complaint concerning the natural gas sites at Eagleridge, the individual did not provide any specific detail about the site or sites mentioned in the comment. There are two natural gas sites operated by Eagleridge in Mansfield, the Woodland Estates West 12H 14H 16H site and the Woodland Estates East Unit. During an investigation conducted between October 16 and 25, 2013, the TCEQ determined that the Woodland Estates West site was failing to capture or route flowback emissions to a completion device. This was in violation of Title 40 of the CFR Chapter 60.5375(a)(3), and was cited in a Notice of Violation letter sent to Eagleridge on December 20, 2013. Sufficient action was taken at the Woodland Estates West site prior to the completion of the investigation to resolve the

violation, and actions had been taken to prevent a similar violation at the Woodland Estates East Unit.

There are different categories of violations. Once a violation is documented, the TCEQ uses established criteria to determine the level of the enforcement that is warranted based on the potential impact to health and the environment. If a violation is referred for formal enforcement action, a penalty will be assessed and technical requirements to correct the violation will be included in an order. For violations that are not referred for enforcement action, the company is given an opportunity to correct the violation through a "notice of violation" (NOV). In this instance, the violation was not of the level to initiate an enforcement action; therefore, no technical requirements were put in place and no penalties were assessed. No changes were made in response to this comment.

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Texas Commission on Environmental Quality

ORDER ADOPTING NEW, AMENDED, AND REPEALED RULES AND REVISIONS TO THE STATE IMPLEMENTATION PLAN

Docket Nos. 2014-1262-SIP, 2014-0501-RUL, and 2014-0707-RUL
Project Nos. 2013-015-SIP-NR, 2013-048-115-AI, and 2013-049-117-AI

On June 3, 2015, the Texas Commission on Environmental Quality (Commission), during a public meeting, considered adoption of the DFW 2008 Eight-Hour Ozone Standard Attainment Demonstration (AD) SIP Revision, and the repeal of § 115.417; new § 115.410 and § 115.411; and amendments to §§ 115.10, 115.110 - 115.112, 115.114, 115.115, 115.117 - 115.119, 115.121, 115.122, 115.125 - 115.127, 115.129, 115.139, 115.215, 115.219, 115.229, 115.239, 115.359, 115.415, 115.416, 115.419, 115.420 - 115.423, 115.425 - 115.427, 115.429, 115.440 - 115.442, 115.446, 115.449 - 115.451, 115.453, 115.459 - 115.461, 115.469, 115.471, 115.473, 115.479, and 115.519 in 30 Texas Administrative Code (TAC) Chapter 115, Control of Air Pollution from Volatile Organic Compounds; amendments to §§ 117.10, 117.403, 117.400, 117.410, 117.423, 117.425, 117.430, 117.435, 117.440, 117.445, 117.450, 117.454, 117.456, 117.1303, 117.1310, 117.1325, 117.1335, 117.1340, 117.1345, 117.1350, 117.1354, 117.8000, 117.9030, 117.9130, 117.9800, and 117.9810; the repeal of §§ 117.200, 117.203, 117.205, 117.210, 117.215, 117.223, 117.225, 117.230, 117.235, 117.240, 117.245, 117.252, 117.254, 117.256, 117.1100, 117.1103, 117.1105, 117.1110, 117.1115, 117.1120, 117.1125, 117.1135, 117.1140, 117.1145, 117.1152, 117.1154, 117.1156, 117.9010, and 117.9110; and new §117.405 and § 117.452 in 30 TAC Chapter 117, Control of Air Pollution from Nitrogen Oxides; and corresponding revisions to the SIP. The amendments to 30 TAC §§ 117.210(c), 117.225, 117.410(d), 117.425, 117.1110(b), 117.1125, 117.1310(b), and 117.1325, and new § 117.405(d) are not being submitted to EPA as revisions to the SIP.

The Commission adopts new, amended, and repealed rules in Chapters 115, Control of Air Pollution from Volatile Organic Compounds; Chapter 117, Control of Air Pollution from Nitrogen Oxides; and the DFW 2008 Eight-Hour Ozone Standard AD SIP Revision. The DFW AD SIP revision incorporates the Chapters 115 and 117 rulemakings to fulfill reasonably available control technology (RACT) requirements for all control techniques guidelines (CTG) emission source categories and all non-CTG major sources of VOC and NO_X as required by FCAA, § 172(c)(1) and § 182(b)(2). The DFW AD SIP revision includes all applicable Federal Clean Air Act (FCAA) and Environmental Protection Agency (EPA) requirements known at the time of proposal. This SIP revision demonstrates attainment of the 2008 eight-hour ozone NAAQS by 2018 based on a

photochemical modeling analysis of reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) emissions from existing control strategies and a weight of evidence analysis. The SIP revision also includes FCAA required analyses for RACT and Reasonably Available Control Measures (RACM), a Motor Vehicle Emissions Budget (MVEB), and a contingency plan. Under Tex. Health & Safety Code Ann. §§ 382.011, 382.012, and 382.023 (West 2010), the Commission has the authority to control the quality of the state's air and to issue orders consistent with the policies and purposes of the Texas Clean Air Act, Chapter 382 of the Tex. Health & Safety Code. Notice of the proposed new, amended and repealed rules in Chapters 115 and 117, and the DFW 2008 Eight-Hour Ozone Standard AD SIP was published for comment in the December 26, 2014, issue of the *Texas Register* (39 TexReg 10548).

Pursuant to 40 Code of Federal Regulations § 51.102 and after proper notice, the Commission conducted public hearings to consider the revisions to the SIP. Proper notice included prominent advertisement in the areas affected at least 30 days prior to the dates of the hearings. Public hearings were held in Arlington on January 15, 2015 and in Austin on January 22, 2015.

The Commission circulated hearing notices of its intended action to the public, including interested persons, the Regional Administrator of the EPA, and all applicable local air pollution control agencies. The public was invited to submit data, views, and recommendations on the proposed SIP revisions, either orally or in writing, at the hearings or during the comment period. Prior to the scheduled hearings, copies of the proposed SIP revisions were available for public inspection at the Commission's central office and on the Commission's website.

Data, views, and recommendations of interested persons regarding the proposed SIP revisions were submitted to the Commission during the comment period, and were considered by the Commission as reflected in the analysis of testimony incorporated by reference to this Order. The Commission finds that the analysis of testimony includes the names of all interested groups or associations offering comment on the SIP revisions and their position concerning the same.

IT IS THEREFORE ORDERED BY THE COMMISSION that new, amended, and repealed rules in Chapter 115, Control of Air Pollution from Volatile Organic Compounds; Chapter 117, Control of Air Pollution from Nitrogen Oxides; and the DFW 2008 Eight-Hour Ozone Standard Attainment Demonstration (AD) SIP Revision incorporated by reference to this Order are hereby adopted. The adopted rules and the preamble to the adopted rules and the adopted revisions to the SIP are incorporated by reference in this Order as if set forth at length verbatim in this Order.

IT IS FURTHER ORDERED BY THE COMMISSION that on behalf of the Commission, the Chairman should transmit a copy of this Order, together with the adopted rules and revisions to the SIP, to the Regional Administrator of EPA as a

proposed revision to the Texas SIP pursuant to the Federal Clean Air Act, codified at 42 U.S. Code Ann. §§ 7401 - 7671q, as amended.

If any portion of this Order is for any reason held to be invalid by a court of competent jurisdiction, the invalidity of any portion shall not affect the validity of the remaining portions.

Date Issued:

TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY

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Bryan W. Shaw, Ph.D., P.E., Chairman