TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AGENDA ITEM REQUEST

for Proposed State Implementation Plan Revision

AGENDA REQUESTED: December 13, 2006

DATE OF REQUEST: November 21, 2006

NAME & NUMBER OF PERSON TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED: Kerry Howard, 239-0556

CAPTION: Docket No. 2006-1900-SIP. Consideration for publication of, and hearing on, a proposed revision to the Dallas-Forth Worth (DFW) State Implementation Plan (SIP) to meet the eight-hour ozone National Ambient Air Quality Standard (NAAQS). The proposed revision includes requirements for the following sources: major industrial, commercial, and institutional sources, minor sources, electric generating facilities, cement kilns, and East Texas combustion sources. All of the proposed requirements apply to the nine-county DFW area except for the East Texas Combustion requirements, which apply in specific counties located in northeast Texas. In addition, the North Central Texas Council of Governments has committed to implementing local-level controls of 2.89 tpd of NOx by ozone season 2009.

This revision also includes a motor vehicle emissions budget, VOC and NOx reasonably available control technology analyses, reasonably available control measures analysis, contingency measures, and emissions inventories. (Mary Ann Cook, Terry Salem) (Rule Project No. 2006-013-SIP-NR)

D.C. Schanbacher
Chief Engineer

Susana M. Hildebrand
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Agenda Coordinator

Copy to CCC Secretary? NO

Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

Commissioners

Date: November 21, 2006

Thru: LaDonna Castañuela, Chief Clerk
Glenn Shankle, Executive Director

David C. Schanbacher, P.E., Chief Engineer DCS

Docket No.: 2006-1900-SIP

Subject: Commission Approval for Proposal of the Dallas-Fort Worth Eight-Hour Ozone Attainment Demonstration SIP Revision
Project No. 2006-013-SIP-NR

Reasons for the SIP revision:
The nine-county Dallas-Fort Worth (DFW) metropolitan area was designated a "moderate" ozone nonattainment area under the eight-hour ozone standard. The Federal Clean Air Act (FCAA), 42 USC, §7410, requires states to submit State Implementation Plan (SIP) revisions for the eight-hour ozone SIP standard by June 15, 2007.

What the SIP Revision will do:
This SIP revision demonstrates attainment of the eight-hour ozone standard using photochemical modeling and weight-of-evidence and includes several proposed Chapter 117 rules. These rules include requirements for the following sources:

- Major Industrial, Commercial, and Institutional Sources
- Minor Sources
- Electric Generating Facilities (EGFs)
- Cement Kilns
- East Texas Combustion Sources

All of the proposed rules apply to the nine-county DFW area except for the East Texas Combustion rule, which applies in specific counties located in northeast Texas. The North Central Texas Council of Governments (NCTCOG) also commits to reduce nitrogen oxides (NO_X) emissions by 2.89 tpd by the 2009 ozone season.

The attainment demonstration includes the 1999 base case and 2009 future case modeling for the August 13-22, 1999, episode and is supported by additional technical work that shows decreasing NO_X and volatile organic compounds (VOC) trends as a result of the control strategies implemented under the one-hour national ambient air quality standards (NAAQS). The SIP revision also explains that several other programs being implemented will improve the area's air quality, but have not been included in the modeling because of difficulty in quantifying emission reductions, determining whether reductions are surplus, or the programs do not have dedicated future funding. The SIP establishes a new motor vehicle emissions budget for transportation conformity purposes.

This SIP revision documents the progress made under the one-hour ozone NAAQS and the downward trends in eight-hour ozone over the past 15 years, even though population and vehicle miles traveled have increased during the same period. Preliminary 2006 data indicate the DFW area is monitoring attainment of the one-hour ozone standard with a design value of 124 ppb.

Re: Docket No. 2006-1900-SIP

This SIP revision also includes changes to reflect implementation of House Bill (HB) 965, 79th Legislature, 2005, and the proposed repeal of the 10 nanogram/joule (ng/J) NO_X emissions standard for Type 0 residential natural gas-fired water heaters in Chapter 117, Subchapter D, Division 1. Consistent with the requirements of HB 965 and with EPA guidance, this SIP revision includes replacement reductions to offset the loss of SIP credit due to the proposed repeal of the 10 ng/J emissions standard for residential water heaters.

Statutory authority:
The authority to propose and adopt this SIP Revision is derived from the Texas Health and Safety Code, 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; TCAA, §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, and Texas Water Code §5.102, General Powers, and §5.013, General Jurisdiction of Commission.

The Federal Clean Air Act (FCAA), 42 USC, §7410, *et seq.*, requires states to submit SIP revisions that specify the manner in which the NAAQS will be achieved and maintained within each air quality control region of the state. EPA's Final Rule to Implement the Eight-Hour Ozone National Ambient Air Quality Standard, published on November 29, 2005, outlines the requirements.

Effect on the:

Regulated community:
Several different source categories within and beyond the DFW nonattainment area will need to comply with the new proposed rules included in this SIP revision In addition, previously unregulated sources may be required to comply with the proposed rules. See the Chapter 117 executive summary memo for more details on the proposed NO_X rules.

Public:
The general public in the DFW area, surrounding counties, and east Texas will benefit from improved air quality.

Agency programs:
Field Operations Division (FOD) conducts field investigations to verify compliance with the rules contained in SIP revisions. FOD will need to inspect for compliance with the proposed requirements when conducting routine site visits. Enforcement of the rules in the SIP would not significantly increase the number of facilities investigated by the state and local governments. The rules may increase the Office of Compliance and Enforcement workload when investigating the affected facilities.

Controversial issues:
Sources outside the nonattainment area subject to the proposed East Texas combustion rule may object to being regulated to help the DFW area attain the eight-hour ozone standard. In addition, sources regulated by the proposed rules may argue that there is inadequate time to comply with the proposed rules (Compliance Date: March 1, 2009).

Legislative interest:
Legislative interest will likely be high since this SIP revision will coincide with the 2007 legislative session.

Re: Docket No. 2006-1900-SIP

Stakeholder involvement:
Public meetings with interested parties, including local governments, industry, environmental groups, and members of the public were held. These included meetings on June 20 and 21, 2006, and September 7, 2006. In addition, status reports have been made monthly since late 2005 to the North Central Texas Clean Air Steering Committee.

Proposed schedule:
Anticipated proposal date: December 13, 2006
Public hearing dates: In DFW area, February 1, 2007; in Longview, February 6, 2007; in Austin, February 8, 2007; in Houston, January 29, 2007
Public comment period: December 29, 2006- February 12, 2007
Anticipated adoption date: May 2007
SIP revision due to EPA: June 15, 2007
Controls must be in place: May 31, 2009

Agency contacts:
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Attachments (SIP narrative)

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Revisions to the State Implementation Plan (SIP)
for the Control of Ozone Air Pollution

DALLAS-FORT WORTH EIGHT-HOUR OZONE NONATTAINMENT AREA ATTAINMENT DEMONSTRATION

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. BOX 13087
AUSTIN, TEXAS 78711-3087

Proposed
December 13, 2006

PROJECT NO. 2006-013-SIP-NR

EXECUTIVE SUMMARY

The Dallas-Fort Worth (DFW) area was initially designated as nonattainment for ozone in 1991. Since then, the TCEQ and DFW area local governments have consistently taken steps to improve DFW air quality through the implementation of numerous control measures targeting attainment of the one-hour ozone National Ambient Air Quality Standard (NAAQS). These control strategies resulted in significant improvements to DFW's air quality as demonstrated by the decrease in the DFW area's one-hour ozone design value over the past 15 years. The DFW area's one-hour ozone design value decreased from 140 parts per billion (ppb) in 1990 to 125 ppb in 2005. On June 15, 2005, the one-hour ozone NAAQS was revoked, leaving only an eight-hour ozone standard, which became effective June 15, 2004. The DFW area was required to attain the new eight-hour ozone standard by the end of ozone season 2009, (69 FR 23951). Therefore, this SIP revision is the first DFW SIP revision under the eight-hour ozone standard.

Despite the significant decreases in one-hour ozone design values, and NO_X and VOC emissions in the DFW area, the increased stringency of the eight-hour ozone standard requires further reductions to bring the area into attainment of the .08 ppm eight-hour standard by modeling 84 ppb or less by 2009. Rapid population growth and economic development in the DFW nonattainment area present numerous and complex challenges to reducing NO_X and VOC emissions.

On-road and non-road mobile sources are the largest contributors to NO_X emissions in the DFW area. TCEQ modeling shows that on-road and non-road mobile sources contribute 74 percent of the NO_X in the 2009 emissions inventory. The trends in total NO_X emissions are dependent upon trends in the NO_X emissions from on-road mobile sources, a source category for which the TCEQ does not have legal authority to set emission standards. Even though population in the DFW area and the vehicle miles traveled have increased, the NO_X emissions from on-road mobile sources as well as the total NO_X emissions have decreased since 1999 largely due to fleet turnover and the implementation of programs such as Texas Emissions Reduction Plan (TERP), the Vehicle Inspection and Maintenance (I/M) Program in the DFW area, and Texas Low Emission Diesel (TxLED) in East and Central Texas.

Although the population of the nine-county area and other factors, such as vehicle miles traveled, continue to increase, the DFW area is experiencing decreasing trends for ozone and its precursors, NO_X and VOC. The one-hour ozone design value has decreased about 10.7 percent over the past 15 years, while the eight-hour ozone design value has decreased 9.5 percent during the same period. In 2005, the peak one-hour ozone design value was reduced to 125 ppb, while the peak eight-hour ozone design value dropped to 95 ppb. NO_X and VOC emissions trends demonstrate decreasing emissions in the DFW area.

Anthropogenic NO_X and VOC emissions fall into the four following categories: point source, on-road mobile sources, non-road mobile sources, and area sources, with the largest source of NO_X emissions in the DFW area being from on-road mobile sources. Over the past 14 years, NO_X emissions from point sources decreased by 44 percent. This decreasing trend in reported emissions is corroborated by the decrease in measured ambient NO_X concentrations over the past 15 years. The VOC emissions in the DFW area come primarily from area sources and on-road mobile sources. Reported VOC emissions decreased by about 30 percent in the past 14 years, with ambient VOC concentrations also decreasing over the last nine years.

This SIP submittal contains the NO_X control strategies summarized below in Table ExSum-1: *Summary of Control Strategies NO_X Reduction Estimates for the DFW Attainments Demonstration* and estimated NO_X reductions in Table ExSum-2: *DFW NO_X Reduction Estimates.*

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Table ExSum-1: Summary of Control Strategies NO_X Reduction Estimates for the DFW Attainment Demonstration

TCEQ-PROPOSED RULES	Estimated NO_X Reductions in 2009 (tpd)
DFW Industrial, Commercial, and Institutional Sources Rule	12.7
DFW Electric Generating Units Rule	2.0
DFW Minor Source Rule	4.5
Cement Kiln Rule	11.0
East Texas Combustion Source Rule	37[1]

[1]- This control strategy applies to 39 of the 61 counties within or traversed by the 200 km perimeter from DFW and the 2009 emissions reductions from the East Texas Combustion rule, as proposed, are estimated at approximately 37 tpd. The modeling control strategy sensitivity run (Combination 4), assumes the rule applies to all 61 counties within 200 km and reduces NO_X by 40.9 tpd.

DFW LOCAL INITIATIVES	Estimated NO_X Reductions in 2009 (tpd)
VMEP in 9 counties	2.63[2]
TCMs in 9 counties	0.26

[2]-The modeling control strategy sensitivity run (Combination 4) is based on NCTCOG's initial VMEP estimates and assumes VMEP will reduce NO_X emissions by 16.3 tpd. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect any updates prior to adoption of this SIP revision.

FEDERAL MEASURES	Estimated NO_X Reductions in 2009 (tpd)
On-Road Measures	217.52
Non-Road Measures	21.49

Table ExSum-2: DFW Modeled NO_X Reduction Estimates

August 17, 1999 Base Case Emissions Inventory	1999 Baseline Emissions (tpd)))	2009 Future Year Base Inventory (tpd)	2009 Future Year Control Inventory (tpd)
Area sources	34	44	40
Non-road sources	148	107	100
Point Sources	134	59	35
On-road mobile sources	430	184	174
Biogenic sources	52	52	51
TOTALS	**747**	**447**	**400**

(See pages 4-1 to 4-3 for a complete list of existing control strategies.)

This SIP revision includes 1999 base and baseline case modeling, 2009 future case modeling with and without the additional controls proposed. Table ExSum-3*: Future Design Value Calculations with Combination 4 Controls* demonstrates the results after controls are included in future modeling. Of the nine monitors exceeding in the baseline model, only two remain above 85 ppb, at 87.7 ppb. Because photochemical modeling is an evaluation tool and not an absolute prediction of future ozone concentrations, additional data must be considered to draw conclusions about the validity of the final predicted design value and whether the attainment demonstration satisfies the requirements of the Federal Clean Air Act (FCAA).

Table ExSum-3: Future Design Value Calculations with Combination 4 Controls

Future Design Values	2009 Baseline			2009 Combo #4		
Site Name	Average RRF	Baseline DV [ppb]	Future DV	Average RRF	Baseline DV [ppb]	Future DV
Frisco C31	0.890	100.3	**89.3**	0.875	100.3	**87.7**
Dallas Hinton C60	0.936	92.0	**86.1**	0.922	92.0	**84.8**
Dallas North C63	0.917	93.0	**85.3**	0.903	93.0	**84.0**
Dallas Exec C402	0.905	88.0	**79.7**	0.888	88.0	**78.1**
Denton C56	0.878	101.5	**89.1**	0.864	101.5	**87.7**
Midlothian C94	0.918	92.5	**84.9**	0.900	92.5	**83.2**
Arlington C57	0.909	90.5	**82.2**	0.885	90.5	**80.1**
FtW NW C13	0.884	98.3	**86.9**	0.862	98.3	**84.7**
FtW Keller C17	0.887	96.3	**85.4**	0.873	96.3	**84.0**

This SIP provides trends analyses and supplementary data to demonstrate that the DFW nine-county nonattainment area is on a path to attain the 0.08 ppm eight-hour ozone standard. The additional analysis in the Weight of Evidence (WoE) section supports a conclusion that this DFW SIP demonstrates attainment of the eight-hour ozone NAAQS.

Overall, this revision includes the control strategies in Table ExSum-1: *Summary of Control Sltrategies NO_X Reduction Estimates for the DFW Attainment Demonstration*, data on progress that the DFW area has made toward attainment, 1999 base photochemical modeling, 2009 future case photochemical modeling, modeling sensitivity runs, a reasonably available control method (RACM) analysis, a reasonably available control technology (RACT) analysis, and motor vehicle emissions budgets (MVEBs). See Table ExSum-4: *Attainment Demonstration Motor Vehicle Emissions Budget for the Nine-County DFW Area* for the MVEB emissions budget. Other measures including EPA's SmartWay and Blue SkyWays Programs, energy efficiency measures, Clean School Bus Program, Texas Low Emission Diesel (TxLed) from locomotive engines, and stationary diesel and dual-fuel engine control measures are also expected to help bring the area into attainment.

Table ExSum-4: Attainment Demonstration Motor Vehicle Emissions Budget for the Nine-County DFW Area

DFW Area	Total Emissions (tpd)	
	NO_X	VOC
DFW motor vehicle emissions budget	178.65	91.33

The modeling control strategy sensitivity run (Combination 4) is based on NCTCOG's initial VMEP estimates and assumes VMEP will reduce NO_X emission by 16.3 tpd. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision. Upon final enactment of this SIP revision, which will occur after a public comment period and finalization of the strategies and modeling, the MVEB will be adjusted to reflect the final on-road emission reductions commitment from the region's transportation policy board.

SECTION V: LEGAL AUTHORITY

A. General

The TCEQ has the legal authority to implement, maintain and enforce the national ambient air quality standards.

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 and 2005. In 1989, the TCAA was codified as Chapter 382 of the Texas Health & Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is 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, and 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. This Chapter 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 Texas Commission on Environmental Quality (TCEQ).

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; 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, the rules or orders of the Commission.

Subchapters F, G, and H of the TCAA authorize the TCEQ to establish low emission vehicle requirements for mass transit authorities, local government fleets and private fleets; create a

mobile emissions reduction credit program; establish vehicle inspection and maintenance programs in certain areas of the state, consistent with the requirements of the federal Clean Air Act; establish gasoline volatility and low emission diesel standards; and fund and authorize participating counties to implement low-income vehicle repair assistance, retrofit and accelerated vehicle retirement programs.

B. Applicable Law

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

Statutes

TEXAS HEALTH & SAFETY CODE, Chapter 382	September 1, 2005
TEXAS WATER CODE	September 1, 2005

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

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, 5.232, 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)

Chapter 7: Enforcement
Subchapter A: General Provisions (§§ 7.001, 7.002, 7.0025, 7.004, 7.005 only)
Subchapter B: Corrective Action and Injunctive Relief (§ 7.032 only)
Subchapter C: Administrative Penalties
Subchapter E Criminal Offenses and Penalties: §§ 7.177, 7.179-7.181

Rules

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

Chapter 7, Memoranda of Understanding, §§ 7.110 and 7.119	May 2, 2002
Chapter 35, Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	December 10, 1998
Chapter 39, Public Notice, §§ 39.201; 39.401; 39.403(a) and (b)(8)-(10); 39.405(f)(1) and (g);39.409; 39.411 (a), (b)(1)-(6) and (8)-(10) and (c)(1)-(6) and (d); 39.413(9), (11), (12) and (14);	August 15, 2002

39.418(a) and (b)(3) and (4); 39.419(a), (b),(d) and (e); 39.420(a), (b) and (c)(3) and (4); 39.423 (a) and (b); 39.601; 39.602; 39.603; 39.604; and 39.605	
Chapter 55, Request for Contested Case Hearings; Public Comment, §§ 55.1; 55.21(a) - (d), (e)(2), (3) and (12), (f) and (g); 55.101(a), (b), (c)(6) - (8); 55.103; 55.150; 55.152(a)(1), (2) and (6) and (b); 55.154; 55.156; 55.200; 55.201(a) - (h); 55.203; 55.205; 55.206; 55.209 and 55.211	August 29, 2002
Chapter 101: General Air Quality Rules	June 23, 2005
Chapter 106: Permits by Rule, Subchapters A	June 30, 2004
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter	November 18, 2004
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	June 15, 2005
Chapter 114: Control of Air Pollution from Motor Vehicles	May 19, 2005
Chapter 115: Control of Air Pollution from Volatile Organic Compounds	May 5, 2005
Chapter 116: Permits for New Construction or Modification	June 15, 2005
Chapter 117: Control of Air Pollution from Nitrogen Compounds	May 19, 2005
Chapter 118: Control of Air Pollution Episodes	March 5, 2000
Chapter 122, § 122.122: Potential to Emit	December 11, 2002

SECTION VI. CONTROL STRATEGY

A. Introduction (No Change)

B. Ozone (Revised)

1. *Dallas-Fort Worth*) **(Revised)**
   Chapter 1: Background and Introduction
   Chapter 2: Photochemical Modeling
   Chapter 3: Corroborative Analysis
   Chapter 4: Control Strategies and Required Elements
2. *Houston-Galveston-Brazoria* (No change)
3. *Beaumont-Port Arthur* (No change**)**
4. *El Paso* (No change)
5. *Regional Strategies* (No change)
6. *Northeast Texas* (No change)
7. *Austin Area* (No change)
8. *San Antonio Area* (No change)

C. Particulate Matter (No change)

D. Carbon Monoxide (No change)

E. Lead (No change)

F. Oxides of Nitrogen (No change)

G. Sulfur Dioxide (No change)

H. Conformity with the National Ambient Air Quality Standards (No change)

I. Site Specific (No change)

J. Mobile Sources Strategies (No change)

K. Clean Air Interstate Rule (No change)

LIST OF ACRONYMS

ACT -- Alternative Control Techniques
AF -- Air-to-Fuel
APU -- Auxiliary Power Units
ARPDB -- Acid Rain Program Data Base
ATCM – Airborne Toxic Control Measure
auto-GC -- Automated Gas Chromatograph
BACT -- Best Available Control Technology
BCCA-AG -- Business Coalition for Clean Air-Appeal Group
BMP -- Best Management Practices
BPA -- Beaumont-Port Arthur
Btu/hr -- British Thermal Units per Hour
Btu/scf -- British Thermal Units per Square Cubic Feet
CAE -- Cetane Additive Enhanced Diesel Fuel
CAIR -- Clean Air Interstate Rule
CAMx -- Comprehensive Air Model with Extensions
CARB -- California Air Resources Board
CBD -- Houston's Central Business District
CFR -- Code of Federal Regulations
CMAQ -- Congestion Mitigation and Air Quality
CO -- Carbon Monoxide
CTG -- Control Technique Guidelines
DECS -- Diesel Emission Control Strategy
DERC -- Discrete Emission Reduction Credits
DFW -- Dallas-Fort Worth
DPM -- Diesel Particulate Matter
DRRP -- Diesel Risk Reduction Program
DV -- Design Value
DVc -- Current Design Value
DVf -- Future Design Value
EAC -- Early Action Compact
EDMS -- Emissions and Dispersion Modeling System
E-GRID-2007 -- Emissions and Generation Resource Integrated Database
EE/RE -- Energy Efficiency/Renewable Energy
EGAS -- Economic Growth Analysis System
EGF -- Electric Generating Facilities
EGU -- Electric Generating Units
EI -- Emissions Inventory
EPA -- United States Environmental Protection Agency
EPS3 -- Emissions Processing System, version 3
ERC -- Emission Reduction Credits
ERCOT -- Electric Reliability Council of Texas
ESAD -- Emission Specification for Attainment Demonstration
ESL -- Energy Systems Laboratory, the Texas A&M University System
F -- Fahrenheit
FAA -- Federal Aviation Administration
FCAA -- Federal Clean Air Act
FCV -- Fuel Cell Vehicle
FGR -- Flue Gas Recirculation
FHWA -- Federal Highway Administration
FR -- Federal Register
FT -- Fischer-Tropsch Diesel Fuel

GIS -- Geographic Information System
GloBEIS -- Global Biosphere Emissions and Interactions System
gpm -- Gallons per Minute
GTM -- Gross Ton Mile
HAP -- Hazardous Air Pollutant
HARC -- Houston Advanced Research Center
HDT -- Heavy-Duty Truck
HECT -- Highly-Reactive Volatile Organic Compound Emissions Cap and Trade Program
HGB -- Houston-Galveston-Brazoria
H-GAC -- Houston-Galveston Area Council
HOV -- High Occupancy Vehicle
hp -- Horsepower
HPMS -- Highway Performance Monitoring System
HRVOC -- Highly-Reactive Volatile Organic Compound
HSC -- Houston Ship Channel
IC -- Internal Combustion
ICI -- Industrial, Commercial, and Institutional
IECC -- International Energy Conservation Code
I/M -- Inspection and Maintenance
km -- Kilometer
K_Vs -- Vertical Exchange Coefficient
LAER -- Lowest Achievable Emission Rate
lb/MMBtu -- Pound per Million British Thermal Units
LDAR -- Leak Detection and Repair
LDIR -- Light Detection and Ranging
LDEQ -- Louisiana Department of Environmental Quality
LDGV -- Light-Duty Gasoline Vehicle
LDT -- Light-Duty Truck
LDV -- Light-Duty Vehicle
LED -- Low Emission Diesel
LEV -- Low Emission Vehicle
LEV II -- California's Low Emission Vehicle II Program
LIRAP -- Low Income Repair and Assistance Program
LNB -- Low Nitrogen Oxides (NO_X) Burners
LNC -- Low Nitrogen Oxides (NO_X) Combustors
LNG -- Liquefied Natural Gas
LTO -- Landing and Take-Off
MACT -- Maximum Achievable Control Technology
Mcf -- Thousand Cubic Feet
MCR -- Mid-Course Review
MDPV -- Medium-Duty Passenger Vehicle
MECT -- Mass Emissions Cap and Trade Program
MM5 -- Fifth Generation Meteorological Model
MMBtu/hr -- Million British Thermal Units per Hour
MMcf -- Million Cubic Feet
MMS -- Minerals Management Service
MOA -- Memorandum of Agreement
MON -- Miscellaneous Organic National Emission Standards for Hazardous Air Pollutants (NESHAP)
mph -- Miles per Hour
MVEB -- Motor Vehicle Emissions Budget
MW -- Megawatts
MY -- Model Year
NAAQS -- National Ambient Air Quality Standard

NEGU -- Non-Electric Generating Units
NEI -- National Emissions Inventory
NESHAP -- National Emission Standards for Hazardous Air Pollutants
ng/J -- Nanogram per Joule
NMIM -- National Mobile Inventory Model
NOAA -- National Oceanic and Atmospheric Administration
NO_X -- Nitrogen Oxides
NO_y -- Nitrogen Species
NSCR -- Non-Selective Catalytic Reduction
NTRD -- New Technology Research and Development Program
O_3 -- Ozone
OGV -- Ocean-Going Vessel
PAYD -- Pay As You Drive
PBL -- Planetary Boundary Layer
PEI -- Periodic Emissions Inventory
PERP -- Portable Engine Registration Program
PiG -- Plume-in-Grid
PM -- Particulate Matter
$PM_{2.5}$ -- Particulate Matter less than 2.5 microns
ppb -- Parts Per Billion
ppbC -- Parts Per Billion Carbon
ppbv -- Parts Per Billion by Volume
ppm -- Parts Per Million
PSCF -- Potential Source Contribution Factors
PSDB -- Point Source Database
psia -- Pounds per Square Inch Absolute
PUC -- Public Utility Commission
RACT -- Reasonably Available Control Technology
RACM -- Reasonably Available Control Measure
RFP -- Reasonable Further Progress
RMSE -- Root Mean Square Error
ROP -- Rate-of-Progress
RRF -- Relative Reduction Factor
SB -- Senate Bill
SCAQMD -- South Coast Air Quality Management District
scfm -- Square Cubic Feet per Minute
SCR -- Selective Catalytic Reduction
SEP -- Supplemental Environmental Programs
SETPMTC -- Southeast Texas Photochemical Modeling Technical Committee
SIC -- Standard Industrial Classification
SIP -- State Implementation Plan
SNCR -- Selective Non-Catalytic Reduction
SOV -- Single Occupancy Vehicle
STP -- Surface Transportation Program
SWCV -- Solid Waste Collection Vehicle
TAC -- Texas Administrative Code
TACB -- Texas Air Control Board
TCAA -- Texas Clean Air Act
TCEQ -- Texas Commission on Environmental Quality (commission)
TCM -- Transportation Control Measure
TDM -- Travel Demand Model
TERP -- Texas Emission Reduction Plan
TexAQS 2000 -- Texas Air Quality Study 2000
TexAQS II -- Texas Air Quality Study 2006

TKE -- Turbulent Kinetic Energy
TNMHC -- Total Nonmethane Hydrocarbon
TNRCC -- Texas Natural Resource Conservation Commission
tpd -- Tons Per Day
tpy -- Tons Per Year
TSE -- Truck Stop Electrification
TTI -- Texas Transportation Institute
TUC -- Texas Utility Code
TxDOT -- Texas Department of Transportation
TxLED -- Texas Low Emission Diesel
USC -- United States Code
VMEP -- Voluntary Mobile Source Emissions Reduction Program
VMT -- Vehicle Miles Traveled
VOC -- Volatile Organic Compound
VRU -- Vapor Recovery Unit
ZEB -- Zero Emission Bus
ZEV -- Zero Emissions Vehicle

DALLAS-FORT WORTH OZONE NONATTAINMENT AREA
EIGHT-HOUR ATTAINMENT DEMONSTRATION

TABLE OF CONTENTS

Executive Summary

List of Acronyms

Table of Contents

List of Appendices

List of Tables

List of Figures

Chapter 1: Background and Introduction
1.1 General
1.2 Health Effects
1.3 Public Hearing Information
1.4 Social and Economic Considerations
1.5 Fiscal and Manpower Resources

Chapter 2: Photochemical Modeling
2.1 Introduction
2.2 Episode Selection
2.3 Model Selection and Set-up
2.4 Meteorological Modeling
2.5 Emissions Inventory
2.6 1999 Base Case, Baseline and Model Performance Evaluation
2.7 Development of DFW 2009 Future Baseline and Sensitivity Tests
2.8 DFW Future Baseline Case (2009) Modeling Results
2.9 DFW Future Case (2009) With Controls Modeling Results
2.10 Bibliography and References

Chapter 3: Corroborative Analysis
3.1 Ozone Design Value Trends
3.2 NO_X and VOC Trends
3.3 NO_X and VOC Limitation Analysis
3.4 Conclusions
3.5 References

Chapter 4: Required Control Strategy Elements
4.1 Overview of Existing Control Strategies
4.2 NO_X and VOC Control Measures
4.3 Post-2009
4.4 On-Road Emissions Inventory Trends for Nine-County DFW from 1999-2012
4.5 Reasonably Available Control Technology (RACT) Analysis
4.6 Reasonably Available Control Measures (RACM) Analysis
4.7 Motor Vehicle Emissions Budget (MVEB)
4.8 Contingency Measures

Appendices

LIST OF APPENDICES

Appendix	Appendix Name
A	Emissions Inventories used in Episode Modeling
B	Emissions Inventory Development
C	Spatial Plots of the daily maximum eight-hour ozone in the DFW 4-km domain using CAMx 4.03 (left), CAMx 4.31 (center), and CAMx 4.40 beta (right) for each episode day
D	DFW Future Case (2009) Sensitivity Tests
E	1999 Base Case/Baseline Run Log
F	Transportation Control Measures for the DFW Eight-Hour SIP
G	DFW Nonattainment Area Ozone Conceptual Model
Attachment 1:	Start of the School Year's Effect on the DFW Area
Attachment 2:	MAPPER Analysis of VOC & NO_X Limitations in the DFW Area
Attachment 3:	Weekday/Weekend Analysis of Ozone in the DFW Area
Attachment 4:	Characterization of VOC Reactivity in the DFW Area
Attachment 5:	Auto-GC Analysis in the DFW Area
H	Voluntary Mobile Source Emission Reduction Programs for the DFW Eight-Hour SIP
I	Reasonably Available Control Measure (RACM) Analysis
Part I-1:	NCTCOG Control Strategy Sources
Part I-2:	NCTCOG Control Strategy Master List
Part I-3:	NCTCOG Stakeholder Presentations
Part I-4:	NCTCOG Final Control Strategy Short List
I-4a:	Letter and Control Strategy Summary Table
I-4b:	Analysis of Short List Strategies
Part I-5:	EPA Control Strategies

Part I-6: Point and Area Source NO_X RACM Analysis for the Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area

Part I-7: Point and Area Source VOC RACM Analysis for the Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area

Part I-8: NCTCOG Final Submittal of On-Road and Non-Road Emissions Benefits

LIST OF TABLES

Number	Table Name
Table 2-1	MM5 and CAMx Vertical Layer Structure
Table 2-2	1999 Baseline Model Inputs
Table 2-3	DFW 1999 Baseline Design Value Calculations
Table 2-4	DFW 2009 Baseline RRF Calculations using CAMx 4.31 and .a2 emissions
Table 2-5	2009 Design Value Calculations
Table 2-6	Control Package Emission Reductions Combination 4 (a2 Baseline)
Table 2-7	Weekday NO_x Emissions (tpd) for 2009 with DFW Combination 4 Controls
Table 2-8	Weekday VOC Emissions (tpd) for 2009 with DFW Combination 4 Controls
Table 2-9	DFW Future Case RRF Calculations with Combination 4 Controls
Table 2-10	Future Design Value Calculations with Combination 4 Controls
Table 3-1	DFW Eight-Hour Ozone Trends
Table 3-2	Relative Reduction Factors (RRFs) for New Monitors
Table 4-1	Existing Dallas-Fort Worth SIP NO_X Control Strategies
Table 4-2	Existing Voluntary Mobile Emission Reduction Programs (VMEP) in the DFW SIP
Table 4-3	DFW Modeled NO_x Reduction Estimates
Table 4-4	Summary of Control Strategies NO_x Reduction Estimates for the DFW Attainments Demonstration
Table 4-5	DFW five percent Increment of Progress reductions
Table 4-6	Total 2009 Estimated Emission Reductions by TCM Program
Table 4-7	NCTCOG Voluntary Mobile Emission Reductions
Table 4-8	Federal Mobile/Engine Standards Implementation Schedule
Table 4-9	Tuesday, August 17 On-Road Emission Trends for Nine-County DFW From 1999-2012
Table 4-10	Change in On-Road Emissions for Tuesday, August 17 in Nine-County DFW From 1999-2012
Table 4-11	DFW VOC RACT Analysis Table 1
Table 4-12	DFW VOC RACT Analysis Table 2
Table 4-13	DFW NO_X RACT Analysis
Table 4-14	2009 Attainment Demonstration Motor Vehicle Emissions Budget for the Nine-County DFW Area

LIST OF FIGURES

Number	Figure Name
Figure 2-1	Texas Ozone Season
Figure 2-2	Wind directions Associated with DFW Eight-Hour Ozone Episodes
Figure 2-3	DFW Ozone vs. Morning and Afternoon Wind Speeds
Figure 2-4	DFW Sites with High Eight-Hour Design Values
Figure 2-5	August 13-22, 1999, Daily Max Ozone and Number of Stations with Exceedances
Figure 2-6	DFW Main Modeling Fine (4-km) Grid with Ozone Monitor Sites
Figure 2-7	DFW Modeling Grids, Original Nesting and Expanded Grids
Figure 2-8	MM5 and CAMx Modeling Grids with the Expanded Domain
Figure 2-9	Boundary Conditions Used for the Expanded Domain in DFW Modeling
Figure 2-10	Daily Site-Averaged MM5 Wind Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain
Figure 2-11	Daily Site-Averaged MM5 Temperature Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain
Figure 2-12	Daily Site-Averaged MM5 Humidity Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain
Figure 2-13	Bias and Gross Error plotted in Error Space for Eight-Hour CAMx modeling runs
Figure 2-14	Base Case Model Performance Statistics for Eight-Hour Ozone in DFW
Figure 2-15a	Hourly time series for the 1999 Baseline comparing three CAMx versions
Figure 2-15b	Hourly time series for the 1999 Baseline comparing three CAMx versions
Figure 2-15c	Hourly time series for the 1999 Baseline comparing three CAMx versions
Figure 2-16	DFW 40 Ton Test Response Chart
Figure 2-17	Comparison of EPA RRF Calculation Method with Daily Calculation Method
Figure 2-18	Spatial Plots of the Daily Maximum Eight-Hour Ozone in 2009 with Combination 4 Controls, and Differences from the 2009 Baseline for Each Episode Day in the DFW 4-km Domain
Figure 2-19	Change in DFW Eight-Hour Ozone Design Values
Figure 3-1	One-Hour and Eight-Hour Ozone Design Values in the DFW Area (1991-2005)
Figure 3-2	Eight-hour Ozone in the DFW area from 1998 to 2003
Figure 3-3	DFW One-Hour Ozone Design Values and Population
Figure 3-4	DFW Eight-Hour Ozone Design Values and Population
Figure 3-5	Frisco Eight-Hour Ozone Trends
Figure 3-6	Denton Eight-Hour Ozone Trends
Figure 3-7	1999 Anthropogenic NO_x Emissions by Source Category in the DFW Area
Figure 3-8	1999 Anthropogenic VOC Emissions by Source Category in the DFW Area
Figure 3-9	NO_x Emission Inventory Trend in the DFW Area from 1990 to 2003
Figure 3-10	VOC Emission Inventory Trend in the DFW Area from 1990 to 2003
Figure 3-11	Spatial Patterns of the Extent of Reaction in the DFW Area
Figure 4-1	Weekday On-Road Emission Inventory Trends in Nine-County DFW From 1999-2012

CHAPTER 1: BACKGROUND AND INTRODUCTION

1.1 GENERAL

"The History of the Texas State Implementation Plan (SIP)," a comprehensive overview of the SIP revisions submitted to Environmental Protection Agency (EPA) by the State of Texas, is available at the following web site:
http://www.tceq.state.tx.us/implementation/air/sip/sipintro.html#History.

Eight-Hour Ozone Standard

As of June 15, 2004, the Dallas-Fort Worth (DFW) eight-hour ozone nonattainment area is classified as a moderate area under the FCAA Amendments of 1990 (42 United States Code (USC) §§7401 et. seq.). The DFW area is therefore required to attain the eight-hour ozone standard of 0.08 ppm by the end of ozone season 2009 with the official deadline of June 15, 2010, and to submit a state implementation (SIP) revision by June 15, 2007 (69 FR 23857). For the DFW area, defined as Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant counties, the TCEQ has developed an attainment demonstration in accordance with 42 USC §7410.

The one-hour ozone national ambient air quality standard (NAAQS), which preceded the eight-hour ozone standard, was revoked June 15, 2005 (69 FR 23951). Hence, this SIP revision is the first eight-hour ozone attainment demonstration submitted for the nine-county DFW eight-hour ozone nonattainment area.

On April 30, 2004, EPA published its Phase I Eight-Hour Implementation Rule. In 40 CFR §51.905(a)(ii) and subsequent guidance, EPA provided three options for areas such as DFW that do not have an approved one-hour ozone attainment plan:

A. Submit a one-hour attainment demonstration 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 provides a five percent increment of emissions reductions progress from the area's 2002 emissions baseline in addition to federal and state measures already approved by EPA, achieving those reductions by June 15, 2007; or
C. Submit an eight-hour ozone attainment demonstration by June 15, 2005.

Texas selected option B, the Five Percent 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.

DFW Five Percent IOP SIP

The Five Percent IOP SIP, adopted by the commission on April 27, 2005, contained several elements:

- 2002 Periodic Emissions Inventory (PEI) for the nine-county DFW eight-hour ozone nonattainment area;
- A five percent reduction in emissions from the 2002 emissions inventory baseline;
- Control measures that achieve the necessary NOx and VOC emission reductions;
- Motor Vehicle Emissions Budgets (MVEBs) for use in transportation conformity demonstrations.
- Current Proposed DFW Eight-Hour Ozone Attainment Demonstration SIP
- The TCEQ is proposing an attainment demonstration for the DFW area that contains photochemical modeling and weight of evidence demonstrating attainment of the eight-hour ozone standard in 2009.

In addition to the existing control strategies in the DFW area, the TCEQ is proposing the following rules as part of this SIP revision.

- DFW Cement Kilns
- DFW Electric Generating Units (EGUs)
- DFW Industrial, Commercial, and Institutional (ICI) Major Source Rule
- DFW Minor Source Rule
- East Texas Combustion

Other control measures, including North Central Texas Council of Governments (NCTCOG) Voluntary Mobile Emissions Reduction Program (VMEP), are expected to help bring the area into attainment. This proposed revision addresses other requirements identified in EPA's Implementation Rule including, Reasonably Available Control Measures (RACM), Reasonably Available Control Technologies (RACT), contingency measures, emissions inventories, and Motor Vehicle Emissions Budgets (MVEBs).

DFW One-Hour Ozone Background

An understanding of the previous DFW SIP and subsequent revisions is helpful in examining the current eight-hour ozone SIP revision. The DFW one-hour ozone nonattainment area (Collin, Dallas, Denton, and Tarrant Counties) was initially classified as moderate in accordance with the Federal Clean Air Act (FCAA) amendments of 1990. As a moderate area, DFW was required to demonstrate attainment of the one-hour ozone standard by November 15, 1996. Ambient air monitoring data for the years 1994-96, however, showed that the one-hour ozone standard was exceeded more than one day per year over the three-year period. As a result, EPA reclassified the DFW area from moderate to serious (effective March 20, 1998) for failure to attain the one-hour ozone standard by the November 1996 deadline. EPA required the State of Texas to submit a SIP revision within one year that showed attainment of the National Ambient Air Quality Standard (NAAQS) and addressed requirements for serious ozone nonattainment areas.

1.1.1 March 1999

The TCEQ submitted a SIP revision containing a Post-1996 Rate-of Progress (ROP) SIP demonstration to EPA on March 18, 1999. The photochemical modeling contained in this 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:

- Reasonably Available Control Technology (RACT) for NOx point sources;
- Nonattainment New Source Review (NSR) for NOx 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 Post-1996 ROP SIP would not have all the rules necessary to bring the DFW area into attainment by the November 1999 deadline and that a complete attainment demonstration would be submitted in the spring of 2000. EPA determined that the Post-1996 ROP SIP was incomplete.

Additional local control strategies were necessary for DFW to reach attainment. To develop further control strategy options to augment the federal and state programs in the Post-1996 ROP SIP, the DFW area established the North Texas Clean Air Steering Committee (NTCASC) made up of local elected officials, business leaders, and other community stakeholders. This committee identified specific control strategies for review by technical subcommittee members.

As the attainment deadline of November 15, 1999, for serious areas under the one-hour ozone standard passed, EPA had not made a determination regarding the DFW area's attainment status. Furthermore, technical data became available suggesting that DFW was significantly impacted by transport and regional background levels of ozone. Therefore, the commission began viewing the reductions for strategies needed for the Houston-Galveston-Brazoria (HGB) area and regional rules as a necessary and integral component in the strategy for DFW's attainment of the one-hour ozone strategy.

1.1.2 April 2000

The Post-1996 ROP SIP was not approved by EPA prior to the next commission action. On April 19, 2000, the commission adopted a SIP revision and associated rules for the DFW ozone attainment demonstration. The April 2000 Attainment Demonstration SIP contained a number of control strategies and the following elements.

- Photochemical modeling of specific control measures and future state and national rules for attainment of the one-hour ozone standard in the DFW area by the attainment deadline of November 15, 2007.
- A modeling demonstration that showed air quality in the DFW area was influenced at times by transport from the HGB nonattainment area. Under EPA's July 16, 1998, transport policy, 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 area, this extended the attainment date to November 15, 2007, the same attainment date as the HGB area.
- Identification of the VOC and NOx emissions reductions necessary to attain the one-hour ozone standard by 2007. The reductions of 141 tpd NOx from federal measures and 225 tpd NOx from state measures resulted in a total of 366 tpd NOx reductions for the attainment demonstration.
- A 2007 motor vehicle emissions budget for transportation conformity.
- A commitment to perform and submit a mid-course review by May 1, 2004.

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

1.1.3 August 2001

The next commission action was required by legislative mandate. Senate Bill 5 (SB5), passed by the 77th Texas Legislature in May 2001, required the repeal of two rules contained in the April 2000 SIP revision. The first rule restricted the use of construction and industrial equipment (non-road, heavy-duty diesel equipment rated at 50 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 by SB5 replaced these two rules allowing the NOx emissions reductions previously claimed to be achieved through TERP. The commission implemented the legislative mandate of SB5 by submitting the rule repeals as part of a SIP revision adopted in August 2001.

1.1.4 March 2003

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

- The adoption of revised Chapter 117 NOx emission limits for cement kilns.
- The estimation of NOx reductions from energy efficiency measures, using a methodology that was to be further refined before energy efficiency credit was formally requested in the SIP.

- The commitment to perform modeling with MOBILE6, the latest version of EPA's emission factor model for mobile sources.

Meanwhile, EPA's July 16, 1998, transport policy, on which the extension of the DFW area's attainment 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 EPA was not authorized to extend BPA's attainment date based on transport. EPA published a final action in the Federal Register on March 30, 2004, reclassifying BPA to serious with an attainment date of November 15, 2005, and requiring a new attainment demonstration to be submitted by April 30, 2005. Although the court decision is relevant specifically for BPA, the direct implication for DFW was that 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, EPA could not approve the April 2000 DFW Attainment Demonstration SIP.

1.1.5 Progress to Date

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 compliance with federal air quality standards. Contributions to improved air quality in the DFW 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 EPA.

The control strategies implemented so far have significantly improved air quality in the DFW area. In the past 15 years, the area's one-hour ozone design value has decreased from 140 ppb in 1990 to 125 ppb in 2005. As of October 2006, preliminary data indicate the DFW area is monitoring attainment of the one hour ozone standard with a design value of 124 ppb. The area's eight-hour ozone design value shows a similar trend, decreasing from 105 ppb in 1990 to 95 ppb in 2005.

1.2 HEALTH EFFECTS

In 1997, EPA revised the NAAQS for ozone from a one-hour to an eight-hour standard based on scientific data that indicated that the eight hour standard provides better protection of public health from longer-term exposures to moderate levels of ozone. To support the eight-hour ozone standard, EPA provided information that indicated that even low levels of ozone can significantly decrease lung capacity temporarily in some healthy adults and cause inflammation of lung tissue, aggravate asthma, and make people more susceptible to respiratory illnesses such as bronchitis and pneumonia.

Children are at a higher risk from exposure to ozone, 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-October) when ozone levels are typically higher. Adults most at risk to ozone exposure are outdoor workers, people outside exercising, and individuals with preexisting respiratory diseases.

1.3 PUBLIC HEARING INFORMATION

The commission will hold public hearings at the following times and locations:

CITY	DATE	TIME	LOCATION
Houston	January 29, 2007	2:00 P.M.	Houston-Galveston Area Council 3555 Timmons Lane, Houston, TX 77027 Conference Room A, (2nd floor)
Houston	January 29, 2007	6:00 P.M.	Houston-Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, Conference Room A, (2nd floor)
Dallas	January 31, 2007	7:00 P.M.	Dallas Public Library Auditorium 1515 Young St., Dallas, TX 75201
Arlington	February 1, 2007	2:00 P.M.	Arlington City Hall 101 W. Abram Street, Arlington, TX 76010
Midlothian	February 1, 2007	6:00 P.M.	Midlothian Conference Center 1 Community Center Circle, Midlothian, TX 76065
Longview	February 6, 2007	2:00 P.M.	Longview Public Library 222 W. Cotton Street, Longview, TX 75601
Austin	February 8, 2007	2:00 P.M.	Texas Commission on Environmental Quality 12100 Park 35 Circle, Austin, TX 78753 Building E, Room 201S

The public comment period will open on December 29, 2006, and close on February 12, 2007. Written comments will be accepted via mail, fax, or through the e-comment system. All comments should reference "the DFW AD SIP" and Project Number 2006-013-SIP-NR. Comments may be submitted to Keith Mars, MC 206, State Implementation Plan Team, Chief Engineer's Office, Texas Commission on Environmental Quality, P.O. Box 13087, Austin, Texas 78711-3087 or faxed to (512) 239-5687 or (512) 239-6188. Electronic comments may be submitted at *http://www5.tceq.state.tx.us/rules/ecomments*. Comments must be received by 5:00 p.m. on February 12, 2007.

1.4 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 proposed rule package accompanying this SIP.

1.5 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.

CHAPTER 2: PHOTOCHEMICAL MODELING

2.1 INTRODUCTION

This chapter describes modeling conducted in support of the eight-hour ozone attainment demonstration SIP revision for the DFW nine-county nonattainment area. The Clean Air Act requires that attainment demonstrations be based on photochemical grid modeling or any other analytical methods determined by the EPA to be at least as effective. EPA's recent "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the Eight-Hour Ozone NAAQS" (October 2005) recommends new procedures for determining whether a control strategy package will lead to attainment of the eight-hour national ambient air quality standard (NAAQS) for ozone.

The new guidance recommends several qualitative methods for preparing attainment demonstrations that acknowledge the limitations and uncertainties of photochemical models when used to project ozone concentrations into future years. First, the guidance recommends using model output in a relative sense and applying the model response to the observed ozone data. Second, the guidance recommends 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, the guidance recommends using supportive analyses (Weight of Evidence) to supplement and corroborate the model results and support the adequacy of a proposed strategy package.

In early 2003, as the TCEQ was preparing to move forward with the Mid-Course Review (MCR) for the DFW area, EPA announced its plans to begin implementation of the eight-hour ozone standard. On June 2, 2003, the Federal Register published EPA's proposed Implementation Rule for the Eight-Hour Ozone Standard. In the same timeframe, EPA also formalized its intentions to designate areas for the eight-hour ozone standard by April 15, 2004, meaning states would need to reassess their efforts and control strategies to address this new standard by 2007.

Recognizing that existing one-hour ozone nonattainment areas would soon be subject to the eight-hour ozone standard, and in an effort to efficiently manage the state's limited resources, the TCEQ developed an approach that addressed the commitments made under the one-hour ozone standard while moving forward on the more stringent eight-hour ozone standard. Using the same episode for both one-hour and eight-hour modeling provided the opportunity to build upon a well-developed and properly performing foundation, as well as the opportunity to update emissions inventory data, use the most current modeling tools, enhance the photochemical grid modeling, and revise control strategies, if necessary.

This attainment demonstration uses photochemical modeling in combination with trends, transport analyses and supplementary data to show that the DFW nine-county nonattainment area is on a path to attain the 0.08 ppm eight-hour ozone standard in 2009. The additional analysis in the Weight of Evidence (WoE) section also supports the attainment conclusion and this DFW SIP demonstrates attainment of the eight-hour ozone NAAQS.

Overview of Ozone Photochemical Modeling Process

Ozone is a secondary pollutant; it is not generally emitted directly into atmosphere. Ozone is created in the atmosphere by a complex chemical reaction between sunlight and several primary emissions. The chemical reaction requires ultraviolet energy from sunlight. The primary emissions fall into two groups, nitrogen oxides (known as NO_x) and volatile organic compounds (known as VOC). As a result of these multiple factors, ozone events are most common during the summer and concentrations peak during the day and fall during the night and early morning hours.

Ozone chemistry is complex, involving more than 80 chemical reactions and hundreds of chemical compounds. As a result, ozone cannot be evaluated using simple dilution and dispersion algorithms. Due to the chemical complexity and the requirement to evaluate the effectiveness of future controls, EPA guidance strongly recommends the use of photochemical computer models to address ozone issues. Computer simulations are the most effective tools to address both the chemical complexity and the future case evaluation.

Ozone Modeling

Ozone modeling involves two major phases, the base case and the future case. The purpose of the base case is to evaluate procedures and to ensure that the model is performing correctly. The purpose of the future case is to evaluate the effectiveness of controls and to demonstrate attainment.

Base Case Modeling

Base case modeling involves several steps. First, there must be an extensive analysis of historical episodes to determine what factors are associated with ozone formation in the area, followed by developing a conceptual model that describes those factors. The technical team then selects an episode to model (a recent, real-world ozone event) that is representative of those typical factors, develops a modeling protocol (plan) to evaluate the ozone in the urban area, and submits the plan to EPA for approval.

The next step is to generate and quality assure the emissions and meteorological data for the episode. Then the meteorological data and emissions information for NO_x and VOC are added into the computer model and the ozone model output is evaluated. The final step is to validate the base case modeling results by comparing them to the real measurements for ozone and precursor compounds to be sure that the model is performing correctly. The model output is assessed based on subjective analysis and statistical tests described in the modeling guidance provided by the EPA. Satisfactory performance of the base case model demonstrates that the model is giving right answers for the right reasons; then the model can be used for future case modeling.

Future Case Modeling

The Future case modeling is designed to evaluate how much ozone will be created in the future. The scientific question is: If the same meteorology were to occur in the future, how much ozone would be formed? To answer this question, a future case emissions inventory must be developed that includes the impact of economic growth in the region as well as all of the state and federal emission reductions that will be in effect in the future.

Initially, the future base case is run with the emissions projected into the future while applying only the existing emissions reduction strategies to determine how well the model responds to existing controls, including state and federal mandated measures. The Relative Response Factor (RRF) is multiplied by the baseline ozone measured during the representative base period. If the product of the RRF and baseline ozone is less than 0.08 ppm, the attainment demonstration is satisfied. If the existing emission reduction strategies are not sufficient to offset the growth and reduce ozone to attainment levels, then additional controls may be needed. The second phase of the future case modeling is to test new, additional strategies to determine what combination of reductions would be most effective to bring the area into attainment.

2.2 EPISODE SELECTION

EPA guidance for episode selection has evolved over the last several years as the focus has shifted from the one-hour ozone standard to the eight-hour ozone standard. As explained in Section 2.1. The current episode was selected to address both the one-hour and eight-hour standards. The August 13-22, 1999, episode was selected because it included both one-hour and eight-hour ozone exceedance events and was consistent with the conceptual model for ozone

formation in the DFW area. Several different candidate episodes were considered, and the final selection was based on evaluation of the meteorology associated with the events, as well as the availability of real time emissions and precursor measurements.

Much of the early development work for this eight-hour episode was done in support of a planned one-hour MCR before EPA issued the draft eight-hour guidance. The one-hour MCR modeling provided a strong foundation for the eight-hour modeling, and since that time, the August 13-22, 1999, eight-hour episode has been further developed and improved. The development process evolved over time, and improvements were added in a continuous cycle involving the incorporation of technical insight, best practices, model upgrades, and performance evaluation.

The August 13-22, 1999, DFW ozone episode is 10 days long and includes 9 days with eight-hour exceedances. The episode also includes a full synoptic cycle with a sequential pattern of different daily wind directions reflecting wind directions associated with DFW ozone events. The episode also includes a full ozone cycle, low ozone concentrations at the beginning and end with a period of high ozone concentrations in the middle, reflecting near calm winds. Weekdays and weekends were both included to properly reflect the occurrence of eight-hour ozone events in the DFW area.

Since the episode was selected before the eight-hour guidance was finalized, some of the early one-hour selection criteria no longer appear in the most recent EPA guidance. However, since a large body of work has been developed with the current DFW episode, and significant performance improvements have been achieved, the August 1999 episode is being used in this eight-hour demonstration. The following discussion will address how the August 1999 episode meets the most recent EPA selection criteria (EPA-454/R-05-002, 2005).

EPA Guidance for Episode Selection

Since 1999, EPA has recommended selecting ozone episodes that represent the most typical and frequent ozone events based upon analysis of the meteorological and geographical patterns associated with high ozone concentrations in the area. EPA also recommends selecting extended episodes that encompass full synoptic cycles from ramp-up to a high ozone period and a ramp-down to allow for a more complete evaluation of model performance through the full cycle. EPA recommends (EPA, 1999) that at least four criteria should be used to select episodes that are appropriate to model:

- Choose a mix of episodes reflecting a variety of meteorological conditions that frequently correspond with observed eight-hour daily maxima greater than 84 ppb at multiple monitoring sites.
- Model periods in which observed eight-hour daily maximum concentrations are close to the average fourth high eight-hour daily maximum ozone concentrations.
- Model periods for which extensive air quality data and meteorological databases exist.
- Model a sufficient number of days so that the modeled attainment test applied at each monitor violating the NAAQS is based on multiple days.

DFW Ozone Episode Selection Process

An episode selection analysis was performed to identify time periods with representative high one-hour and eight-hour ozone levels suitable for developing regional scale modeling (Environ, 2002 and Environ 2003b). Episode selection was based upon the considerations developed in those studies.

The TCEQ agrees that ozone episodes selected for modeling should represent the most frequent, typical, and representative patterns associated with high ozone in the DFW area. Detailed analysis of individual ozone events for the conceptual model has shown that although DFW ozone is associated with winds blowing from the northeast through the east, southeast, and south,

the common factor in all of these events is light wind speeds. Light winds are typically less than seven mph.

The TCEQ evaluated the following factors as part of the episode selection process and determined that the best candidate was the period of August 13-22, 1999.

- The best time period from which to select additional episodes to model is during August-September when ozone episodes occur most frequently in Texas and when the highest design values are established at most of the area's monitors. The August 13-22, 1999, episode occurs during the core of the Texas ozone season, as shown by Figure 2-1: *Texas Ozone Season*.

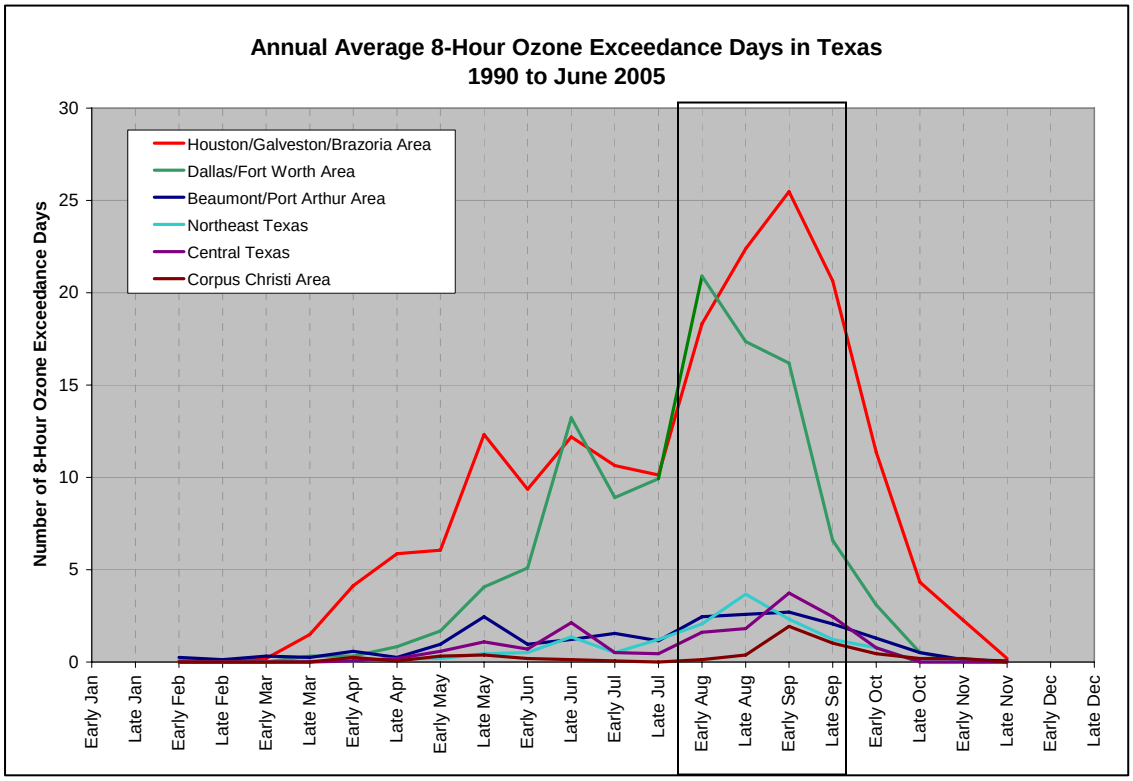


Figure 2-1: Texas Ozone Season

- Recent episodes are preferable to older episodes because recent episodes better represent the current emissions inventory, including mobile and point source configurations. At the time of the decision, the August 13-22, 1999, episode was the most recent and representative episode.
- Well-monitored episodes (with more meteorology, VOC, and NO_x data) are preferable to data-poor episodes. Additional data allow for a more thorough model evaluation and provide the information necessary to understand the processes leading to high ozone. During 1999, there were nine active ozone monitors, six NO_x monitors, and one VOC monitoring gas chromatograph system.
- Episodes should include a variety of wind directions and speeds associated with high ozone concentrations. The August 13-22, 1999, episode included a variety of wind directions associated with a complete synoptic cycle, as shown by Figure 2-2: *Wind directions associated with DFW Eight-Hour Ozone Episodes.* The August 13-22, 1999, episode also included a variety of morning and afternoon wind speeds including near calm conditions, as shown by Figure 2-3: *DFW Ozone vs. Morning and Afternoon Wind Speeds.*

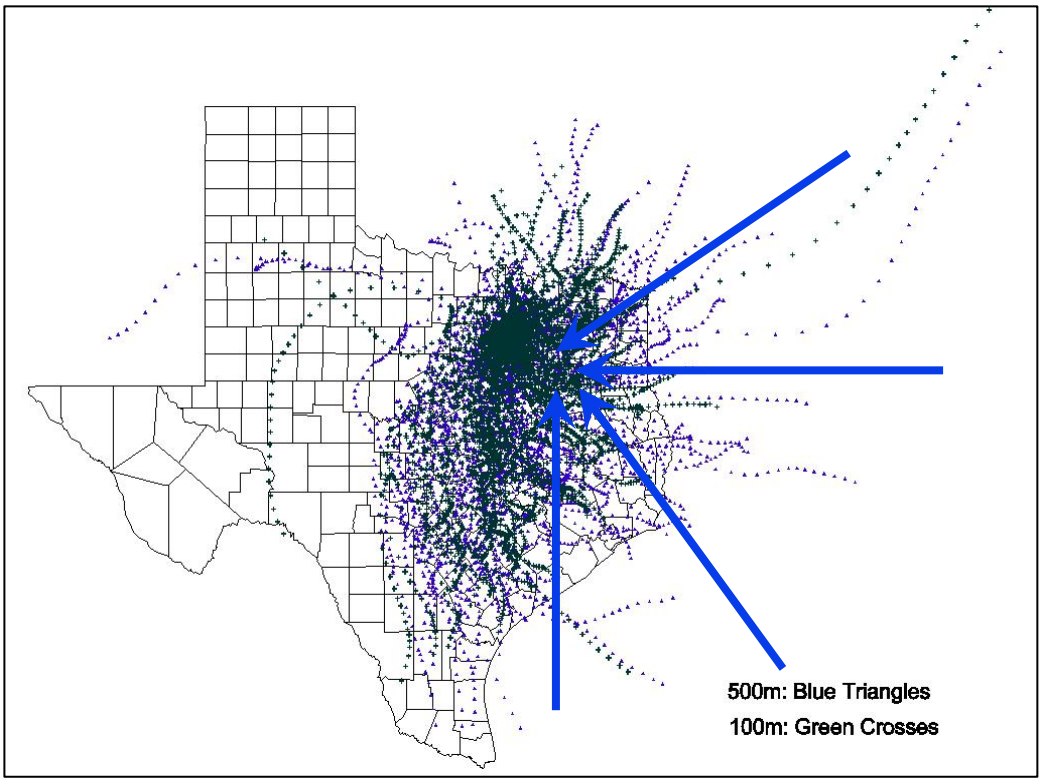


Figure 2-2: Wind Directions Associated with DFW Eight-Hour Ozone Episodes

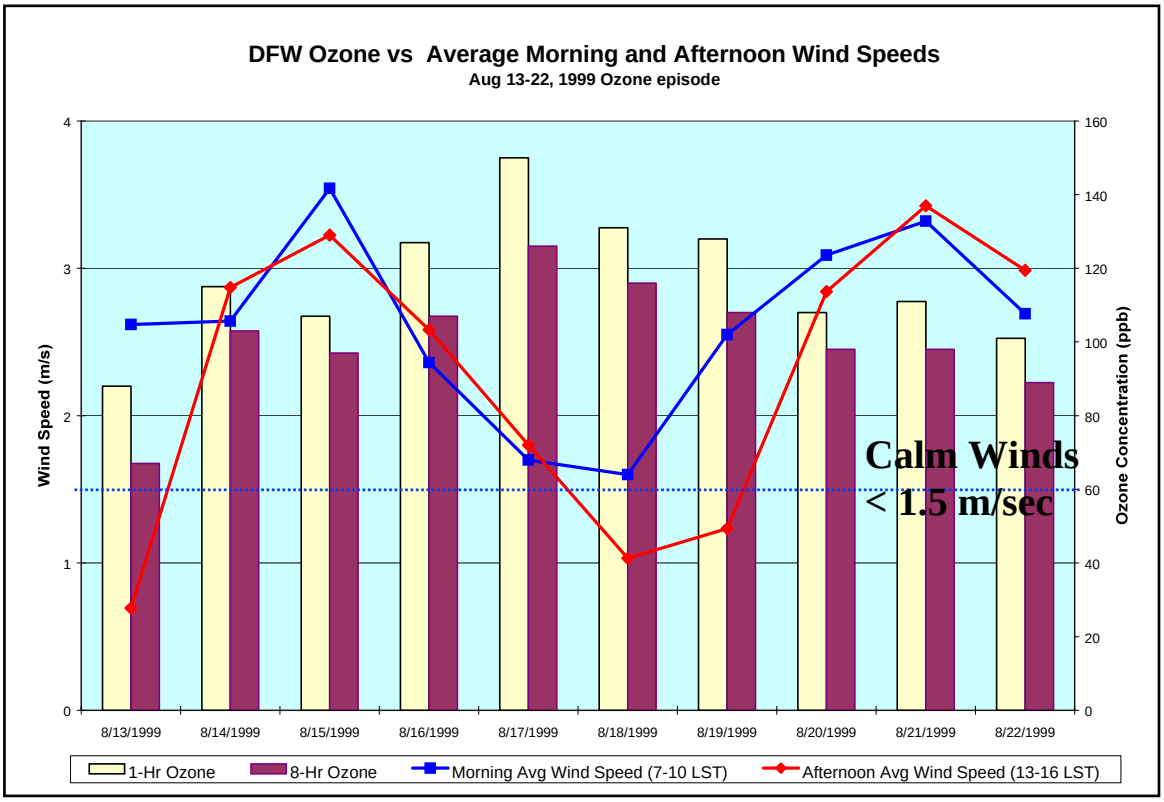


Figure 2-3: DFW Ozone vs. Morning and Afternoon Wind Speeds

- Episodes should include days that have high ozone concentrations in the geographical locations where high values typically occur. The Frisco, Denton, and Keller monitors experienced multiple exceedances during the period and are on the north and west side of the DFW area, the areas that most frequently experience high ozone, as shown in Figure 2-4: *DFW Sites with High Eight-Hour Design Values*.

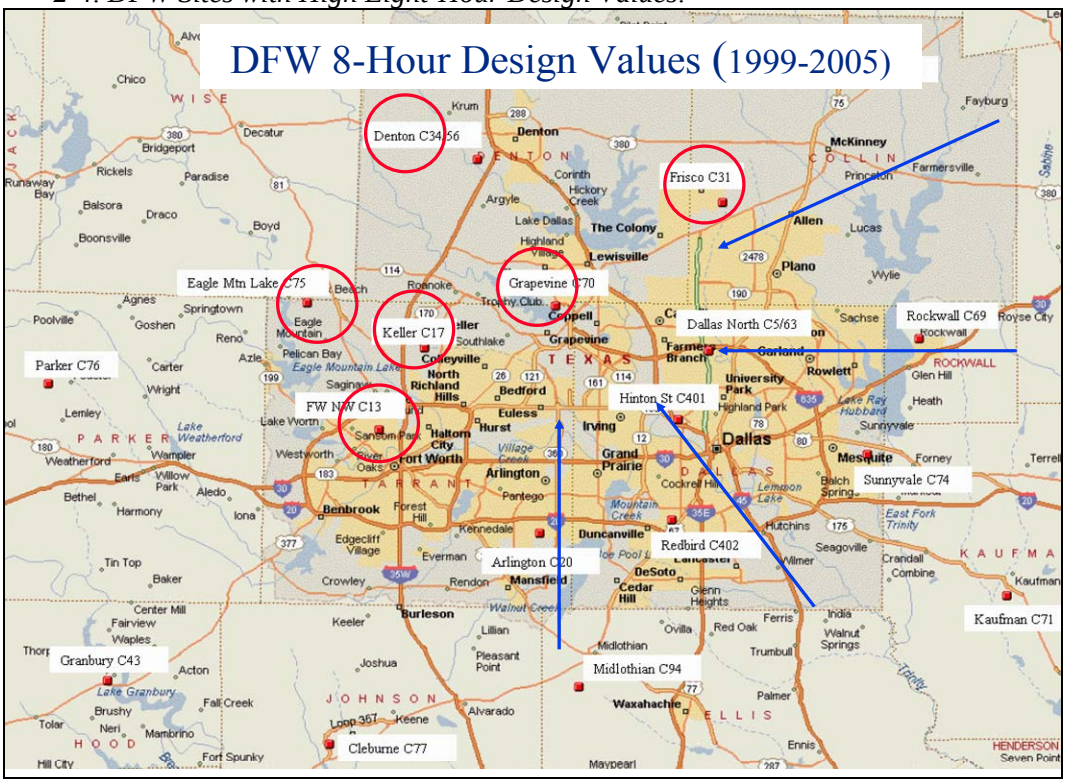


Figure 2-4: DFW Sites with High Eight-Hour Design Values

- Episodes should include days with monitored ozone concentrations within 10 ppb of the design value to represent the magnitude of ozone that must be controlled. There were 36 eight-hour exceedances recorded during the August 13-22 period, and 22 of those measurements were within 10 ppb of the site specific design value.

- The August 13-22, 1999 period starts on a low ozone day, includes nine consecutive days with eight-hour ozone exceedances, and ozone concentrations decline at the end of the period.

- The highest monitored ozone occur on the days with lighter winds in the middle of the episode and at the Frisco and Denton Monitors, which have the highest design values for the period, as illustrated by Figure 2-5: *August 13-22, 1999, Daily Max Ozone and Number of Stations with Exceedances.*

DFW 8-Hour Ozone Episode

August 13 - August 22, 1999

Day	Date	Max O3	Site Name	# Sites	Remarks
F	Aug 13	67	Frisco	0	SW Winds, Ramp Day
Sa	Aug 14	103	Arlington	4	NE Winds
Sun	Aug 15	97	Keller	6	East Winds
M	Aug 16	107	Keller	6	East Winds
T	Aug 17	**126**	Frisco, Denton	7	Light SE Winds
W	Aug 18	116	Frisco	4	Light South Winds
Th	Aug 19	108	Midlothian	2	Weak Front, N Winds
Fri	Aug 20	98	Midlothian	1	NE Winds
Sa	Aug 21	98	Arlington	5	East Winds
Sun	Aug 22	89	Denton	2	SE Winds
Mon	Aug 23	59	Denton	0	S Winds, Low Ozone

TCEQ/Breitenbach January 26, 2006

Figure 2-5: August 13-22, 1999, Daily Max Ozone and Number of Stations with Exceedances

As a result of these considerations, the August 13-22, 1999, ozone episode was selected for one-hour ozone modeling for the DFW area. Additional review of the event confirmed that the August 13-22, 1999, episode was also typical of eight-hour ozone episodes. On February 1, 2005, TCEQ staff met with EPA Office of Air Quality Planning and Standards (OAQPS) and Region 6 staff and jointly agreed that the August 13-22, 1999, episode provided an acceptable platform for eight-hour SIP development.

Since that time, the TCEQ has revisited the conceptual model (Dallas/Fort Worth Nonattainment area Ozone Conceptual Model, TCEQ, November 2005) and confirmed that the meteorological and geographical patterns that occurred in the 1999 episode are still occurring. Therefore, the August 13-22, 1999, episode is still valid and represents both typical and current ozone events in the DFW area.

Finally, the TCEQ also performed preliminary modeling of additional ozone episodes to see if the additional data would assist in the attainment demonstration. Coarse grid (12 km) modeling using data from the Oklahoma extension period (August 23-September 1, 1999) indicated that the model performance during the extended period was not as reliable as the existing DFW core episode and that the extra days would not change the model response in the DFW area. Similarly, analysis of DFW 12 km results during the Houston 2000 episode indicated that the Houston modeling did not perform as well as the DFW core episode. In both cases, the extra time and effort to bring the modeling up to performance standards would commit staff resources and delay the schedule without significant benefit. Therefore, a decision was made to focus only on the DFW core episode.

The details of the evolution and gradual improvement in the performance of this episode may be reviewed by referring to the supplementary documents in the appendices and the bibliography.

2.3 MODEL SELECTION AND SETUP

This section discusses the most recent formulation of the model, including selection of the air quality model, the modeling domain, and the initial and boundary conditions. As the result of some exploratory work done by Environ (Tai, 2005a) several upgrades were incorporated into the modeling, including an expanded modeling domain, more vertical layers, better low level mixing, and enhanced boundary conditions. These changes improved model performance and were incorporated into the DFW modeling.

2.3.1 Selection of Air Quality Model

The air quality model selected must be scientifically appropriate for the intended application and be freely accessible to all stakeholders. The following three simple prerequisites were set for selecting the photochemical grid model to be used for SIP-related modeling. The model must:

- have a reasonably current, peer-reviewed, scientific formulation;
- be available at no or low cost to stakeholders; and
- not require the reformatting of available model inputs from earlier rounds of the study

The only model to meet all three of these criteria is the Comprehensive Air Model with Extensions (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 plume-in-grid sub-model that helps avoid the artificial diffusion that occurs when point source emissions are inserted into a grid volume. The model software and the CAMx user's guide are publicly available at http://www.camx.com.

Version 4.03 of CAMx was used for all of the base case diagnostics and performance analysis and for the future case modeling for the majority of the sensitivity tests in order to maintain continuity and consistency with previous results. However, in June 2006, a new version of CAMx was adopted to incorporate the latest upgrades and to be consistent with the Houston modeling. The new version (CAMx version 4.31) improves the plume dispersion algorithms and adds full NO_x and VOC chemistry in the plumes. CAMx 4.31 was tested in the base case and demonstrated improved performance, especially on August 17, the day with the highest monitored ozone concentrations. As a result of the improved base case performance in the DFW episode, CAMx 4.31 was adopted for the DFW future case modeling.

Similarly, the modeling emissions inventory underwent refinement over the course of the current modeling analysis. The original emissions inventory, designated ".a0", was used for early modeling. The .a0 inventory was subsequently upgraded to the ".a1" inventory, which incorporated 2005 acid rain data for point source emissions. This .a1 inventory was then used for the future case sensitivity tests to maintain consistency and comparability. In June 2006, the final version of the emissions inventory, designated ".a2", was developed. This version of the inventory incorporated adjustments to the future case point source emissions for the Houston area cap and trade program and was used for all subsequent work.

2.3.2 Modeling Domain and Horizontal Grid Cell Size

Early photochemical modeling for the DFW episode used the original DFW 36-km domain extending as far north as southern Nebraska and as far east as Georgia and the Florida Panhandle. The TCEQ expanded the modeling domain further east and north to reduce the influence of boundary conditions on ozone concentrations in the DFW core. The new domain expands the eastern boundary out to the Atlantic Ocean to include all of the eastern states and extends the northern boundary into North Dakota and part of Canada. The southern and western boundaries were unchanged.

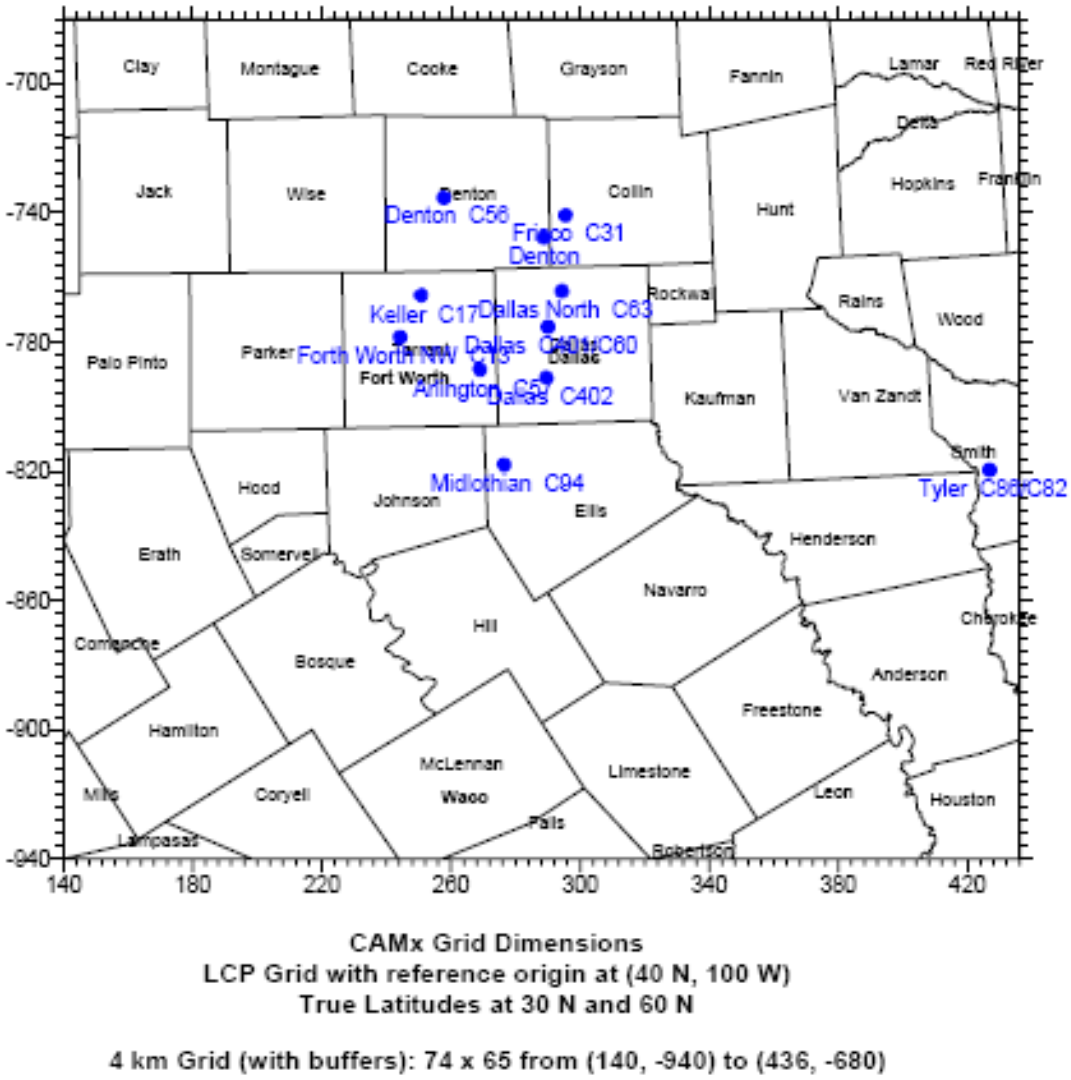


Figure 2-6: DFW Main Modeling Fine (4-km) Grid with Ozone Monitor Sites

Figure 2-6: *DFW Main Modeling Fine (4-km) Grid with Ozone Monitor Sites*, shows the DFW fine (4 x 4 km) grid used in all phases of the eight-hour modeling of the August 1999 ozone episode. The grid shows the four core counties (Denton, Collin, Dallas, and Tarrant) as well as the surrounding five counties (Rockwall, Kaufman, Ellis, Johnson, and Parker) that were added as part of the eight-hour ozone standard nonattainment designation. The figure also shows the locations of the nine ozone monitors used in this modeling exercise.

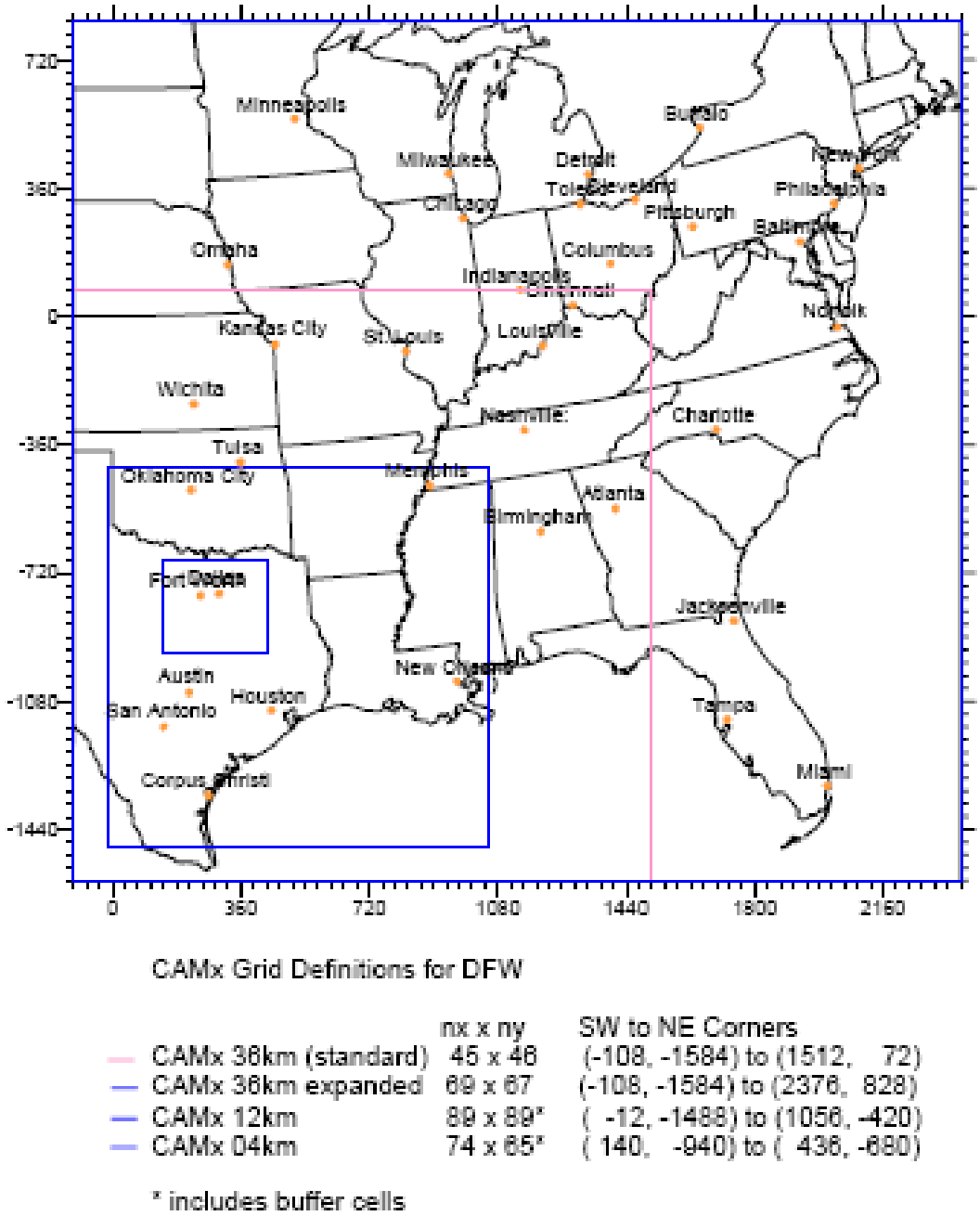


Figure 2-7: DFW Modeling Grids, Original Nesting and Expanded Grids (From Tai 2005a, Figure 4-1)

Figure 2-7: *DFW Modeling Grids, Original Nesting and Expanded Grids,* shows the original grid configuration as well as the extended domain used for the more recent modeling. The pink line shows the original smaller domain, and the blue lines show the current configuration. The expanded CAMx modeling domain consists of three nested grids depicted in blue. The finest grid (4 km × 4 km) encompasses the nine DFW nonattainment counties and is nested within a 12 km × 12 km grid covering the eastern part of Texas and extending into Louisiana and Mississippi. The outer 36 km × 36 km grid extends out to the Atlantic Ocean. The dimensions of the largest grid were selected based upon back trajectory analyses, which indicated that the expanded domain was large enough to minimize the impact of the contributions from the boundary conditions upon the 4-km inner grid while preserving reasonable model run times.

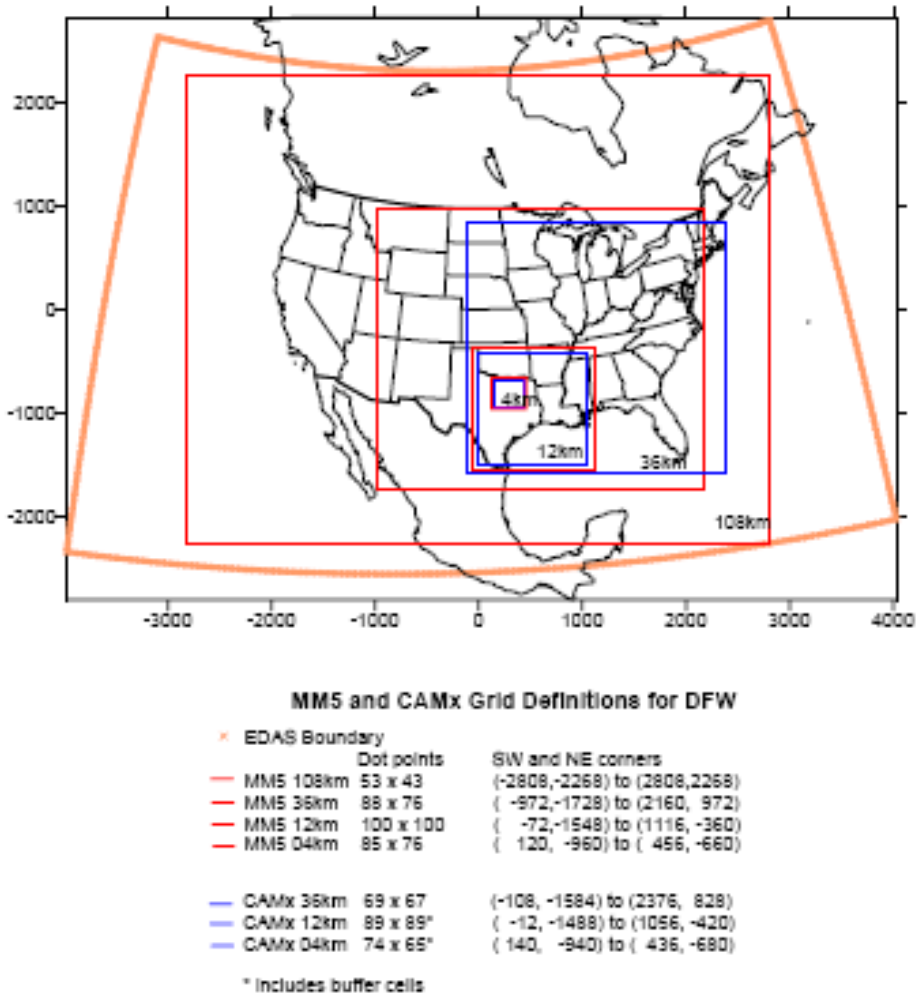


Figure 2-8: MM5 and CAMx Modeling Grids with the Expanded Domain (From Tai 2005a, Figure 4-2)

Figure 2-8: *MM5 and CAMx Modeling Grids with the ExpandedDomain* shows both the MM5 meteorological grid and the CAMx grids together. The meteorological grid is generally three cells larger than the CAMx grid, so that the interpolated meteorological conditions at the edge of each MM5 grid, which may not be balanced, are not used in the CAMx chemistry model.

2.3.3 Vertical Layer Structure

Determining the number of vertical layers chosen for the modeling domain is a balance between including enough detail to accurately characterize the vertical layering of the atmosphere and managing the amount of computer time required to run the model. In the past, the first 15 vertical layers from MM5 and CAMx coincided, peaking at an altitude just below 4 km. Later work extended the model top to over 15 km by adding five additional layers, each spaced roughly 2 to 3 km apart.

The vertical layering structure from MM5 and CAMx is listed in Table 2-1: *MM5 and CAMx Vertical Layer Structure*. The layers are thinner near the surface and thicker at higher levels. The high level of vertical resolution in the lower layers helps the model to properly characterize the pollutant concentrations and the vertical gradients as the mixing depth changes throughout the day.

Table 2-1: MM5 and CAMx Vertical Layer Structure
(From Tai, 2005a. Table 4-1)

MM5 Layers	sigma	pressure	height	thickness	CAMx Layers	IC/BC
=====	=====	======	======	=======	=========	======
28	0.0000	50.00	18874.41	1706.76		
27	0.0250	73.75	17167.65	1362.47		
---------					----------	
---------			Extended	CAMx Top	----------	
26	0.0500	97.50	**15805.17**	2133.42	--20---	^
25	0.1000	145.00	**13671.75**	1664.35	--19---	|
24	0.1500	192.50	12007.40	1376.75		|
23	0.2000	240.00	**10630.65**	1180.35	--18---	|
22	0.2500	287.50	9450.30	1036.79		|
21	0.3000	335.00	**8413.52**	926.8	--17---	|
20	0.3500	382.50	7486.72	839.57		|
19	0.4000	430.00	6647.15	768.53		Clean IC
18	0.4500	477.50	**5878.62**	709.45	--16---	|
17	0.5000	525.00	5169.17	659.47		|
16	0.5500	572.50	4509.70	616.58		|
----------			Original	CAMx Top	----------	|
15	0.6000	620.00	**3893.12**	579.34	--15---	|
14	0.6500	667.50	**3313.78**	546.67	--14---	|
13	0.7000	715.00	**2767.11**	517.77	--13---	|
						ˇ
12	0.7500	762.50	**2249.35**	491.99	--12---	
11	0.8000	810.00	**1757.36**	376.81	--11---	----------
10	0.8400	848.00	**1380.55**	273.6	--10---	^
9	0.8700	876.50	**1106.95**	266.37	---9---	|
8	0.9000	905.00	**840.58**	259.54	---8---	|
7	0.9300	933.50	**581.04**	169.41	---7---	|
6	0.9500	952.50	**411.63**	166.65	---6---	|
5	0.9700	971.50	**244.98**	82.31	---5---	Moderate IC
4	0.9800	981.00	**162.67**	65.38	---4---	|
3	0.9880	988.60	**97.29**	56.87	---3---	|
2	0.9950	995.25	**40.43**	20.23	---2---	|
						ˇ
1	0.9975	997.62	**20.19**	20.19	---1---	
0	1.0000	1000.00	**0.00**	========	Surface	========

2.3.4 Initial and Boundary Conditions

The initial and boundary conditions were developed by ENVIRON for modeling conducted in the DFW and Northeast Texas areas. EPA default concentrations were used for most species, but concentrations of several important ozone precursors, including isoprene and NO, were modified based on monitoring data collected at Kinterbish, Alabama, a rural site near the eastern border of the modeling domain. Additional details may be found in Mansell (2003), starting on page 6-22.

Boundary conditions are classified into three categories: clean, moderate, and dirty. The table in Figure 2-9: *Boundary Conditions Used for the Expanded Domain in DFW Modeling* shows the boundary concentrations associated with each category. Boundaries over the Gulf of Mexico and the Atlantic were assigned clean conditions. The western boundary, the southern boundary over Mexico, and the northern boundary over Nebraska were set to the moderate group up to 1700 m

and clean farther aloft. The dirty category was used over land areas with the smaller domain but not used in the extended domain. Initial conditions were clean everywhere.

Species	Dirty	Moderate	Clean
O3	40	40	40
CO	200	200	100
NO	0.1	0.1	0.1
NO2	1	1	1
HNO3	3	3	1
HNO2	0.001	0.001	0.001
ALD2	0.555	0.555	0.05
ETH	0.51	0.51	0.15
HCHO	2.1	2.1	0.05
OLE	0.3	0.3	0.05
PAR	14.9	14.9	7.6
TOL	0.18	0.18	0.0786
XYL	0.0975	0.0975	0.0688
ISOP	3.6	0.1	0.001
PAN	0.1	0.1	0.1
H2O2	3	3	1
MEOH	8.5	0.001	0.001
ETOH	1.1	0.001	0.001

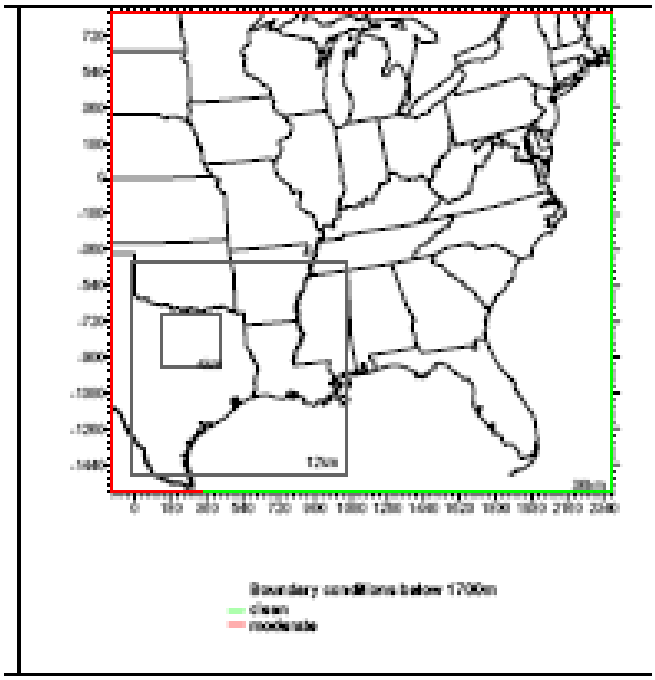


Figure 2-9: Boundary Conditions Used for the Expanded Domain in DFW Modeling

2.3.5 CAMx Model Options

CAMx has several user-selectable options that are specified for each simulation through the CAMx control file. Four model options must be decided for each project: the advection scheme, the plume-in-grid scheme, the chemical mechanism, and the chemistry solver. The selection for each option is decided during the base case model performance evaluation and then held fixed for the evaluation of any future year emission scenarios. The recommended choices for these options are discussed below. See the CAMx User's Guide (ENVIRON, 2000) for more details on these options.

Advection Scheme

CAMx version 4.02 has three optional methods for calculating horizontal advection (the movement of pollutants due to resolved horizontal winds). These are known as Smolarkiewicz, Bott, and the Piecewise Parabolic Method (PPM). The Smolarkiewicz scheme has been used for many years and used in previous modeling for Northeast Texas (ENVIRON, 1999). The Smolarkiewicz scheme has been criticized for causing too much artificial diffusion of pollutants, tending to dilute features and artificially overstate transport. The Bott and PPM schemes are newer and have less artificial diffusion than the Smolarkiewicz scheme. The PPM scheme was used for this study because it was determined to be the least numerically diffusive; it runs at speeds similar to Smolarkiewicz; and it does not exhibit certain noisy features near sharp gradients that are apparent with the Bott approach.

Plume-in-Grid

CAMx includes an optional sub-grid scale plume model which can be used to represent the dispersion and chemistry of major NO_x point source plumes close to the source. The TCEQ used the Plume-in-Grid (PiG) sub-model for major NO_x sources (i.e., point sources with episode-average NO_x emissions greater than two tons per day in the 4-km grid).

Chemical Mechanism
CAMx provides two alternatives for the chemical mechanisms used to describe the gas-phase chemistry of ozone formation: the Carbon Bond 4 (CB4) and SAPRC99 mechanisms. The most widely used mechanism for regional applications is CB4 with the updated isoprene and radical termination reactions. CB4 was used for this study.

Chemistry Solver
CAMx has two options for the numerical scheme used to solve the chemical mechanism. The first option is the Chemical Mechanism Compiler (CMC) fast solver which has been used in every prior version of CAMx. The second option is an Implicit Explicit (IEH) solver. The CMC solver is faster and more accurate than most chemistry solvers used for ozone modeling. The IEH solver is even more accurate than the CMC solver, but slower. The CMC solver was used for this study.

2.4 METEOROLOGICAL MODELING

This section discusses the results of a series of studies designed to improve the meteorological modeling in support of the DFW August 13 - 22, 1999, ozone episode. The first meteorological modeling for this episode was done in 2003 (Mansell, 2003) in support of both one-hour and eight-hour modeling requirements. That work used the following physics configuration:

- Simple-ice microphysics is employed for all domains;
- Kain-Fritsch cumulus parameterization scheme is invoked for 108-km, 36-km, and 12-km grids;
- No cumulus parameterization scheme is invoked for the 4-km domain, as convection is explicitly fully resolved at this resolution scale;
- The Rapid Radiative Transfer Model (RRTM) radiation scheme is used for all of the grids;
- Two-way interactive 108-km, 36-km, 12-km, and 4-km grids are used;
- The Pleim-Xiu Land Surface Model (LSM) with its own Planetary Boundary Layer (PBL) scheme; and
- 28 layers reaching up to 50 mb or 18,874 meters.

The early work was satisfactory but showed a general tendency to under predict ozone levels. The tendency to under predict was attributed to problems with high wind speed and wind direction errors that diluted ozone concentrations and carried the urban plume out of the DFW area. However, one CAMx sensitivity test also indicated that the CAMx model was not properly replicating the growth of the boundary layer and the afternoon maximum mixing height. Any additional meteorological modeling was recommended to evaluate vertical mixing parameterization. Another CAMx sensitivity test indicated that ozone concentrations within the DFW eight-hour ozone nonattainment area are particularly sensitive to the boundary conditions, highlighting the importance of setting the correct concentrations at the boundaries of the model. Due to these findings, the next round of modeling should evaluate the effect of a larger modeling domain to allow the CAMx model to correct the boundary concentrations as they interact with emissions over a longer path before arriving in the DFW area.

Second Round
A second round of MM5 modeling (Emery, 2004) was designed to address the generalized ozone under prediction by reducing the wind speeds and directional errors. The project focused primarily on enhancing the performance of the previous meteorological modeling with the ultimate goal of improving ozone model performance. The meteorological improvements were validated using statistical comparisons to the data measured during the episode.

Three MM5 sensitivity tests were conducted to evaluate impacts on the high wind speeds. Run 1 decreased wind speed by increasing the surface roughness. The temperature and humidity performance showed slight improvement in this simulation. Run 2 tested model performance without nudging (the model runs free without forcing to observed data or analyses), which damaged wind and temperature performance. Nudging was found to have a positive effect on the model performance. Run 3 nudged the model toward a different large-scale analysis (NCER/NCAR Reanalysis Project (NNRP), but without increased surface roughness), which suggested improvements to the temperature and humidity performance and decreased the wind speeds. Neither the Run 2 nor Run 3 sensitivity tests significantly improved MM5 model performance when analyzed with the metstat statistical package and criteria.

In Run 4, additional observed meteorological data (DFW radar profiler data, Oklahoma Mesonet data, and SODAR data) were incorporated to improve the wind performance. The fifth and final test run repeated this, except that the EDAS analyses were replaced with NNRP analyses. The increased surface roughness used in the first run was adopted in both of these last two MM5 runs. Adding profiler and Oklahoma data to the observational Four Dimensional Data Assimilation (FDDA) inputs did not have significant impact on MM5 performance, which remained quite similar to the performance observed in Run 1.

Follow-up tests with CAMx to compare the ozone generated with original meteorology and the different meteorological data fields did not significantly change CAMx model performance. Therefore, the choice of meteorological fields was reduced to determining which set of meteorology performed the best against the observed wind, temperature, and humidity data. The fifth run in this series of tests (Run 5 - with increased surface roughness, additional meteorological data, and NNRP analyses) was selected for future photochemical simulations.

Recent Upgrades

The next round of meteorological modeling was funded by the Houston Advanced Research Center (HARC) and reported in 2005 (Tai, 2005a). The goals of the HARC project were to improve ozone model performance for the August 13- 22, 1999, DFW episode and to investigate how changes in modeling inputs impact ozone formation. There were three components to this HARC project, but only the first component of the study and relevant tests are discussed in this section on meteorological modeling.

The previous rounds of modeling have suggested that extending the modeling domain into the Atlantic Ocean and the Gulf of Mexico would reduce the sensitivity to precursor concentrations at the edges of the model. Previous modeling also suggested that raising the top of the model would reduce sensitivity to the boundary conditions at the top. Therefore, these two changes were incorporated into all of the following MM5 modeling.

Figure 2-8: *MM5 and CAMx Modeling Grids with the Expanded Domain,* shows the extended domains for both the MM5 meteorological modeling and the CAMx photochemical modeling. The MM5 and CAMx boundaries are slightly different so that mass balance problems caused by interpolation at the edges of the MM5 domain are not carried into the CAMx modeling.

Table 2-1: *MM5 and CAMx Vertical Layer Structure,* shows the vertical profiles for both MM5 and CAMx, as well as the initial concentrations and boundary conditions used in the different layers of the model. The MM5 modeling has 28 layers topping out at 50 mb or 18.8 kilometers (approximately 62,000 feet). The CAMx modeling has 20 layers, topping out near 100 mb or 15.8 kilometers (approximately 52,000 feet). The layers in both models are thinner near the surface to improve model resolution but increase in thickness higher in the model. Layers 1-15 are identical in both models to avoid vertical interpolation problems.

A key component of the HARC project sensitivity tests was to develop two alternative MM5 simulations and to investigate their impacts on CAMx performance. Statistical model performance was determined for the two alternative MM5 runs similarly to that reported by ENVIRON for the original MM5 configuration (Emery, 2004). For the purposes of this chapter, the original run will be called "Run 5," and the other simulations will be labeled "Run 6" and "Run 7," respectively. Run 6 replaces the Pleim-Xiu LSM/PBL schemes with Eta + Noah schemes. Run 7 replaces the Kain-Fritsch sub-grid cumulus convection scheme with the Grell scheme.

Several years ago, ENVIRON selected the Pleim-Xiu (P-X) LSM/PBL scheme for Texas MM5 modeling due to its improved performance for winds, temperature, and PBL depth over the original configuration (i.e., the simple 5-layer soil model with Gayno-Seaman and Medium Range Forecast model (MRF) PBL schemes). Recent MM5 modeling for DFW has indicated that PBL depths remain much too high using P-X, as indicated by comparison to real data.

The Eta PBL scheme is a widely used alternative approach that is known to generally lead to lower mixing depths. An alternative soil model was necessary since Eta does not couple to the P-X LSM. The TCEQ selected the Noah LSM, which is the only other approach available that has technical capabilities on par with the P-X methodology.

Daily performance statistics for these runs are shown below in Figures 2-10: *Daily Site-Averaged MM5 Wind Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain, 2-11: Daily Site-Averaged MM5 Temperature Performance for Runs 5,6, and 7 in DFW 4-km Modeling Domain* and 2-12: *Daily Site-Averaged MM5 Humidity Performance for Runs 5,6, and 7 in DFW 4-km Modeling Domain*. As expected, results from Run 5 and Run 7 are comparable for wind, temperature, and moisture. Both runs show slight over estimation of wind speed during most of the episode days, a relatively high warm bias for the daytime temperature, and a low humidity bias.

In Run 6, however, the over prediction of wind speed is reduced, and wind speed is biased low rather than high. The picture is not as clear with wind direction except that the gross error (total error) is comparable in all three runs. In Run 6 the temperatures run high since the heat is trapped in a shallower mixed layer, but the reduced mixing also improves the underestimation of moisture in Run 5 and 7. As a result of these tests and the importance of reducing wind speeds, Run 6 with the Eta/Noah PBL was selected for use in the DFW attainment demonstration modeling.

Numerous future case (2009) sensitivity tests indicate that the high design values downwind of the DFW urban core are more responsive to NO_x reductions than to VOC reductions and that significant NO_x reductions would be needed to reach attainment at those downwind locations. The tests also show that the urban core is more sensitive to VOCs than the downwind areas but that the NO_x reductions required to bring the downwind areas into attainment would also bring the monitors in the urban core into attainment. Further, different monitors in the DFW area respond differently to reductions in the point, area/non-road, and mobile source emissions.

In order to maintain continuity and comparability, all of the sensitivity tests were run with the same inventory inputs and model configuration. Once the sensitivity tests were completed, a final upgrade to the emissions inventory was incorporated and the CAMx model was upgraded from version 4.03 to 4.31. Another series of tests were done to revalidate the model performance with the upgrades, and the baseline model performance was incrementally improved over the previous iterations of the emissions inventory and model versions. Since that time, all of the combination runs and final results have been done based upon the latest version of the emissions inventory (.a2) and version 4.31 of CAMx. As a result of this continuous improvement process, the August 13-22, 1999, base case and baseline performance now satisfy EPA benchmarks on all days.

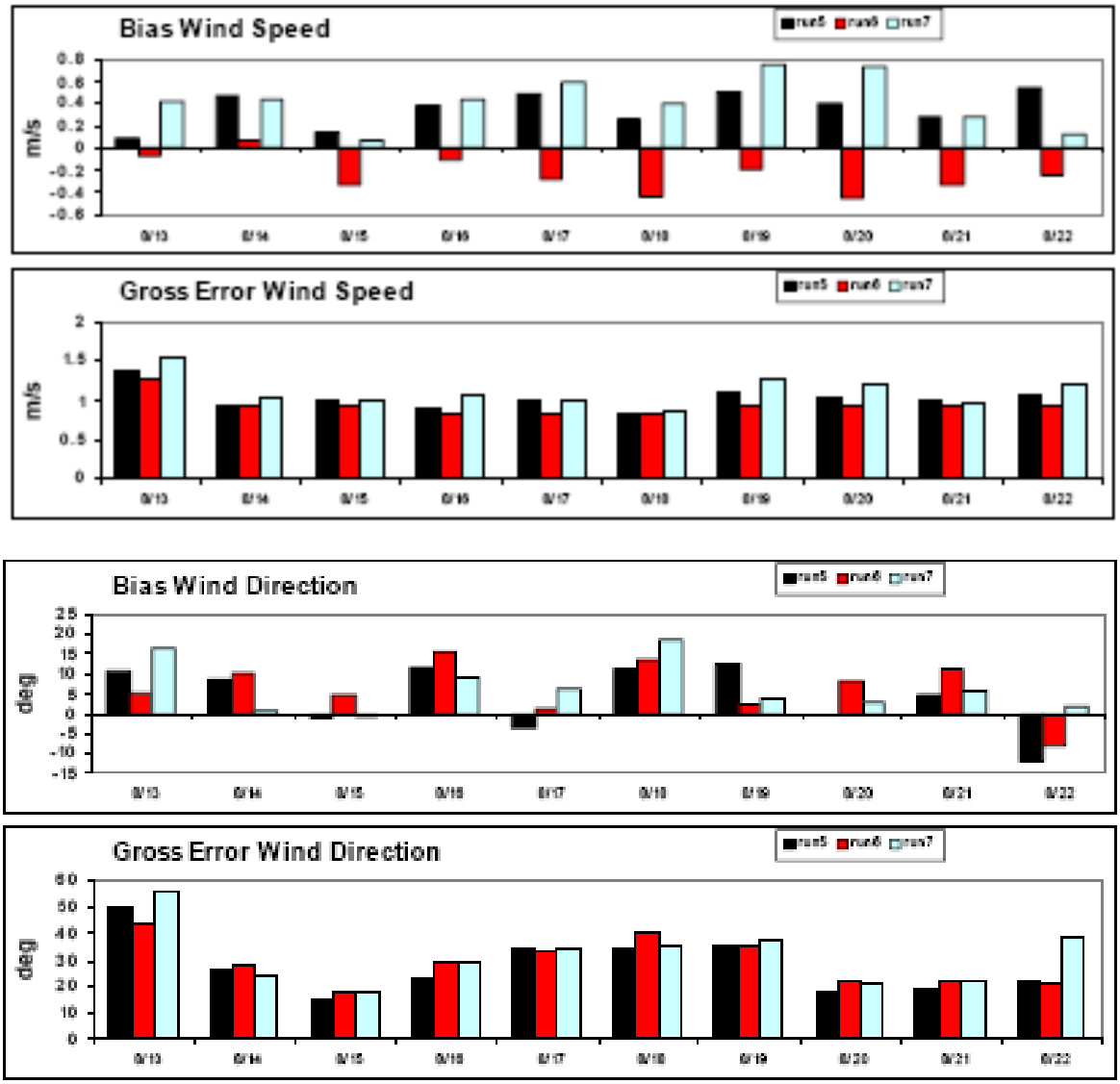


Figure 2-10: Daily Site-Averaged MM5 Wind Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain. Chart from Tai, 2005a, Figure 2-2(a).

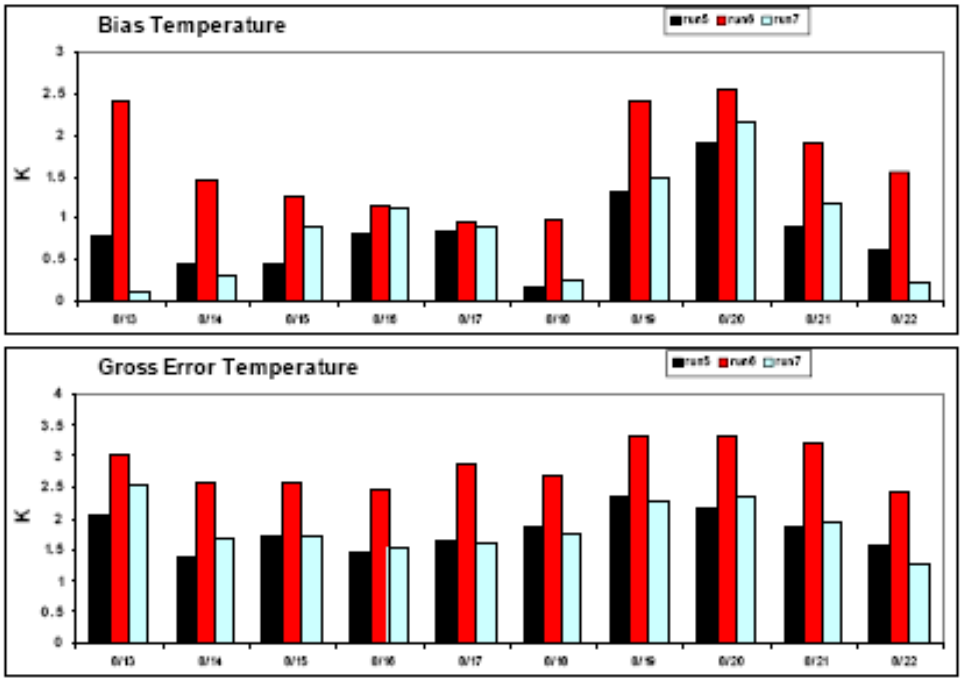


Figure 2-11: Daily Site-Averaged MM5 Temperature Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain.

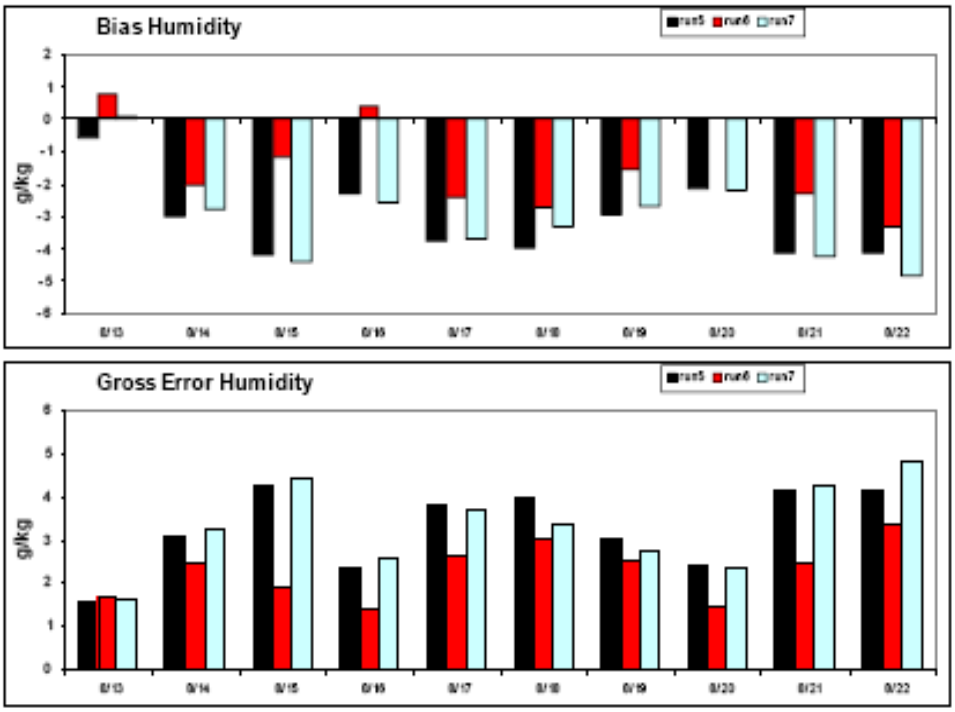


Figure 2-12: Daily Site-Averaged MM5 Humidity Performance for Runs 5, 6, and 7 in the DFW 4-km Modeling Domain.

Comparisons between the observed and modeled vertical profiles also indicate vertical mixing problems with the Pleim-Xiu PBL scheme. The Pleim-Xiu method (Runs 5 and 7) develops relatively deep and uniform mixing all over the domain, whereas the Eta-Noah (Run 6) scheme develops variable mixing heights that are both lower and more realistic. The Eta-Noah scheme

also predicted the vertical profiles for temperature and moisture, as well as the evening mixing height at the Fort Worth rawinsonde, better than the other two PBL schemes.

Ozone modeling results suggested that low level mixing problems might be the cause of low ozone production in the urban core. In particular, the modeled VOC and NO_x concentrations were higher than the measured values at the Hinton monitor, while the VOC/NO_x ratio was approximately correct. It was determined that the mixing in the lowest layers of the model was too weak, trapping the emissions in the lowest layers of the model. The "Kv100" vertical mixing adjustment was applied in post-processing, which increased the mixing in the first three layers to match the mixing at 100 meters. The "Kv100" adjustment improved ozone predictions in the urban core by producing more ozone in areas with strong NO_x emissions that had previously experienced low ozone production.

Overall, Run 6 resulted in better vertical wind speed, temperature, and humidity profiles with lower bias for most of the time periods examined. Hence, Run 6 meteorology and the "Kv100" adjustment were used in all later CAMx modeling.

2.5 EMISSIONS INVENTORY

The photochemical modeling process requires four emissions inventories:

- the *base case inventory*,
- the *baseline inventory*,
- the *future-year inventory*, and
- the *future-year control strategy inventory*.

Base Case Inventory

The purpose of the base case emissions inventory is to validate both the meteorology and the emissions development procedures. Once the emissions and meteorology are generated, they are used in CAMx to model ozone concentrations during the episode. Model performance analyses are then conducted as described in EPA modeling guidance (EPA 1999 and 2005). If the base case model performance is acceptable (correct concentrations, timing, and locations for every day of the episode), then the meteorology and emissions development procedures are considered to be sufficiently representative of the episode. Once the base case is accepted, the meteorology data are held constant through the next three phases of emission inventory development. The base case inventory for a typical episode day is summarized in Appendix A: *Emissions Inventories used in Episode Modeling*.

Baseline Inventory

EPA procedures require the development of an RRF to calculate future ozone concentrations. Future-year emissions are projected based upon the base case year's emissions. However, the base case emissions can include day-specific and hourly emissions data. In order to keep the base and future case results used in the RRF comparable, a generic baseline emissions inventory is developed using the same averaging and estimating procedures that will be used in the future case. This baseline inventory is used with the base case meteorology to calculate the ozone concentrations that would occur with a generalized emission inventory. The baseline inventory for a typical episode day is summarized Appendix A: *Emissions Inventories used in Episode Modeling*.

Future-Year Inventory

Emissions for the future-year inventory are generated by applying the projection ("growth") estimates and controls that will be in effect in the future year to the baseline inventory. This projection provides the future base inventory, as opposed to the future controlled inventory discussed next. The same averaging procedures are used in both the baseline and future-year inventory to maintain comparability between the baseline and future-year ozone. The future-year

inventory for a typical episode day is summarized in Appendix A: *Emissions Inventories used in Episode Modeling*.

Future-Year Control Strategy Inventory

A future-year control strategy inventory (the future-year inventory with proposed controls applied) is often required to determine the effectiveness of additional controls. In this situation, a future-year emissions inventory with additional emissions reductions is generated. Control estimates are incorporated into the future-year emissions inventory, and the CAMx model is run to determine the effectiveness of the control concepts. The future-year control strategy inventory for a typical episode day is summarized in Appendix A: *Emissions Inventories used in Episode* Modeling.

2.6 1999 BASE CASE, BASELINE AND MODEL PERFORMANCE EVALUATION

Overview

The purpose of the base case is to develop the best possible meteorological and emissions inputs and procedures before moving on to forecasting the future case ozone. As described in previous sections, the emissions inventory and the meteorological inputs are generated on a day- and hour-specific basis and should match the real meteorology and emissions as closely as possible. Once the emissions and meteorology are generated, they are used as input to the photochemical model and the ozone generated each day and hour during the episode period is determined. The model results are then compared to the real-world ozone measurements at each monitoring site in the area using a package of graphical evaluations and statistical benchmarks established by the EPA (EPA, 1999 and 2005). If the base case modeled ozone reproduces the measured ozone concentrations, timing, and locations within acceptable criteria specified in EPA guidance, both the meteorology and emissions development procedures are sufficiently representative to move to the future case.

In its 2005 eight-hour ozone modeling guidance, EPA indicates that air quality model performance can be evaluated with two types of tests: 1) Operational tests - How well does the model replicate observed concentrations of ozone and precursors, and 2) Diagnostic tests - How well does the model respond to changes in emissions? EPA recommends a suite of statistical tests and graphical tests for the operational evaluation that is based upon measured data. EPA also encourages the use of diagnostic tests, but since diagnostic tests are more subjective, they are more difficult to quantify. Finally, EPA acknowledges that there is no single definitive test or criterion for evaluating model performance.

Background

Work on the August 13-22, 1999, DFW ozone episode has been underway for some time, since before the EPA eight-hour ozone modeling guidance was finalized. Initially, work on this episode began in support of the one-hour ozone standard and the DFW one-hour MCR. Over time, the negative bias (indicative of low ozone production) has been addressed, and the model performance has been significantly improved. Previous work regarding the August 13-22, 1999, DFW ozone episode is listed in the bibliography (Environ, 2003; Mansell, 2003; Emery, 2004 and Environ, 2004, located on the web at: http://www.tceq.state.tx.us/implementation/air/airmod/data/dfw1.html). Because EPA has reviewed and approved this previous work as part of the DFW one-hour SIP, this previous work will not be discussed here. This section will discuss model improvements, starting with Run #20, focused on the 1999 base case and baseline performance, and a comparison of the model output data against the precursor concentrations and measured ozone.

A HARC project (Tai, 2005a) improved ozone model performance for the August 13-22, 1999, DFW SIP episode and investigated how various updated modeling assumptions impacted ozone formation. There were five components to the work:

- ten CAMx sensitivity runs were completed to investigate how changes in modeling inputs and assumptions affect ozone model performance;
- two MM5 runs were completed to support the CAMx sensitivity analysis;
- a revised 1999 base case (CAMx Run 34) was developed from the sensitivity tests;
- process analysis was used to investigate the revised 1999 base case and two related model scenarios; and
- the Anthropogenic Precursor Culpability Analysis (APCA) technique was used to investigate the effect of several modeling assumptions on ozone transport for 2010 future year scenarios.

After each group of tests, performance was assessed, and the best combination of factors incorporated into subsequent modeling. As a result of this series of sensitivity tests, eight-hour ozone model performance was further improved as demonstrated in Figure 2-13: *Bias and Gross Error plotted in Error Space for Eight-Hour CAMx Modeling Runs*. Run 23 continues to show a strong negative bias, but Run 34 is inside the box on all except ramp up days. The Run 46 cluster has only one ramp up day outside of the box and sits lower in the 'V' indicating even less total error than any of the other runs. Run 46 is the final 1999 baseline run and provides the basis for future work on the 2009 attainment demonstration.

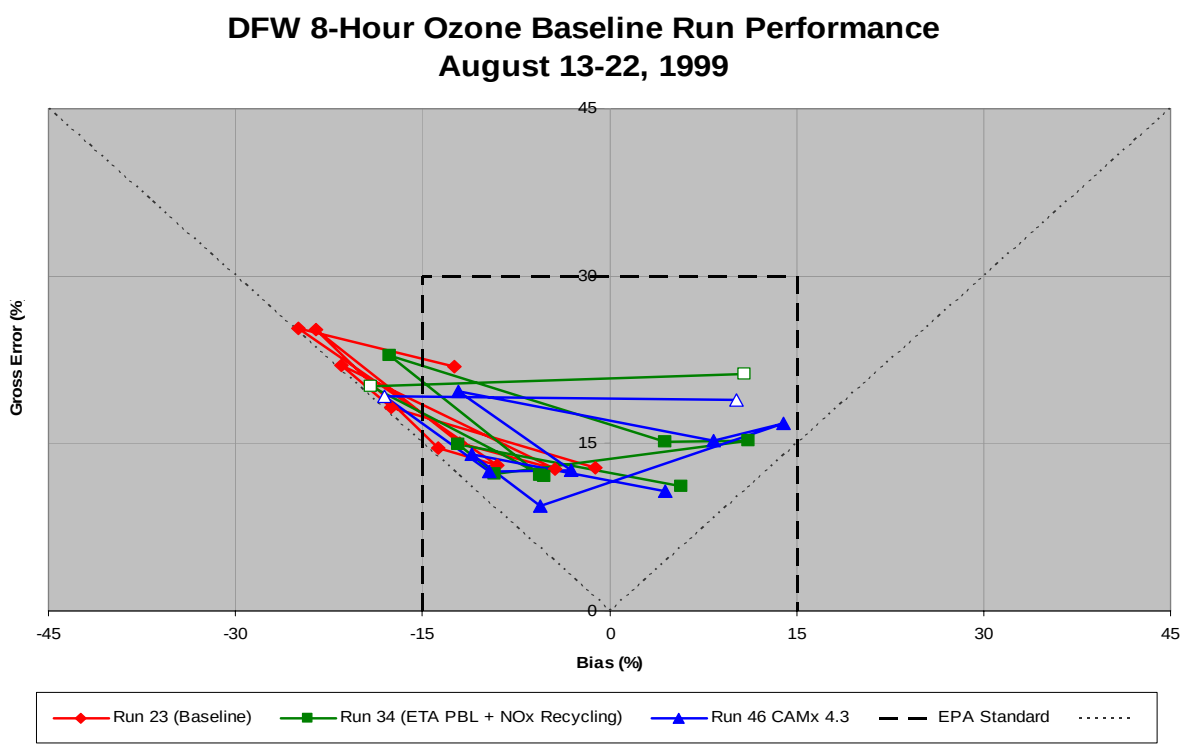


Figure 2-13: Bias and Gross Error plotted in Error Space for Eight-Hour CAMx modeling runs.

Improving Model Performance

The HARC project started from the CAMx base case that was developed for the DFW August 13-22, 1999, episode referred to as "Run 17b" (Emery et al., 2004). Ten modifications were applied separately to understand how model performance changed for both one-hour and eight-hour

ozone, and how model performance might be improved. Sensitivity tests included changes in the size and top of the modeling domain, meteorology, emissions, and chemistry. All runs used CAMx version 4.03 and started from model inputs for the August 13-22, 1999, episode described by Emery et al. (2004).

Domain Modifications
Two of the modifications examined expanding the modeling domain. One test expanded the horizontal domain eastward into the Atlantic Ocean and northward into parts of Canada, yielding slightly improved model performance. The second modification extended the model top from 4 km to 14 km and also resulted in minor improvements in ozone performance. When both assumptions were applied, model performance improved even more. These modifications were judged to be improvements because they improved model performance and reduced dependence on boundary condition (BC) assumptions. As a result, all remaining sensitivity tests used the expanded horizontal domain and the higher model top.

Alternative Meteorology
As discussed in Section 2.4, ozone sensitivity to different CAMx meteorological input data was also examined. Overall, Run 24 (including MM5 Run 6) was judged to give superior meteorological and air quality model performance, so it was selected and carried forward into subsequent work.

Emission Modifications
Sensitivity tests were also conducted to evaluate model response to changes in the emissions. Ozone model performance in the DFW 4-km domain improved when the mobile source NO_x emissions were reduced by 30 percent inside the four DFW core counties. This result may be due to intense surface NO_x emissions in the DFW core area inhibiting ozone formation immediately downwind of the core where high ozone levels are observed. The peak ozone on August 17th was increased and shifted eastward closer to the observed peak location. Increasing biogenic emissions by 30 percent domain-wide also produced higher daytime ozone but did not systematically improve model performance. Doubling VOC emissions from non-EGU point sources had little impact on ozone levels and model performance.

The results of the sensitivity test showing improved ozone model performance with lower NO_x emissions in the DFW core were not sufficient to justify changing the emission inventory. Ozone model performance in DFW also is sensitive to changes in meteorology and chemistry. However, comparing modeled precursor concentrations to monitored concentrations indicated that the vertical mixing in the lowest layers of the model was inadequate.

Chemistry Mechanisms
Two additional chemical mechanism changes were evaluated. The first test evaluated a revised version of the CB4 mechanism called CB2002. CB2002 reduced ozone levels relative to the standard CB4 mechanism, degraded model performance and was not implemented further. The second test, called CB4xi, extended the CB4 mechanism by adding 17 inorganic chemistry reactions. The most important of the extra inorganic reactions in CB4xi are several "NO_x recycling" reactions which bring some of the NO_x from terminal reactions back into the model chemistry. For short model runs, NO_x recycling is negligible. However, for extended episodes and long transport paths, some of the NO_x should be recycled. When the NO_x recycling reactions were added to CB4, ozone concentrations were increased regionally by a few ppb both in the daytime and at night.

Conclusions from the Sensitivity Tests
The sensitivity tests improved model performance and better replicated monitored values by:

- increasing NO_x in the DFW core counties;
- adding more biogenic emissions; and

- implementing the NO_x recycling reactions in CB4.

These runs generally improved the normalized bias, the gross error and average paired peak accuracy, but reduced the accuracy of the unpaired peak. However, the unpaired peak accuracy is an old one-hour test that evaluates the difference between two numbers: the maximum monitored ozone and the maximum modeled ozone. Since these two maxima are not matched in either time or space, the test only indicates whether the model is generating enough one-hour ozone somewhere in the domain. The unpaired peak test is not relevant in eight-hour ozone modeling since the focus is no longer on the one-hour worst-case modeled ozone peak, but instead on the relative reduction in the eight-hour ozone generated at each monitor. The use of the CMAQ-based vertical diffusivity profiles and the CB2002 chemical mechanism lowered ozone, which did not improve model performance. Therefore, these options were not pursued further.

Revised Base Case: Run 34

As a result of these sensitivity tests and the improvements in model performance, a revised base case was developed for the DFW August 13-22, 1999, SIP episode referred to as Run 34. Changes in Run 34 compared to the previous Run 17b base case include:

- expanded modeling domain extending to the Atlantic Ocean and Canada;
- higher model top at about 14-km;
- meteorology from MM5 "Run 6" using the Noah/Eta PBL scheme;
- enhanced near surface mixing from the "Kv100" adjustment; and
- extended inorganic chemistry (CB4xi) with "NO_x recycling" reactions.

Run 34 shows improved ozone model performance compared to Run 17b. A tendency toward ozone under-prediction (negative bias) was improved by the updated meteorology "MM5 Run 6" and the chemistry updates (NO_x recycling). The "Kv100" adjustment increased vertical mixing and improved the ozone predictions in areas with intense surface NO_x emissions in the DFW core area.

The modeling grid was expanded as the result of several sensitivity tests (Tai, 2005a) that indicated the expansion of the modeling domain eastward and northward, as well as a higher model top, produced slightly improved model performance with less dependence upon boundary condition assumptions. Using the larger domain, additional sensitivity tests were run to evaluate the ozone response to changes in the emissions, meteorology, and chemistry. These tests demonstrated that reducing excess NO_x in the four core counties, adding more biogenic emissions, and implementing the NO_x recycling reactions in CB4 consistently produced higher ozone and improved model performance, especially on the critical high ozone days.

On most days, these runs improved the normalized bias statistic and reduced the gross error statistics which measures total error in the system. The test runs also improved the average accuracy of the paired peak statistic, which reflects the average peak ozone generated at all the sites in the domain.

Supplemental Modeling Analysis

Other supplementary tests were also run to address the evolving changes in EPA draft guidance. EPA's latest draft of eight-hour ozone modeling guidance (EPA, 2005a) suggests that states should model an extended period that includes a complete synoptic cycle of ozone buildup through peak and decay. The DFW core episode period includes a complete synoptic cycle, but there also were additional high ozone days in late August 1999 after the core episode period that had been previously modeled for Oklahoma. This SIP models the "supplemental period" from August 23 – September 1, 1999, as well as the TexAQS 2000 episode to evaluate the benefit of adding more high ozone days to the calculations.

Oklahoma Extension

Modeling results for the Oklahoma supplemental period were intended to be used to corroborate the primary results obtained for the core episode (August 13-22, 1999). This study used the same Run 34 CAMx configuration found to yield the best model performance in the previous work (Tai 2005a). Oklahoma emissions (Tai, 2005b) were available for the supplemental period, but detailed Texas emissions were not. Texas emissions for the supplemental period were linked on a day-of-the-week basis to the Texas emissions in the core period. The supplemental period results are considered less reliable than the core period results because they were modeled on a coarser grid with a less detailed emissions inventory. The meteorological performance for the supplemental period was also worse than the performance during the core period with under predicted (low) wind speeds and over predicted (high) temperatures.

In the supplemental period, Run 40 under predicted daytime ozone levels on August 25th and 26th at most monitoring stations. Run 40 vastly over predicted the ozone on August 31 and September 1 at the three most northern stations – Frisco (CAMS 31) and Denton (CAMS 56 and Colony). On one day, August 25th, the supplemental modeling placed the peak ozone east of DFW, when the highest observed ozone was in Tarrant and Denton Counties. The poor ozone performance in the supplemental period is primarily related to the poor meteorological model performance discussed previously. In general, the supplementary episode was biased low and did not perform as well as the core episode. Review of the data indicated that the model results would not be as reliable as results from the core episode. Since considerable work would be required to bring the level of performance up to that of the core episode, further effort on this episode was terminated.

Texas Air Quality Study (TexAQS) 2000 Episode
TCEQ also considered using the TexAQS 2000 modeling (done for the Houston area) to generate more days for the EPA statistical test. The meteorology and the emissions were taken directly from the Houston work, but performance was evaluated in the 12 km grid in the DFW area. The TexAQS modeling performed poorly in the DFW area. The eight-hour ozone concentrations in the DFW area were biased consistently low on 14 of the 16 days during the episode, every day except the last two. A regression line through the scatter plot indicated that the ozone production was roughly one-half of the observed values, and the correlation coefficient (r2) was only 0.226. Since performance on this supplementary episode was not as good as performance during the DFW core episode and therefore would not be as reliable, further effort on this episode was also terminated.

Final 1999 Base and Baseline Cases (Run 46)
As a result of the series of previous base case sensitivity tests, base case modeling was temporarily frozen and further modeling efforts were redirected to evaluate the 2009 future case, and the model response to a series of sensitivity tests. While these sensitivity tests were being done, all the future case emissions inputs were frozen to keep the results comparable. However, also during this period, the 2009 future emissions inventory was upgraded, and a newer version of CAMx became available. Once the sensitivity test series was complete, and the emissions upgrades were finalized, the base case was reevaluated with the new version of CAMx. Based on the improvement in base case model performance, all the changes were made at once, updating to the newer version of CAMx as well as the updated inventory and several other minor changes.

The 1999 base and baseline cases with the new version of CAMx were then re-validated, so that the relative reduction factors would be based on similar assumptions. The final base line model configurations for Run 34 and Run 46 are documented in Table 2-2: *1999 Baseline Model Inputs*.

Table 2-2: 1999 Baseline Model Inputs

Model Input	Run 34 Configuration	Run 46 Configuration
CAMx Version	CAMx 4.03	CAMx 4.31
Plume in Grid Treatment	-----	Full VOC/NO_x Chemistry
Domain	Expanded Domain	No Change
Model Top	High Top (14 km)	No Change
Meteorology	MM5 Run 6 Using Noah/ETA PBL	No Change
MM5 to CAMx Extraction	-----	Updated mm5-camx version includes cloud/rain inputs
Vertical Mixing Adjustment	Kv100 post processing Increases low level mixing	Kv 100 Patch
Base Case Emissions	TCEQ Base/NEI Ver 2	NEI Ver 3 Updated Mobile + Offshore
Chemistry	CB4xi w/NO_x Recycling	No Change

The most significant changes in model configuration were the CAMx upgrade from version 4.03 to version 4.31. CAMx version 4.2 had already included an upgraded plume-in-grid module to improve plume dispersion as well as full VOC and NO_x chemistry. CAMx version 4.3 incorporated a more sophisticated second-order closure puff spread calculation that operates at sub-grid scales (Environ 2006).

Model Performance

Tests were run to compare the results of three different CAMx versions. Run 44 used CAMx 4.03; Run 46 used CAMx 4.31; and Run 50 used CAMx 4.4, a beta version. The beta version (4.40) increased the bias and gross error and was not selected. CAMX 4.31 performed better than both 4.03 and 4.40 and so was selected for future case modeling. A full package of eight-hour performance statistics, time series, and tile plots showing the spatial distribution of ozone each day are included as Figure 2-14: *Base Case Model Performance Statistics for Eight-Hour Ozone in DFW*, Figure 2-15: *Hourly time series for the 1999 Baseline comparing three versions of CAMx,* and Appendix C: *Spatial plots of the daily maximum 8-hour ozone in the DFW 4-km domain using three versions of CAMx for each episode day.*

For a list of all the base case and baseline sensitivity tests to date, please refer to Appendix E: *1999 Base Case/Baseline Run Log.*

Conclusion

As previously discussed and demonstrated in Figure 2-13: *Bias and Gross Error plotted in Error Space for Eight-Hour CAMx*, Run 46 (using CAMx 4.31) develops more ozone than the previous runs, and thus improves performance with essentially the same meteorology and base case emissions inventory. The increased ozone production over the entire domain has almost completely removed the persistent negative bias that was present in previous model runs, as well as reduced the total error in the modeling system. Since the purpose of the base case and baseline modeling is to optimize model performance and thereby to increase confidence in the future case results, Run 44 is the best foundation for future case work and control strategy testing. From this point forward, the Run 44 configuration was used for all future case modeling.

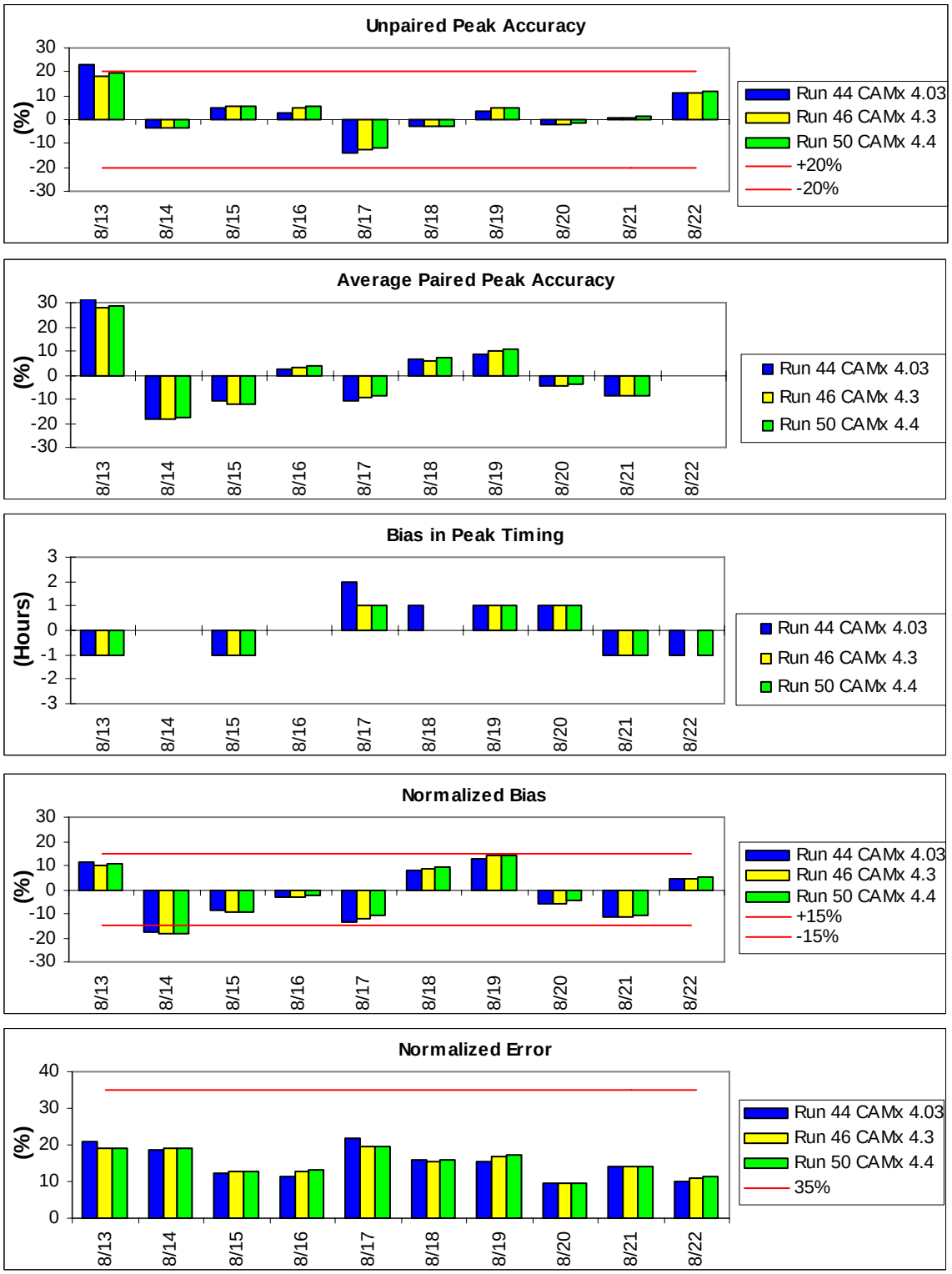


Figure 2-14: Base Case Model Performance Statistics for Eight-Hour Ozone in DFW

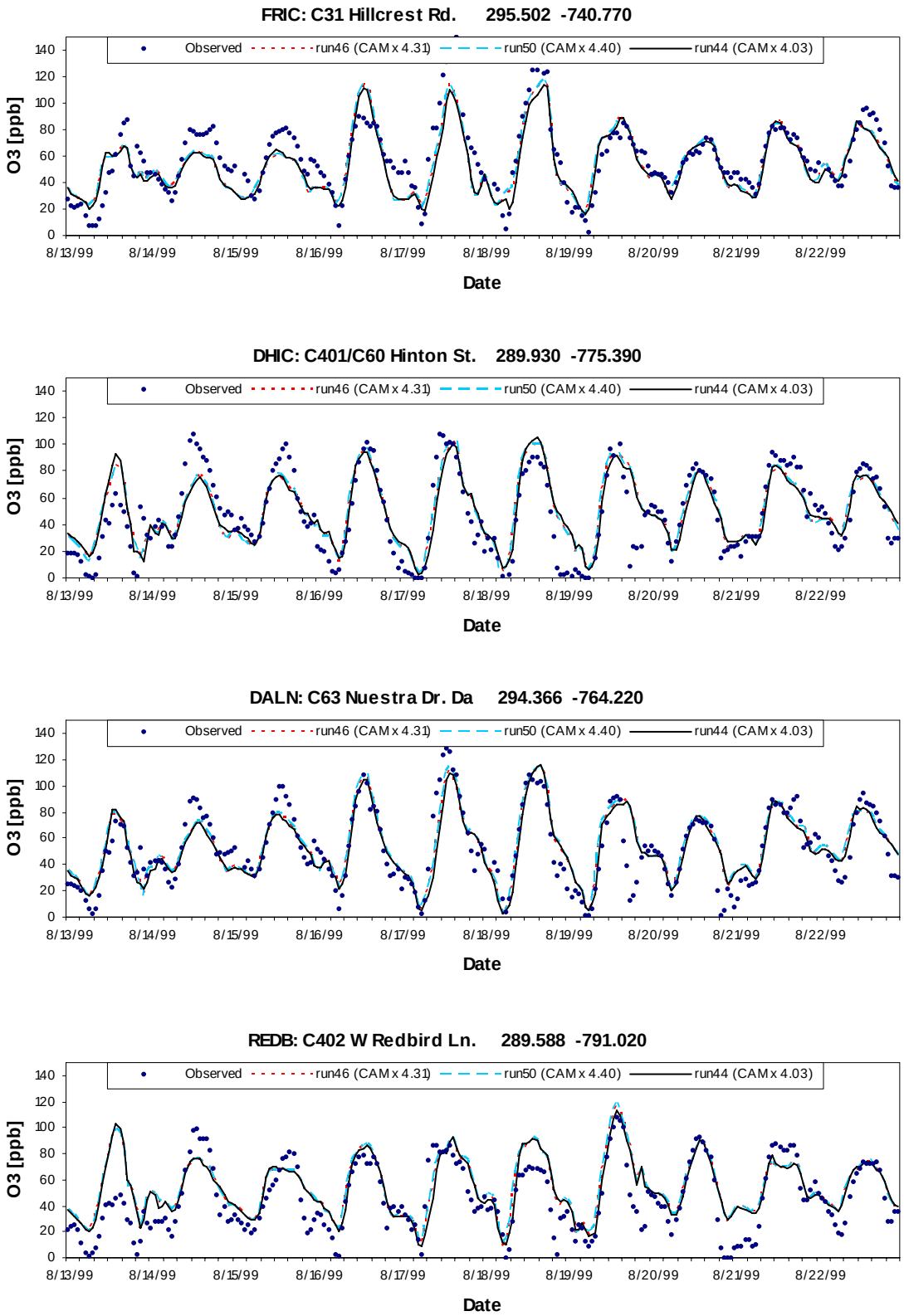


Figure 2-15a: Hourly time series for the 1999 Baseline comparing three CAMx versions

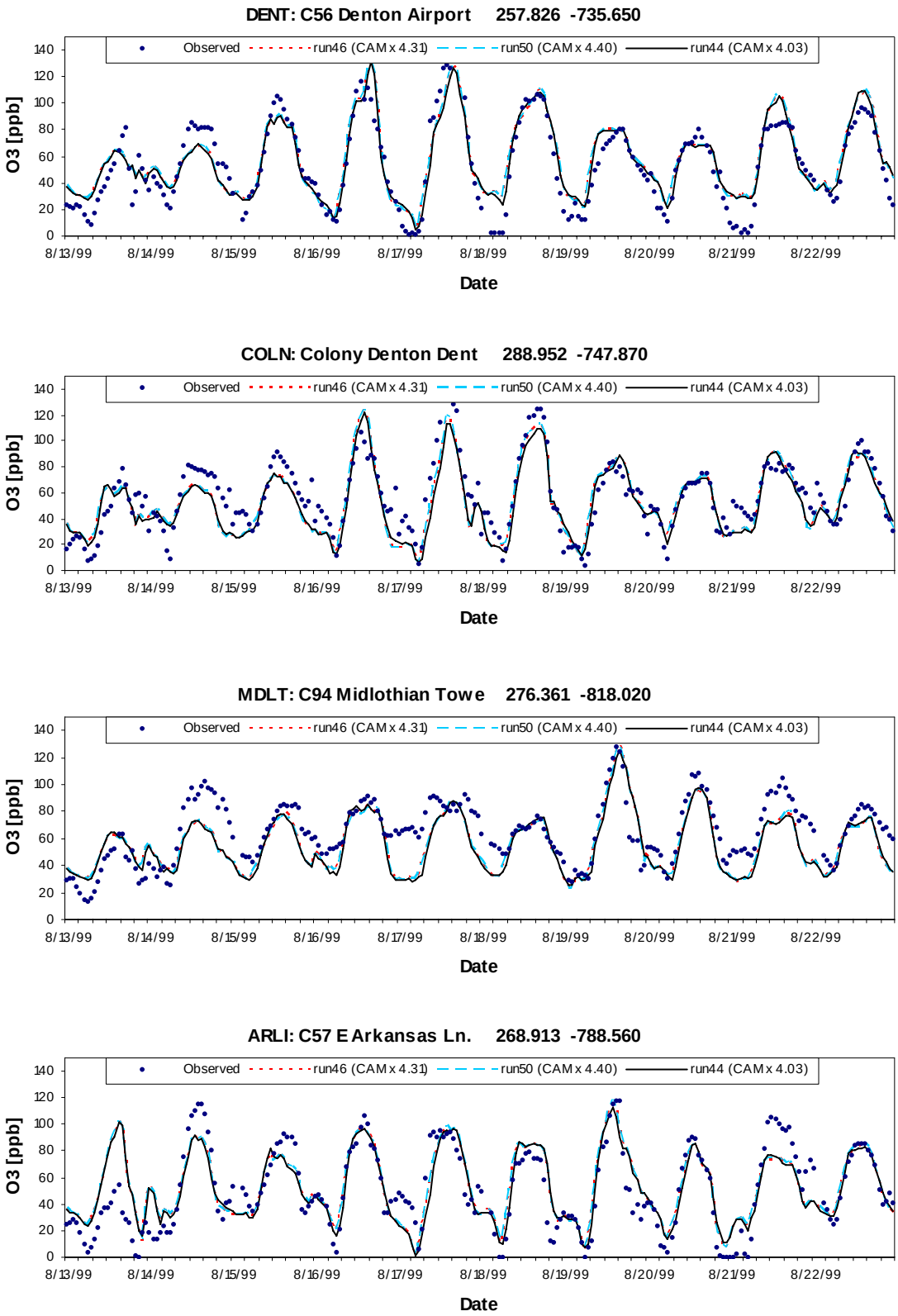
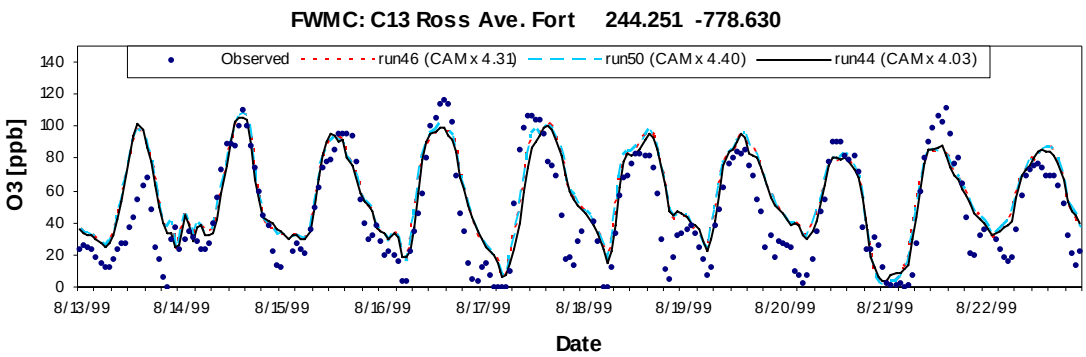


Figure 2-15b: Hourly time series for the 1999 Baseline comparing three CAMx versions



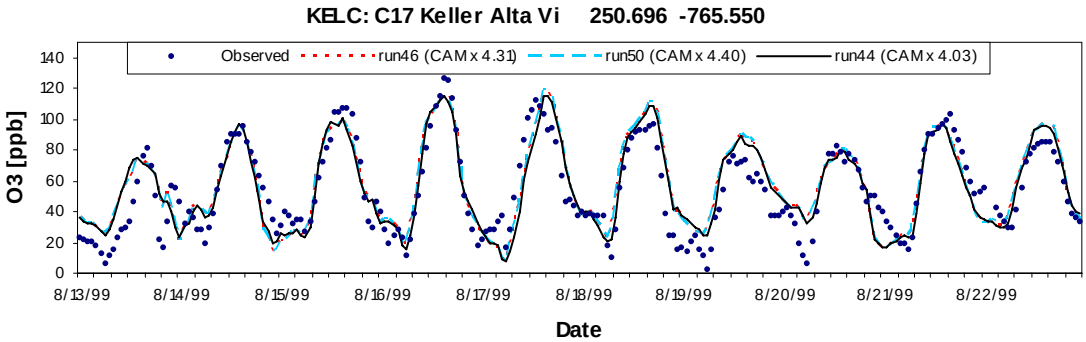


Figure 2-15c: Hourly time series for the 1999 Baseline comparing three CAMx versions

2.7 DEVELOPMENT OF DFW 2009 FUTURE BASELINE AND SENSITIVITY TESTS

Overview

The purpose of the future baseline case and sensitivity tests is to determine:

- whether the area will attain the ozone standard without any additional controls,
- the estimated amount of emissions reductions that may be required to meet the standard,
- whether the area is more responsive to VOC or NO_x controls,
- which geographical areas are most difficult to bring into compliance, and
- the model response to different categories of controls.

Typically the first step is done with a future case baseline model run using the same meteorology that was validated in the base case, but using a future case inventory that accounts for growth and existing rules, without any additional controls. If the future case ozone design values are below 85 ppb at all monitors, attainment has been demonstrated. If not, modeling sensitivities are run to determine the type and amount of reductions that may be required to bring the area into attainment and then which types of controls would be the most effective.

Background

As discussed previously, the DFW eight-hour ozone episode (August 13-22, 1999) has been under development for several years, and both the meteorology and the emissions have been continuously upgraded and improved over time. Initially, it was assumed that EPA would require an attainment demonstration for 2010, so emissions development was started with a goal of 2010 attainment. However, in EPA's draft and final eight-hour ozone modeling guidance (2005a and 2005b), EPA clarified that the attainment demonstration would require modeling using 2009 emissions estimates.

Before the EPA guidance was issued, some of the early DFW sensitivity tests involved 2010 modeling, and some of those results are included below. The model has been producing stable results leading to consistent directional guidance and conclusions even while modifications have been made to improve model performance.

40 Ton Test Series

In order to make a preliminary assessment of the effectiveness of NO_x and VOC controls applied to different emissions source categories, a series of sensitivity runs imposing various emissions reductions on the 2010 inventory was completed. Each emissions category was reduced by the same amount to maintain comparability between categories. For example, 40 tons of NO_x were removed from the point source emissions inside the DFW nine-county nonattainment area and tested in the model. Then 40 tons of NO_x were removed from the on-road mobile and then from the area/non-road categories. Finally 40 tons of VOC were removed from the on-road mobile and area/non-road components, VOC from point sources was not tested since they do not emit enough VOC to be comparable. The graphical results of these runs are shown in Figure 2-16: *DFW 40 Ton Test Response Chart*.

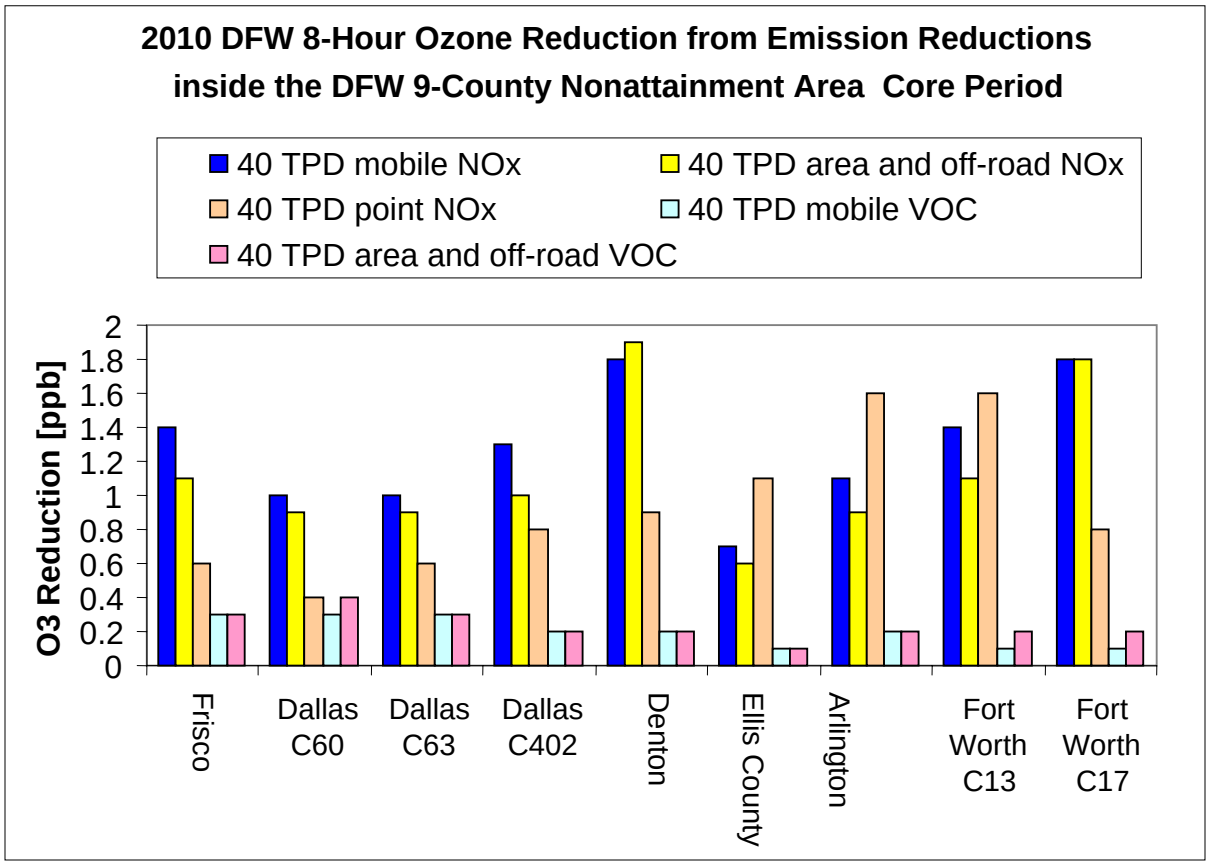


Figure 2-16: DFW 40 Ton Test Response Chart

The 40 ton test series shows that DFW ozone is more responsive to NO_x reductions than to VOC reductions in all areas. For example, 40 tons of NO_x controls inside the DFW nine-county area reduce ozone by as much 1.9 ppb at Denton, and 1.8 ppb at Fort Worth-C17. In contrast, 40 tons of VOC reduction reduces ozone by 0.4 ppb at the Hinton Drive monitor and 0.1 ppb at Ellis County.

In terms of source categories, reducing on-road mobile and area/non-road NO_x by 40 tons inside the nine-county area is more effective than equivalent NO_x reductions applied to point sources at

six out of the nine sites. On-road mobile source NO_x reductions are more effective than area/non-road reductions at all sites except Denton. However, point source NO_x reductions are more effective than on-road mobile or area/non-road reductions at Ellis County, Arlington, and Fort Worth-C13.

While all areas are responsive to NO_x reductions, the degree to which they respond varies. The 40 ton test series indicates that the DFW area is not homogeneous and that different areas respond differently to VOC and NO_x controls. Some areas of the city respond better to mobile and area source controls, whereas other areas respond better to point source controls.

The monitors in the urban core (Dallas-C6- and Dallas-C63) tend to be more responsive to VOC controls than those in other areas. In contrast, monitors downwind of the city (where the highest concentrations of ozone are measured) are NO_x limited and more responsive to NO_x controls. Overall, the NO_x controls are more effective than VOC controls.

Control Strategy Sensitivity Tests

The relative effectiveness of the different control strategies that were under consideration were evaluated. Each of the proposed control strategies was tested in the 2009 future case using the same CAMx version (4.03), meteorology (Run 44) and the same emissions inventory (.a1) so that all results would be comparable. Each strategy was initially tested separately to compare the relative effect and determine which were most effective and to compare the relative effectiveness of controls applied inside the DFW nine-county area with controls applied in other areas of Texas.

For a list of all the future case sensitivity tests to date, please refer to Appendix D: *DFW Future Case (2009) Sensitivity Tests.* This appendix describes the effect of those reductions on the Frisco and Denton monitors, as well as the average ozone reduction over the DFW area and the reduction in area of exceedance that resulted from the strategy. The results of all of these tests are discussed in detail in Tai, 2006b.

Results of Control Sensitivity Tests

The 2009 control sensitivity tests reiterated some of the 2010 results shown in Table 2-8: *Weekday VOC Emissions (tpd) for 2009 with DFW Combination 4 Controls.* On a ton-for-ton basis, reductions made in the surface layers of the model are more effective than reductions made in elevated emissions. In addition, reductions made inside the DFW nine-county nonattainment area are more effective than similar reductions applied to distant sources. The response to NO_x reductions is progressive: the larger the total reductions, the more effective they become.

Based on the results of these tests, combinations of the more effective control sensitivities were selected for testing. The results of these combination runs, the modeled design values, and the final package of control strategies proposed are discussed in Section 2.9.

2.8 DFW FUTURE BASELINE CASE (2009) MODELING RESULTS

Overview

This section explains how much ozone was generated in the DFW 2009 future baseline case and how the future ozone design values are calculated. The future baseline case includes only the controls that are already enacted in law and expected to be in effect by 2009. No additional controls or reductions are assumed. Additional controls being proposed by the TCEQ as part of this SIP revision and their effect upon future design values are not included in the future baseline case. The effects of the future control strategies will be discussed in Section 2.9.

Two additional adjustments were made to the 2009 baseline modeling including an upgrade to CAMx 4.31 and a future case emissions inventory adjustment. The 2009 emissions inventory incorporated an update based upon EPA's 2005 Acid Rain data.

Projecting Future Design Values

In their most recent eight-hour ozone modeling guidance (EPA, 2005), EPA describes a new procedure for estimating future case ozone expected to occur in the attainment year. This procedure is designed to eliminate some of the concerns of the previous one-hour procedure, which was based strictly on the modeled maximum future case ozone. In some of the one-hour cases the future modeled ozone was biased high, in other cases it was biased low. If the ozone in the future case ozone was too high, a significant level of controls would be required to reduce the value down to the standard. If the future case ozone was biased low, a smaller reduction (possibly even no additional controls) would be required to bring the area into compliance.

The new EPA procedure calculates a ratio between the base and future case ozone, which is then applied to the measured ozone values to estimate future ozone levels. The procedure is based upon two elements: the baseline design value and the relative reduction factor.

The baseline design value is an EPA term designed to represent the ozone that occurred in the past, as well as representing the value that must be reduced to meet the eight-hour ozone standard. The EPA recommends calculating the current design value by averaging the three, three-year design values that occurred in the area for the following specific periods: the year before the base year selected for modeling; the base year; and the year after the base year selected for modeling. Mathematically speaking, the new procedure recommends a five year center-weighted average of the fourth high eight-hour ozone concentrations measured at each monitor in the area. Since it is center-weighted, the calculation emphasizes the ozone that was measured during the base year. The baseline design value is the foundation for estimating the ozone that the model predicts will occur in the attainment year.

The relative reduction factor (RRF) is the second element used to estimate future ozone levels. The relative reduction factor is based on modeling and describes the amount of reduction expected to occur in the future year for a particular level of control. RRFs are calculated for each monitor individually by dividing the future year ozone modeled at a site by the base year ozone modeled at the site, expressed as a three digit decimal number. For example, a RRF of 0.900 indicates that future ozone is expected to be 90% of the base year ozone.

Once both elements are calculated for every monitor in the area, the baseline design value is multiplied by the RRF to determine the ozone predicted in the future at each monitor. For example, if the base year design value was 90 ppb, and the RRF was 0.900, the calculated future design value would be 81 ppb.

DFW 1999 Baseline Design Value

The DFW modeling base year is 1999; therefore, the EPA baseline design value is determined by averaging the three annual design values from the year before (1998), the base year (1999) and the year after (2000). Table 2-3: *DFW 1999 Baseline Design Value Calculations* shows the values for each period for each of the monitors operating in the DFW area during the period. The last column shows the baseline design value, calculated as the average of the other three columns.

Table 2-3: DFW 1999 Baseline Design Value Calculations

DFW 1999 Baseline Design Value Calculations					
Site Name	CAMS	1999 97-99	2000 98-00	2001 99-01	Baseline DV
Frisco	C31	101	101	99	100.3
Anna	C68				---
Dallas Hinton	C60	91	93	92	92.0
Dallas North	C63			93	93.0
Dallas Exec (Redbird)	C402	92	88	84	88.0
Denton	C56		102	101	101.5
Midlothian	C94		97	88	92.5
Arlington Reg Office	C57		95	86	90.5
FtW NW (Meacham)	C13	99	99	97	98.3
FtW Keller	C17	95	97	97	96.3
Design Value identified by trailing year					
Based on http://epa.gov/air/data/					

DFW Relative Reduction Factor (RRF) Calculations

The EPA recommends a two-step procedure to calculate the relative reduction factors that averages the base case and future case ozone concentrations at a monitor before calculating the RRF. Since the essential element of the EPA attainment test is applying the relative reduction ratio to the baseline ozone, it is important to maintain the integrity of the individual day-and monitor-specific RRFs. Since averages are distorted by extremely high and low values, the EPA averaging-first method may distort the relationship the RRF is attempting to calculate.

The EPA method for calculating future design values is straightforward, but it masks some of the information otherwise available. Since the EPA method averages the daily ozone over all the days of the episode, it substitutes a statistical assessment for a dynamic cause and effect analysis. Effectively, the method smooths over the model performance information that is contained in the daily response data.

As allowed in EPA's modeling guidance (EPA 2005a) in the Foreword and on page 30, the TCEQ is using an alternative method to calculate future design values by calculating the ratios for each day and monitor first, and then averaging the ratios. This method preserves the relationship (RRF) between the base and future case at each monitor, and thereby the integrity of the RRF method. This daily method provides additional insight into daily model performance by showing which days and areas respond to precursor reductions. When combined with data on wind directions, internal and external sources, and source alignments, the daily response data permits analysis of VOC/NO_X sensitivities in different portions of the urban area.

Comparisons of the two methods show that in most cases, the results are very similar. Figure 2-17: *Comparison of EPA RRF Calculation Method with Daily Calculation Method* shows that the two methods give almost the same results except at monitors with extremely high or low calculated ozone values. The regression equation shows that TCEQ's daily method is strongly correlated with the EPA method (R^2=.9881), and the regression line for the daily RRF is only 1.9% different from the EPA calculations. Since EPA recommends truncating (discarding) the

last digit in the future design value calculations, in most cases the 1.9% difference between the two methods is relatively unimportant.

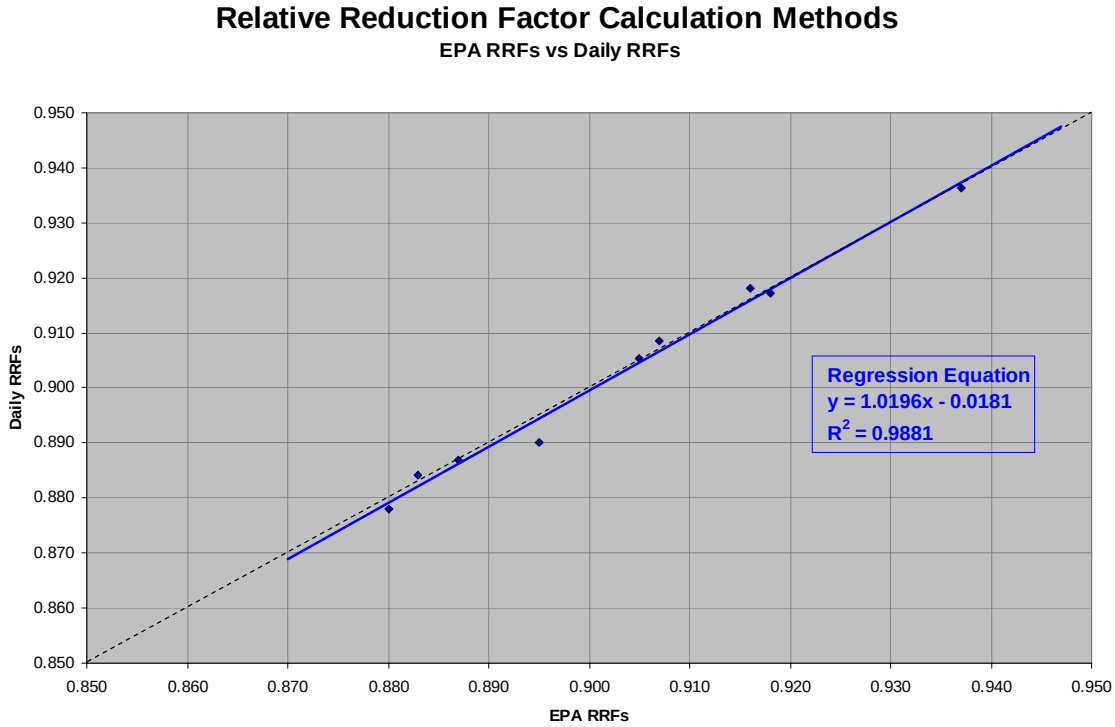


Figure 2-17 Comparison of EPA RRF Calculation Method with Daily Calculation Method

Daily Relative Reduction Factor Calculations

Table 2-4: *DFW 2009 Baseline RRF Calculations using CAMx 4.31 and .a2 Emissions* shows the RRF calculations using TCEQ's daily RRF method. The top two panels of Table 2-4 show the modeled ozone output at each monitor in the 1999 base and 2009 future case using the latest model configuration, Run 46 with CAMx 4.31 and the .a2 version of the inventory.

EPA guidance recommends removing base case data points that are less than 85 ppb because those days do not respond well to controls. The Frisco data from August 20 is colored orange in both the base and future cases to show that the data were not used in the daily RRF calculations, as recommended by EPA. Although base case ozone was modeled below 85 ppb at several monitors, the TCEQ has taken a more conservative approach by only removing data less than 70 ppb. This removes only the very lowest values, while still leaving enough data to develop stable averages. However, leaving the other low values in the calculation makes the RRFs less responsive and ultimately results in higher (more conservative) future design values.

The third panel of Table 2-4, *DFW 2009 Baseline RRF Calculations using CAMx 4.31 and .a2 Emissions* shows the daily RRFs calculated for each monitor, color coded to indicate the amount of response. Numbers labeled in blue represent RRFs less than 0.9, indicating that on that day ozone was reduced between 10-20% in the future case. Numbers in black indicate that the future modeled ozone was reduced from 0-10% compared to the base case. Numbers colored red indicate that the future case ozone increased at those monitors.

The color coding in the third panel illustrates the insight that can be gained by using daily RRF calculations. For example, when the RRFs are colored blue, it indicates that the model responds

well on that day. The blue RRFs on August 15, 16, 18, 19, 21 and 22 indicate that the model is responding well to the future case ozone reductions on many days during the episode.

However, the daily RRF data also show RRFs greater than 1.0 at several sites on August 17 and 20, indicating that the ozone at these monitors increased in the future case (2009) compared to the baseline (1999). Since the biggest reductions between 1999 and 2009 were due to the NO_x component of the inventory, the RRF results suggest that ozone in the city core is probably being scavenged by mobile NO_x emissions, and as those NO_x emissions are reduced in the future, less scavenging leads to increased ozone in those areas.

Table 2-4: DFW 2009 Baseline RRF Calculations using CAMx 4.31 and .a2 emissions

1999 Base Case: run46									
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**#Days>70**
Frisco C31	81.3	107.0	102.6	109.2	86.0	69.9	87.1	89.5	7
Dallas Hiinton C60	83.1	99.8	103.4	103.8	99.2	78.0	85.5	85.3	8
Dallas North C63	82.6	101.3	102.6	106.6	96.5	76.4	86.8	88.4	8
Dallas Redbird C402	77.0	93.3	98.5	96.6	107.4	83.7	79.4	79.5	8
Denton C56	102.6	113.1	110.0	112.5	84.7	73.1	101.6	99.6	8
Midlothian C94	78.3	86.1	85.9	76.2	114.0	88.8	75.7	76.7	8
Arlington C57	86.2	98.4	100.2	95.2	106.9	83.1	81.9	86.7	8
FtW NW C13	93.8	105.5	104.3	106.0	96.0	80.1	89.8	92.0	8
FtW Keller C17	101.1	111.1	110.4	108.3	92.4	78.6	95.9	94.9	8

2009 Future Base: run46.fy2009.a2			(No Additional Controls)					
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**
Frisco C31	67.7	100.9	101.9	100.5	73.2	63.9	74.8	74.4
Dallas Hiinton C60	73.1	93.0	103.5	97.8	91.4	80.7	78.0	74.0
Dallas North C63	71.0	95.6	101.9	99.7	84.4	77.4	76.2	74.1
Dallas Redbird C402	66.7	82.4	89.5	85.1	97.0	85.2	70.3	71.3
Denton C56	88.5	103.4	108.0	92.0	71.6	64.6	89.8	83.5
Midlothian C94	72.6	77.3	78.8	70.3	99.0	85.7	69.9	70.7
Arlington C57	75.0	89.2	90.6	81.8	95.5	85.2	73.1	79.6
FtW NW C13	80.9	94.7	94.3	87.9	83.6	75.7	79.2	81.1
FtW Keller C17	89.3	99.1	104.4	90.3	79.2	70.6	88.1	82.2

Daily RRF Calculations			(With August 20th Removed)						Average
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**RRF**
Frisco C31	0.833	0.942	0.993	0.921	0.851	---	0.859	0.831	0.890
Dallas Hinton C60	0.88	0.932	1.001	0.942	0.921	1.035	0.912	0.867	0.936
Dallas North C63	0.86	0.944	0.993	0.935	0.875	1.014	0.878	0.838	0.917
Dallas Exec C402	0.866	0.883	0.908	0.881	0.903	1.018	0.886	0.897	0.905
Denton C56	0.863	0.914	0.982	0.817	0.845	0.883	0.883	0.838	0.878
Midlothian C94	0.927	0.898	0.917	0.922	0.869	0.966	0.923	0.922	0.918
Arlington C57	0.87	0.907	0.904	0.859	0.894	1.025	0.892	0.918	0.909
FtW NW C13	0.863	0.897	0.904	0.83	0.871	0.945	0.882	0.881	0.884
FtW Keller C17	0.883	0.893	0.946	0.834	0.857	0.898	0.919	0.866	0.887

Future (2009) Design Values

The future design values for the DFW area in 2009 are calculated in Table 2-5: *2009 Design Value Calculations*. The first column indicates the monitor site name; the second column shows the average RRF for that monitor; and the third column shows the 1999 baseline design value taken from Table 2-3, *DFW 1999 Baseline Design Value Calculations*. The future design values are shown in the last column, calculated by multiplying the average RRF by the 1999 baseline design value. EPA recommends truncating the last digit of the calculation; however, the TCEQ shows the last decimal place in the calculation for clarity.

Table 2-5: 2009 Design Value Calculations

Future Design Values	2009 Baseline		
Site Name	Average RRF	Baseline DV [ppb]	Future DV
Frisco C31	0.890	100.3	**89.3**
Dallas Hinton C60	0.936	92.0	**86.1**
Dallas North C63	0.917	93.0	**85.3**
Dallas Exec C402	0.905	88.0	**79.7**
Denton C56	0.878	101.5	**89.1**
Midlothian C94	0.918	92.5	**84.9**
Arlington C57	0.909	90.5	**82.2**
FtW NW C13	0.884	98.3	**86.9**
FtW Keller C17	0.887	96.3	**85.4**

Summary

Of all the monitors, Frisco had the highest calculated future design value at 89.3 ppb. The second highest future design value was 89.1 ppb calculated at Denton. Although Denton started with the highest baseline design value, it also had the lowest (most effective) relative reduction factor. As a result, Denton shows the largest change between the base and future case, with a future design value below the Frisco value.

The future (2009 Baseline) calculations show that the future case ozone is below 85 ppb at only three monitors, Dallas Executive, Midlothian, and Arlington. Thus additional controls are needed to bring the remaining monitors into compliance with the eight-hour standard.

According to the 1999 baseline data, all the sites in the DFW area were out of compliance in 1999. Therefore, according to the modeling, the controls that are already adopted with compliance dates prior to 2009 are expected to bring three out of the nine monitors below 85 ppb.

Reversing the order of operations in the RRF calculations by determining the daily response at each monitor before averaging the RRFs to derive a monitor-specific RRF results in essentially the same number as the EPA calculation methodology but preserves the daily response information. The advantage of the daily RRF method is that it allows the TCEQ to analyze the daily response in each area of the city, to evaluate the responses with different wind directions, and to evaluate whether the model is performing as expected.

2.9 DFW FUTURE CASE (2009) WITH CONTROLS MODELING RESULTS

Overview

This section evaluates the effect of the VOC and NO_x controls being proposed for the DFW area. Section 2.7 described the results of the individual sensitivity tests performed to evaluate the effectiveness of various options for emissions reduction. Section 2.8 illustrates the controls already in place provide emissions reductions benefits toward attaining the eight-hour standard, but that additional controls will be required to bring the last two DFW monitors into compliance with the ozone standard.

This section describes the modeling results with the additional controls and uses the Daily RRF method to calculate the future design values and attainment status for the 2009 Future Case.

2009 Control Package

The TCEQ evaluated various options for controlling DFW ozone and selected a package of controls that will help to bring the area into attainment of the ozone standard. Several different packages were tested with CAMx 4.31, and the fourth combination represents the strategies being proposed. Combination 4 includes reductions for the following: DFW major and minor sources, DFW EGUs, Ellis County cement kilns, NCTCOG on-road and off-road sources, and East Texas engines within 200 km of DFW. Table 2-6: *2009 Control Package Emission Reductions Combination 4 (.a2 Baseline),* shows the list of controls included in Combination 4.

Table 2-6: 2009 Control Package Emission Reductions Combination 4 (.a2 Baseline)

DFW Proposed 2009 Emissions Reductions		
Controls	**NO_x reduction [tpd]**	**VOC reduction [tpd]**
9 county area DFW major source	-12.7	0.0
9 county area DFW minor source	-4.5	0.0
9 county area DFW EGUs	-2.0	0.0
Ellis County cement kilns	-11.0	0.0
NCTCOG off-road mobile	-6.9[1]	-0.3
NCTCOG on-road mobile	-9.4[1]	-7.7
East Texas engines (<200 km DFW)	-40.9[2]	0.0
Totals	-87.4	-8.0

1-These estimates are based on NCTCOG's initial VMEP estimates. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision.

2- The proposed East Texas Combustion rule for gas-fired engines affects to 39 of the 61 counties within or traversed by the 200 km perimeter from DFW. The 2009 emissions reductions from the East Texas Combustion rule, as proposed, are estimated at approximately 37 tpd of NOx. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision.

2009 Emissions with Combination 4 Controls

Table 2-7: *Weekday NOx Emissions (tpd) for 2009 with DFW Combination 4 Controls* and Table 2-8: *Weekday VOC Emissions (tpd) for 2009 with DFW Combination 4 Controls* summarize the NO_x and VOC reductions tested in the 2009 future case with Combination 4. NO_x and VOC emissions were reduced 87 and 8 tpd, respectively, from the 2009 .a2 baseline.

Table 2-7: Weekday NO_x Emissions (tpd) for 2009 with DFW Combination 4 Controls.

NO_x [tpd]	Biogenics	TX Mobile	Elev Points	TX Low Points	TX Area	TX Off-road	Non-TX Low Anthro	All Anthro	Anthro Change from 2009.a2 baseline
Collin Co	10	14	1	0	2	8	0	24	-1.6
Dallas Co	4	74	5	1	17	43	0	139	-10.1
Denton Co	8	16	0	0	11	9	0	36	-3.4
Tarrant Co	3	44	1	1	9	26	0	82	-6.9
Parker Co	1	5	0	0	1	2	0	8	-1.5
Johnson Co	5	4	2	0	0	5	0	11	-4.2
Ellis Co	15	8	19	0	0	5	0	33	-15.8
Kaufman Co	5	6	3	0	0	2	0	11	-1.8
Rockwall Co	2	3	0	0	0	1	0	4	-0.3
DFW nine-county	**51**	**174**	**32**	**3**	**40**	**100**	**0**	**349**	**-45.7**
DFW 16 County	**83**	**203**	**46**	**4**	**61**	**116**	**0**	**431**	**-58.1**
NE Texas	16	79	176	7	66	42	1	371	-22.8
Central TX	113	88	136	2	53	69	0	348	-4.4
Houston	21	175	226	11	53	63	0	528	0.0
South TX	229	189	261	21	75	100	0	646	-1.9
West TX	524	160	140	21	212	105	1	639	0.0
Texas	**986**	**894**	**985**	**67**	**521**	**494**	**2**	**2963**	**-87.2**
Gulf + Mexico	79	5	436	0	4	2	444	891	0.0
Oklahoma	227	1	256	0	2	3	661	924	0.0
Louisiana	106	1	715	1	2	1	1183	1903	-0.1
Arkansas	125	2	220	0	0	2	468	692	0.0
Mississippi	121	0	353	0	0	0	455	808	0.0
Alabama	75	0	442	0	0	0	491	932	0.0
Tennessee	118	0	244	0	0	0	662	907	0.0
Kentucky	145	0	289	0	0	0	770	1060	0.0
Georgia	110	0	408	0	0	0	823	1230	0.0
Florida	56	0	367	0	0	0	1206	1573	0.0
Mid Atlantic (SC, NC, VA, WV)	293	0	977	0	0	0	2333	3310	0.0
NE US	314	0	1302	0	0	0	5748	7051	0.0
Northern Plains	5238	0	3269	0	0	0	8623	11892	0.0
Total	**7992**	**903**	**10264**	**68**	**530**	**502**	**23869**	**36136**	**-87.4**
Total change from baseline	0.0	-9.4	-42.6	-15.4	-13.1	-6.9	0.0	-87.4	

Table 2-8: Weekday VOC Emissions (tpd) for 2009 with DFW Combination 4 Controls.

VOC [tpd]	Biogenics	TX Mobile	Elev Points	TX Low Points	TX Area	TX Off-road	Non-TX Low Anthro	All Anthro	Anthro Change from 2009.a2 baseline
Collin Co	27	7	0	1	12	3	0	23	-0.6
Dallas Co	50	39	4	8	72	17	0	140	-3.7
Denton Co	65	7	1	1	15	4	0	28	-0.7
Tarrant Co	64	23	2	7	54	9	0	94	-2.1
Parker Co	121	2	0	0	5	1	0	8	-0.2
Johnson Co	111	2	0	0	6	1	0	9	-0.2
Ellis Co	90	2	3	2	6	2	0	15	-0.2
Kaufman Co	112	2	0	0	7	1	0	11	-0.2
Rockwall Co	3	1	0	0	2	1	0	4	-0.1
DFW nine-county	**641**	**84**	**10**	**20**	**180**	**37**	**0**	**332**	**-7.9**
DFW 16 County	**1538**	**95**	**34**	**22**	**216**	**44**	**1**	**411**	**-7.9**
NE Texas	4917	27	14	41	82	14	1	179	0.0
Central TX	6098	33	20	20	85	21	1	180	0.0
Houston	1683	80	91	215	247	41	0	675	0.0
South TX	2069	78	20	48	217	46	0	408	0.0
West TX	6198	59	11	29	215	52	3	367	0.0
Texas	**22503**	**373**	**188**	**374**	**1060**	**218**	**6**	**2220**	**-7.9**
Gulf + Mexico	658	3	32	0	10	4	329	378	0.0
Oklahoma	7940	1	3	0	5	1	481	490	0.0
Louisiana	9941	0	47	3	4	1	546	601	0.0
Arkansas	13925	0	23	0	2	0	441	466	0.0
Mississippi	14818	0	35	0	0	0	548	583	0.0
Alabama	13954	0	39	0	0	0	656	695	0.0
Tennessee	8679	0	66	0	0	0	895	961	0.0
Kentucky	3753	0	34	0	0	0	622	656	0.0
Georgia	12199	0	53	0	0	0	869	922	0.0
Florida	9793	0	42	0	0	0	1594	1636	0.0
Mid Atlantic (SC, NC, VA, WV)	31294	0	67	0	0	0	2836	2903	0.0
NE US	20472	0	248	0	0	0	5407	5655	0.0
Northern Plains	40144	0	226	0	0	0	8224	8450	0.0
Total	**210073**	**377**	**1104**	**377**	**1080**	**224**	**23453**	**26614**	**-8.0**
Total change from baseline	0.0	-7.7	0.0	0.0	0.0	-0.3	0.0	-8.0	

Future Case Model Response with Combination 4 Controls

Spatial plots of the daily maximum eight-hour ozone in the 2009 run with Combination 4 controls and differences from the 2009 baseline are shown in Figure 2-18: *Spatial Plots of the Daily Maximum Eight-Hour Ozone in 2009 with Combination 4 Controls* for each episode day in the DFW 4-km domain. On four days (August 15, 16, 21 and 22), the difference plots show that the largest ozone reductions occurred in plumes downwind of the Ellis County cement kilns and

benefited Tarrant County. These plumes reflect the combined ozone benefit of all of the controls modeled in Combination 4.

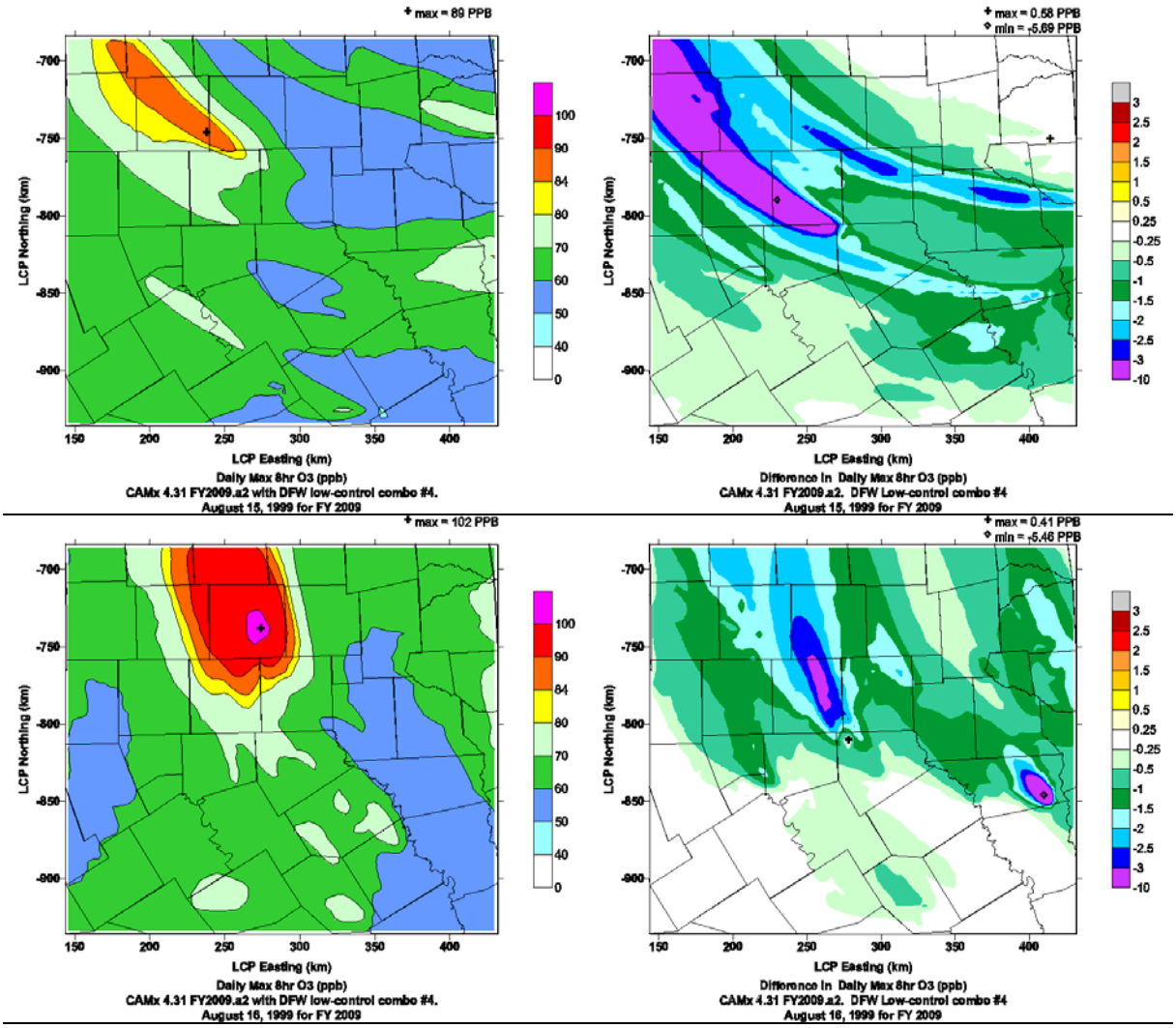


Figure 2-18: Spatial Plots of the Daily Maximum Eight-Hour Ozone in 2009 with Combination 4 Controls, and Differences from the 2009 Baseline for Each Episode Day in the DFW 4-km Domain

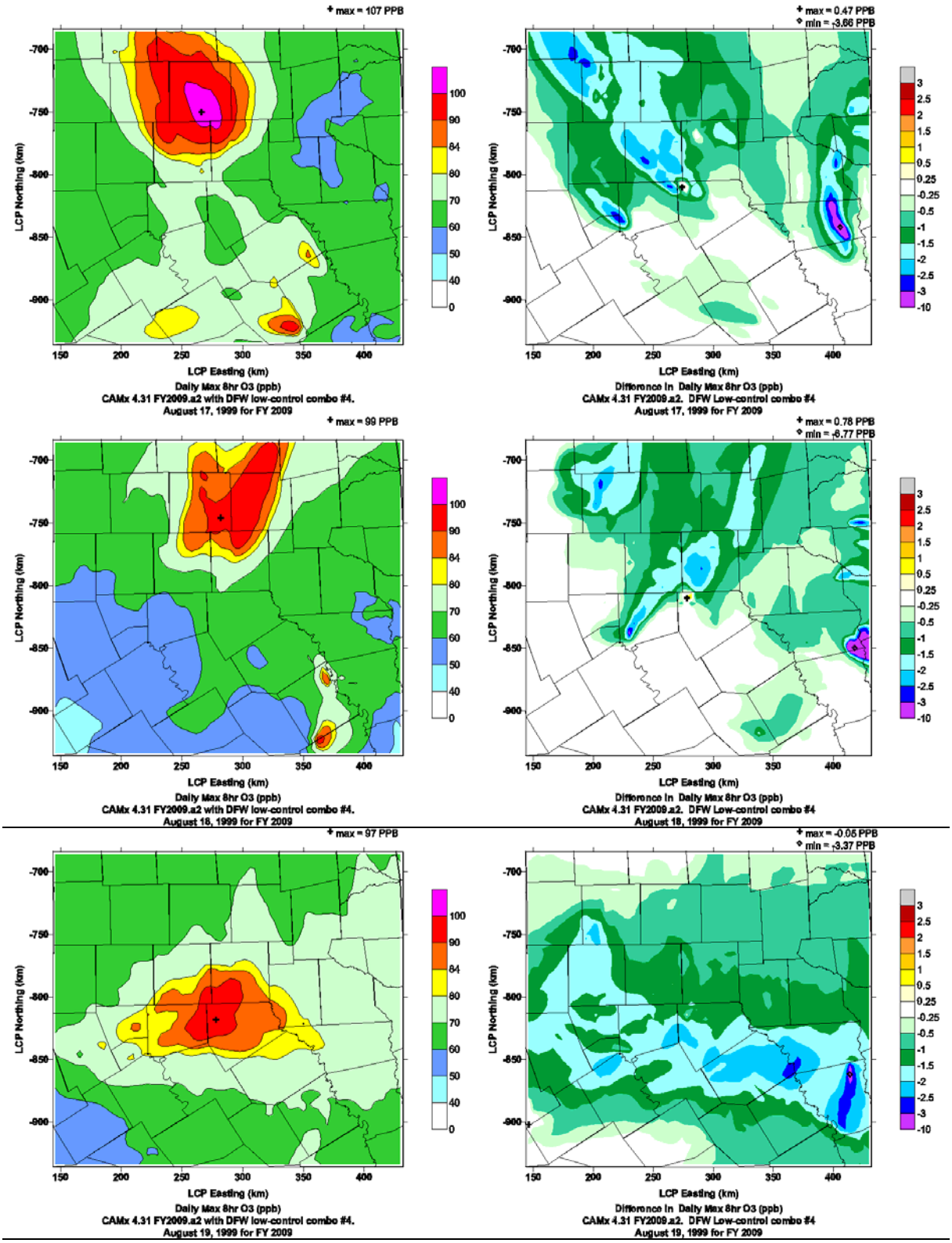


Figure 2-18: (Continued) Spatial Plots of the Daily Maximum Eight-Hour Ozone in 2009 with Combination 4 Controls, and Differences from the 2009 Baseline for Each Episode Day in the DFW 4-km Domain

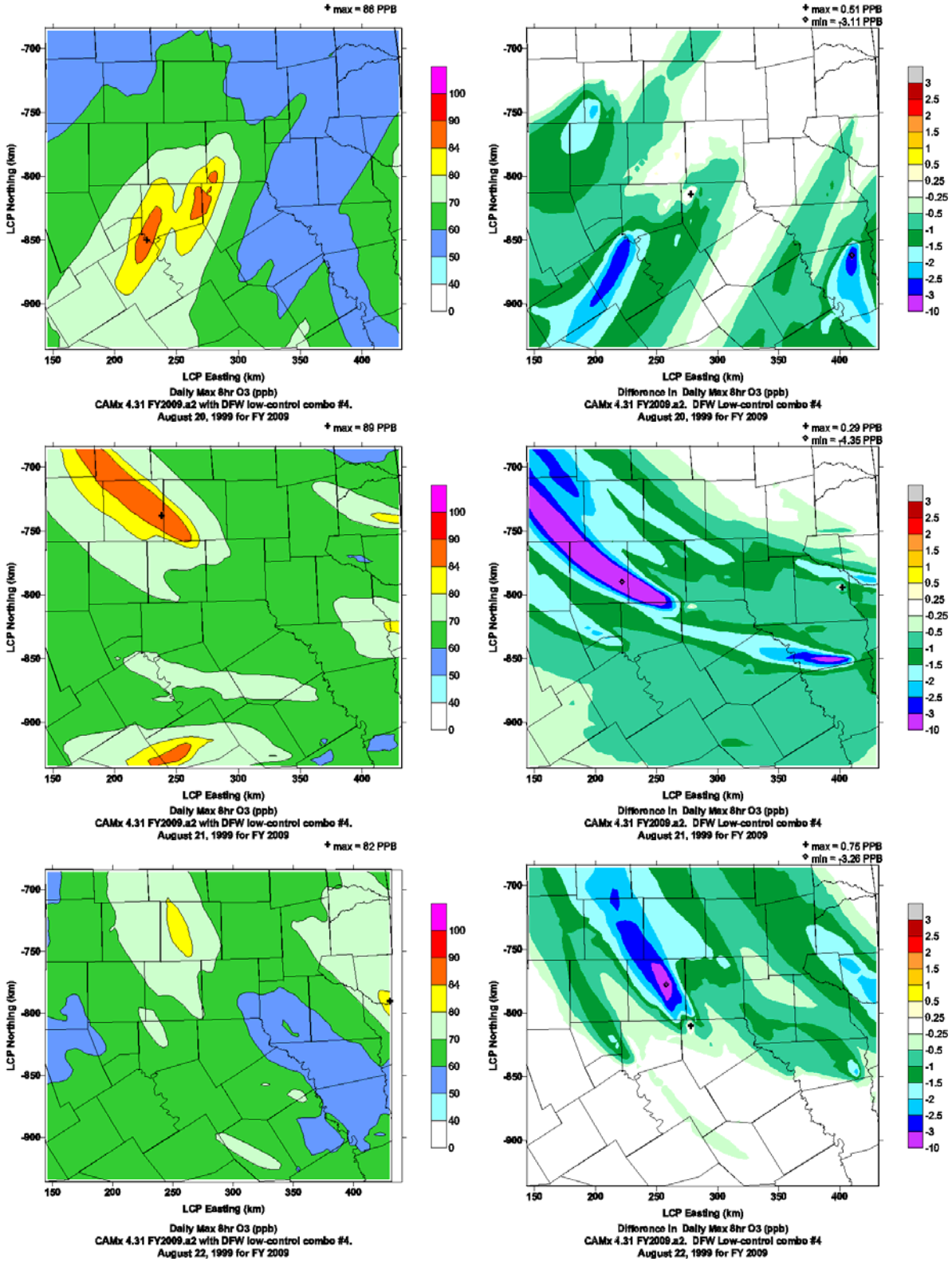


Figure 2-18: (Continued) Spatial Plots of the Daily Maximum Eight-Hour Ozone in 2009 with Combination 4 Controls, and Differences from the 2009 Baseline for Each Episode Day in the DFW 4-km Domain

Relative Reduction Factor Calculations for Controlled Scenario

The future case RRF calculations for 2009 with Combination 4 controls are shown below in Table 2-9: *DFW Future Case RRF Calculations with Combination 4 Controls*. All calculations are made using a daily RRF method. The RRF for each monitor and each day are individually calculated, with the average of the RRFs for that monitor shown in the last column on the right. Numbers labeled in blue represent RRFs less than 0.9, indicating that on that day ozone was reduced between 10-20% in the future case. Numbers in black indicate that the future modeled ozone was reduced from 0-10% compared to the base case. Numbers colored red indicate that the future case ozone increased at those monitors.

EPA guidance recommends removing data where the ozone modeled in the baseline case is below 85 ppb. The TCEQ is using a conservative approach, removing only one low value. Since the ozone at the Frisco monitor on August 20th is modeled at only 69.9 ppb in the baseline case, it was removed from the RRF calculations for the Frisco monitor. RRF calculations for all other monitors are based on a complete data set.

Table 2-9: DFW Future Case RRF Calculations with Combination 4 Controls

Base Case: run46									
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**#Days>70**
Frisco	81.3	107.0	102.6	109.2	86.0	69.9	87.1	89.5	7
Dallas C60	83.1	99.8	103.4	103.8	99.2	78.0	85.5	85.3	8
North Dallas C63	82.6	101.3	102.6	106.6	96.5	76.4	86.8	88.4	8
Dallas C402	77.0	93.3	98.5	96.6	107.4	83.7	79.4	79.5	8
Denton	102.6	113.1	110.0	112.5	84.7	73.1	101.6	99.6	8
Ellis County	78.3	86.1	85.9	76.2	114.0	88.8	75.7	76.7	8
Arlington	86.2	98.4	100.2	95.2	106.9	83.1	81.9	86.7	8
Fort Worth C13	93.8	105.5	104.3	106.0	96.0	80.1	89.8	92.0	8
Fort Worth C17	101.1	111.1	110.4	108.3	92.4	78.6	95.9	94.9	8

Future Year: run46.fy2009.a2.dfw_Combo4								
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**
Frisco C31	65.5	99.5	100.9	99.2	72.3	63.7	73.3	72.8
Dallas C60	70.8	91.4	102.5	96.2	90.4	80.6	76.3	72.5
North Dallas C63	69.0	94.3	100.9	98.1	83.3	77.2	74.5	72.5
Dallas C402	65.2	80.5	88.0	83.0	95.5	84.6	69.1	69.3
Denton C56	86.2	101.8	106.8	90.6	70.6	64.0	88.3	81.8
Ellis County C94	69.0	75.4	78.1	70.1	97.2	84.9	67.9	69.5
Arlington C57	71.4	86.0	88.7	80.0	94.1	84.6	71.5	76.3
Fort Worth C13	76.9	91.5	92.3	86.6	82.3	75.2	77.6	77.9
Fort Worth C17	87.3	96.7	102.8	89.1	78.0	70.3	86.8	80.5

Daily RRF Calculations			(With Frisco/August 20th Data Removed)						Average
Site	**990815**	**990816**	**990817**	**990818**	**990819**	**990820**	**990821**	**990822**	**RRF**
Frisco	0.805	0.929	0.983	0.909	0.841	----	0.842	0.813	0.875
Dallas C60	0.852	0.916	0.991	0.927	0.911	1.034	0.893	0.850	0.922
North Dallas C63	0.835	0.931	0.983	0.920	0.864	1.011	0.859	0.820	0.903
Dallas C402	0.847	0.862	0.893	0.859	0.889	1.011	0.871	0.871	0.888
Denton	0.840	0.900	0.970	0.805	0.834	0.875	0.869	0.820	0.864
Ellis County	0.881	0.876	0.909	0.920	0.852	0.956	0.897	0.907	0.900
Arlington	0.828	0.874	0.885	0.841	0.880	1.018	0.873	0.880	0.885
Fort Worth C13	0.820	0.867	0.885	0.818	0.857	0.939	0.864	0.847	0.862
Fort Worth C17	0.864	0.870	0.932	0.823	0.844	0.895	0.905	0.849	0.873

Future Design Value Calculations for Controlled Scenario

The future design value calculations for the 2009 baseline and with Combination 4 controls are shown in Table 2-10: *Future Design Value Calculations with Combination 4 Controls*. The baseline design value numbers were described in Section 2.8 and are identical for both calculations. The future design values for both cases are calculated by multiplying the site-specific RRF by the baseline design value.

The future design value calculations show the effectiveness of the proposed control package. Whereas six of the nine monitoring sites were above 85 ppb in the 2009 baseline modeling, only two sites (Frisco and Denton) exceed the standard in 2009 with the Combination 4 control package.

Compared to the 2009 baseline, future design values with controls were reduced an additional 1.3 to 2.2 ppb. The design value at the Frisco monitor dropped 1.5 ppb to 87.72 ppb; the Denton monitor dropped 1.4 ppb to 87.71 ppb. When the proposed control package is applied, the design value at the other seven DFW monitors models below 85 ppb.

Table 2-10: Future Design Value Calculations with Combination 4 Controls

Future Design Values	2009 Baseline			2009 Combo #4		
Site Name	Average RRF	Baseline DV [ppb]	Future DV	Average RRF	Baseline DV [ppb]	Future DV
Frisco C31	0.890	100.3	**89.3**	0.875	100.3	**87.7**
Dallas Hinton C60	0.936	92.0	**86.1**	0.922	92.0	**84.8**
Dallas North C63	0.917	93.0	**85.3**	0.903	93.0	**84.0**
Dallas Exec C402	0.905	88.0	**79.7**	0.888	88.0	**78.1**
Denton C56	0.878	101.5	**89.1**	0.864	101.5	**87.7**
Midlothian C94	0.918	92.5	**84.9**	0.900	92.5	**83.2**
Arlington C57	0.909	90.5	**82.2**	0.885	90.5	**80.1**
FtW NW C13	0.884	98.3	**86.9**	0.862	98.3	**84.7**
FtW Keller C17	0.887	96.3	**85.4**	0.873	96.3	**84.0**

Examination of the RRFs in Table 2-10: *Future Design Value Calculations with Combination 4 Controls* indicates that the RRFs for the Frisco and Denton monitors are responsive, both in the 2009 baseline and the 2009 control case. As previously mentioned, RRFs less than 0.900 are considered relatively responsive and color coded in blue. The Frisco and Denton monitors are neither the least nor most responsive monitors. They are in the middle of the range of RRF values. The two least responsive monitors in the control case are Hinton and Dallas North, both urban core sites.

However, further examination of Table 2-10: *Future Design Value Calculations with Combination 4 Controls* suggests why the Frisco and Denton monitors are difficult to bring below 85 ppb. The 1999 baseline design values in the table are the starting point for the future design value calculations. The baseline values for both the Frisco and Denton monitors are unusually high, 100.3 ppb at the Frisco monitor and 101.5 ppb at the Denton monitor. In fact, the DFW modeling is based upon the August 13-22, 1999 episode that included days with the highest eight-hour average ozone ever measured at both the Frisco and Denton monitors. The EPA calculation method for the baseline design value is effectively a 5-year center weighted average of the fourth high ozone occurring each year. Since the EPA calculation procedure is center year weighted, the high 1999 ozone is weighted three times in the calculation of the baseline design value. Therefore, the Frisco and Denton baseline design values are unusually high and thus, more difficult to model below 85 ppb in the future than the other design values in the area.

Comparing Calculated Design Values

Figure 2-19: *Change in DFW Eight-Hour Design Values* shows a graphical comparison of the design values calculated for the three stages of the modeling: the 1999 Baseline case, the 2009 Future Base, and the 2009 Control case. All of the DFW monitoring sites exceeded the 85 ppb ozone standard in the 1999 base year, and remarkable progress has been made since that time. The figure shows that the DFW modeling with the Combination 4 package of controls results in a significant reduction in ozone at all of the monitoring sites in 2009 and results in all but two monitors (Frisco and Denton) being below 85 ppb.

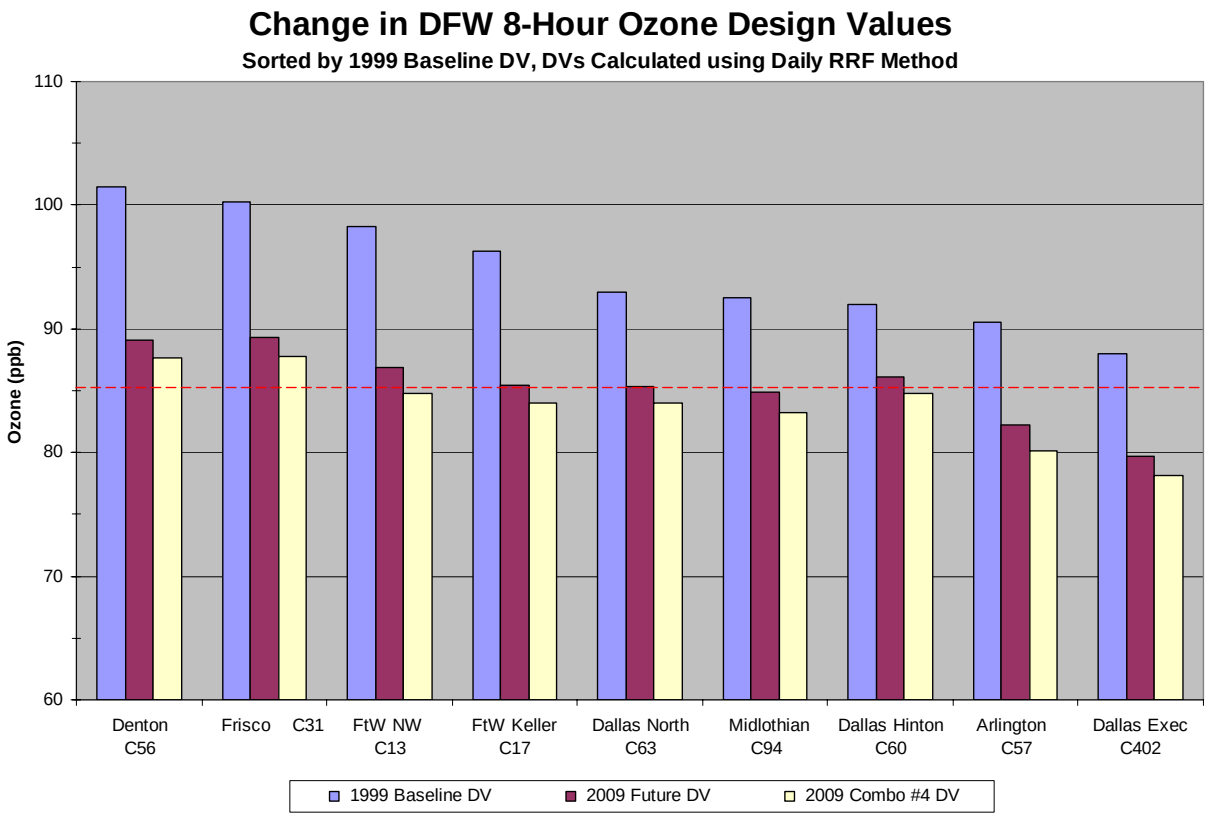


Figure 2-19: Change in DFW Eight-Hour Ozone Design Values

Chapter 3 will review additional factors, trends, and evidence indicating that the DFW nine-county nonattainment area will attain the eight-hour ozone standard in 2009.

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CHAPTER 3: CORROBORATIVE ANALYSIS

3.1 OZONE DESIGN VALUE TRENDS

The air quality in the DFW nine county nonattainment area is improving as a result of existing control measures. See Chapter 4 for descriptions of those control strategies. Despite a continuous increase in the population of the nine county area and increases in other factors such as vehicle miles traveled, the DFW area is exhibiting decreasing trends for ozone and its precursors, NO_X and VOC. The one-hour and the eight-hour ozone design values for the DFW area from 1991 to 2005 are shown in Figure 3-1: *One-hour and Eight-hour Ozone Design Values in the DFW Area (1991-2005)*. By 2005, the one-hour design value had been reduced to125 ppb, which indicates substantial progress towards attainment of the former one-hour ozone NAAQS. The 2005 eight-hour design value for the DFW area was 95 ppb and occurred at three different monitors: Fort Worth Northwest, Keller, and Eagle Mountain Lake. These three monitors are located to the northwest of the Dallas-Fort Worth area, which is consistent with the prevailing wind direction during DFW ozone episodes.

The one-hour ozone design value is decreasing at a faster rate than the eight-hour ozone design value. The trend line for the one-hour ozone design value for the DFW area shows a decrease of about 1 ppb per year, and the trend line for the eight-hour ozone design value shows a decrease of 0.2 ppb per year. The one-hour ozone design value showed a decrease of about 10.7 percent from 1991 to 2005. During the same period, the decline in the eight-hour design value was about 9.5 percent. The TCEQ's SIP efforts prior to 2005 focused on addressing the one-hour ozone standard.

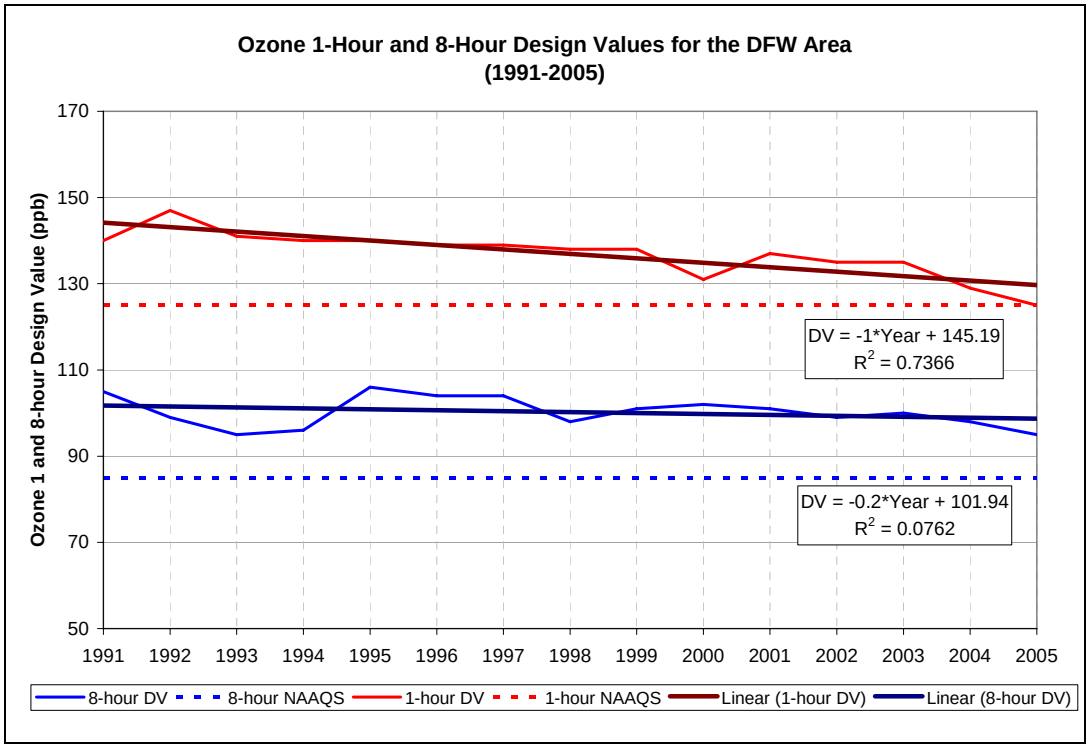


Figure 3-1: One-Hour and Eight-Hour Ozone Design Values in the DFW Area (1991-2005)

One reason for the difference in the downward trends for one-hour and eight-hour could relate to the transported component or background ozone. Background ozone is generically referred to as ozone entering the nonattainment area from outside its boundaries. Nonattainment area ozone levels are the sum of the background ozone and locally produced ozone. The local ozone

contribution was determined by subtracting the maximum ozone concentration from the background ozone concentration, usually measured on the upwind side of the area. Figure 3-2: *Eight-hour Ozone in the DFW Area from 1998 to 2003* shows that, in the DFW area, the average background ozone contribution is a large part of the maximum eight-hour ozone while the local ozone contribution is much less of the total. 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, Tobin, McNeel, and Li).

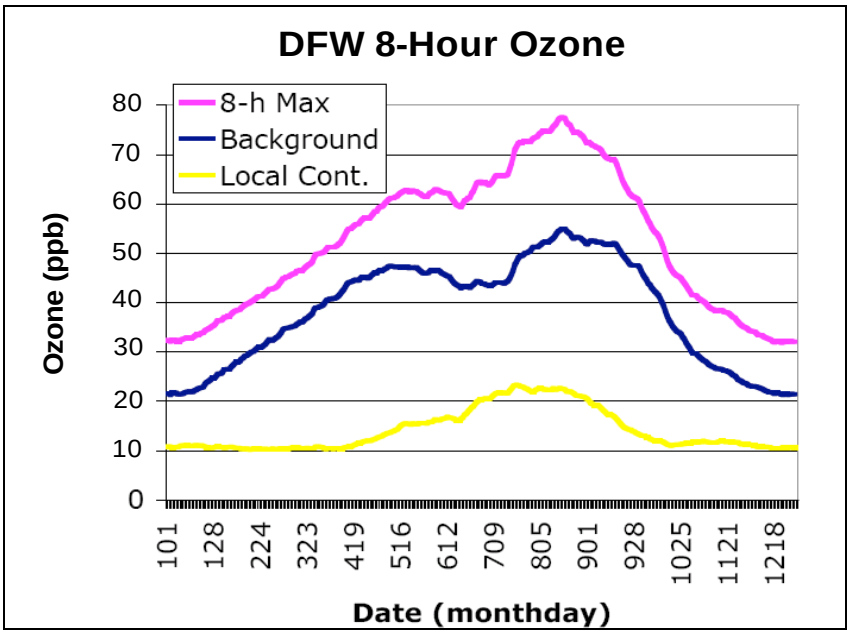


Figure 3-2: Eight-hour Ozone in the DFW area from 1998 to 2003 (Nielson-Gammon, Tobin, McNeel, and Li)

In addition to background concentrations, population growth is also a consideration in development of air quality plans. For both one-hour and eight-hour standards, ozone design values have decreased despite a steady increase in the area's population, as shown in Figures 3-3: DFW One-Hour Ozone Design Values and Population and 3-4: DFW Eight-Hour Ozone Design Values and Population.

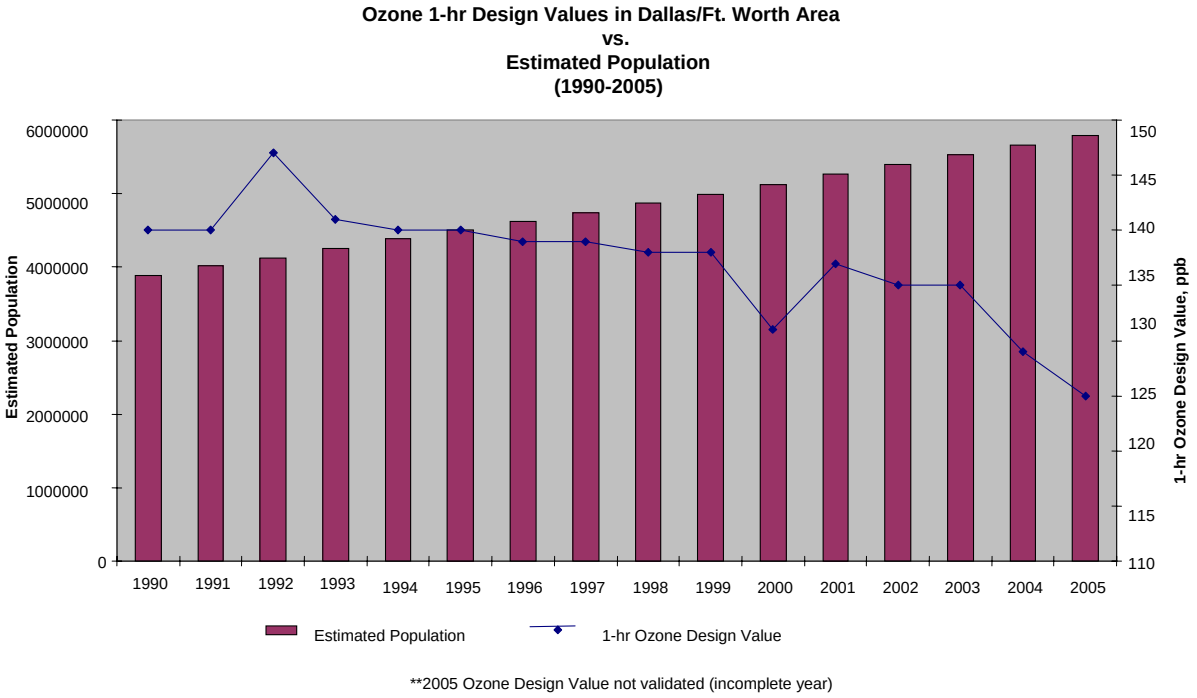


Figure 3-3: DFW One-Hour Ozone Design Values and Population

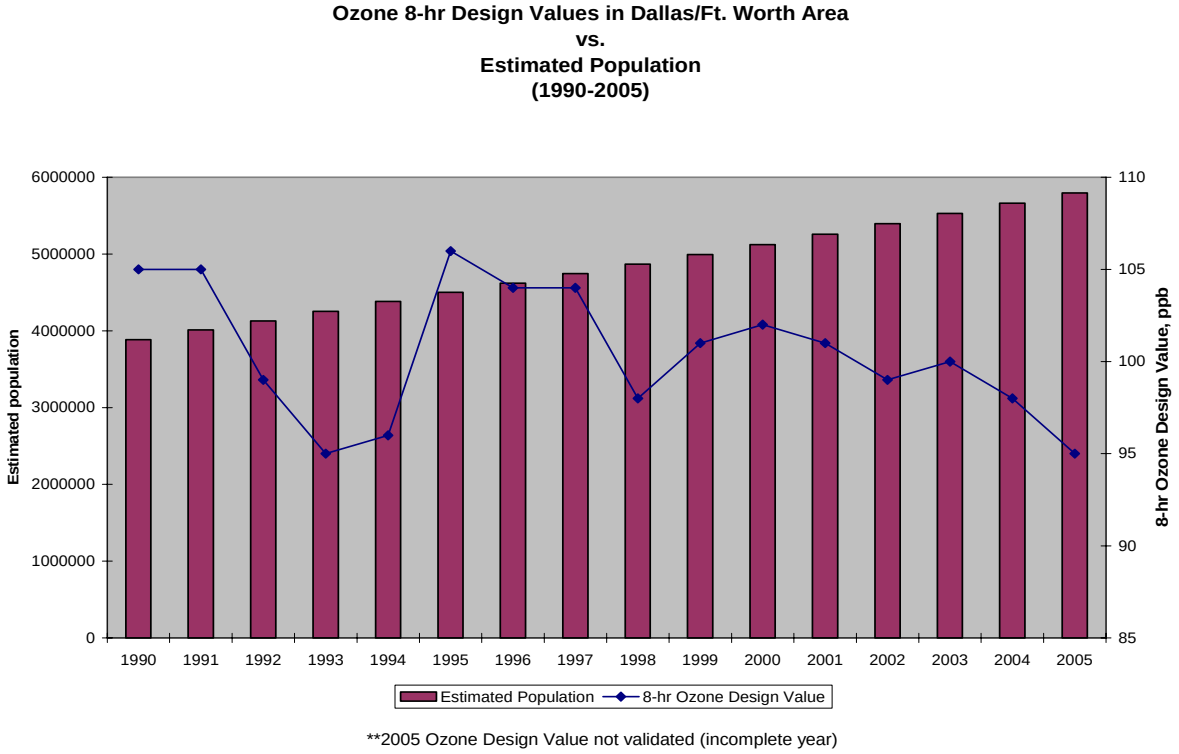


Figure 3-4: DFW Eight-Hour Ozone Design Values and Population

The eight-hour ozone standard is based upon averages of the 4th highest ozone at each monitor. Figures 3-5: *Frisco Eight-Hour Ozone Trends* and 3.6: *Denton Eight-Hour Ozone Trends* show the eight-hour trend lines at the Frisco and Denton monitors between 1997 and 2006. These two monitors have proven the most difficult to model attainment, thus the trends at these monitors are important components of any analysis. The plots show the 1st, 2nd, 3rd, and 4th highest ozone measured at each monitor during the 10-year period. The dotted lines show the best-fit trend lines for the 1st and 4th highest ozone data.

Figure 3-5: *Frisco Eight-Hour Ozone Trends* shows that the measured values vary considerably each year due to differences in meteorology. The graph shows that the highest ozone measured at Frisco in 1999 was much higher than for any other year, but has not been repeated since that time. The 2nd, 3rd, and 4th highest values were also anomalously high that year. However, the trend line for the 4th highest at Frisco, since that time, shows a distinct downward trend. The equation for the 4th highest trend line indicates that the measured eight-hour ozone at Frisco is declining at approximately 1.4 ppb per year. The correlation coefficient for this equation is .4405, indicating that even though the ozone varies around the straight line, the line accounts for 44 percent of the variance in the annual measurement.

Similarly, Figure 3-6: *Denton Eight-Hour Ozone Trends* shows the annual ozone and trend lines for the Denton monitor for the same period. The Denton graph also shows that extremely high ozone was measured during 1999, but those high values have not been repeated since. Both the 1st and 4th highest trend lines again show that ozone is declining at this monitor. The equation for the 4th highest indicates that the ozone measured at the monitor is decreasing at about 1.01 ppb per year, despite the uptick in 2005-2006. The correlation coefficient indicates that approximately 44 percent of the annual variance is captured by the equation.

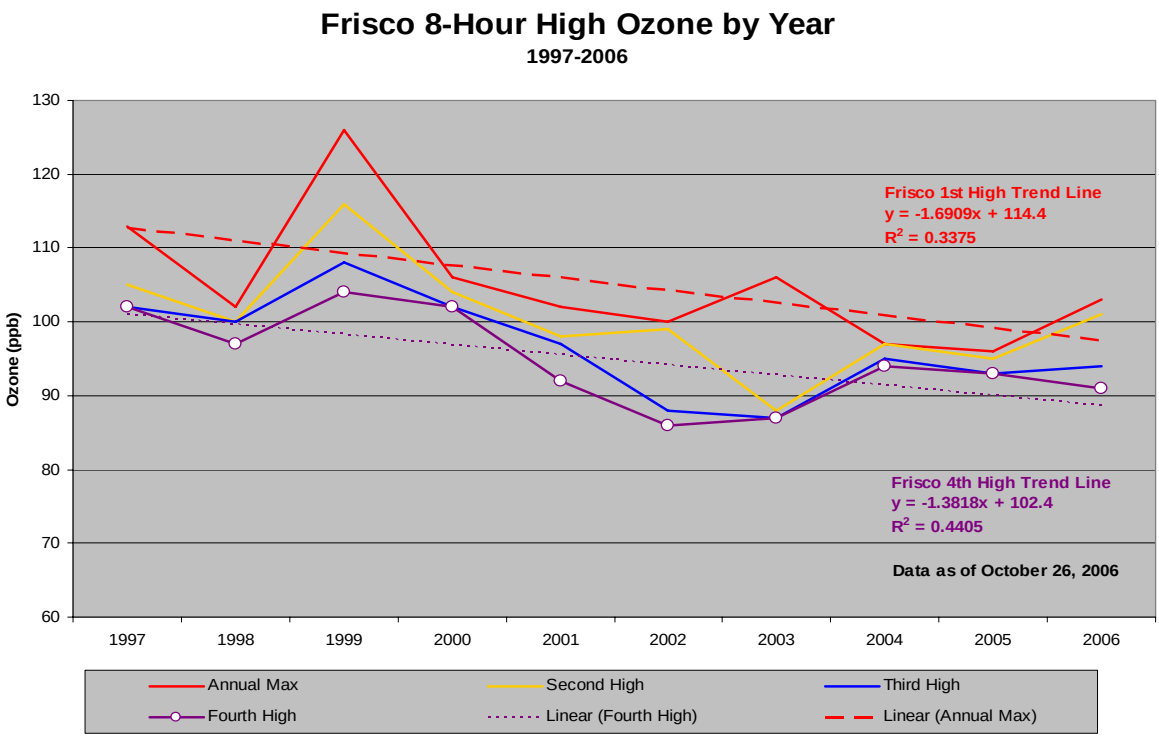


Figure 3-5: Frisco Eight-Hour Ozone Trends

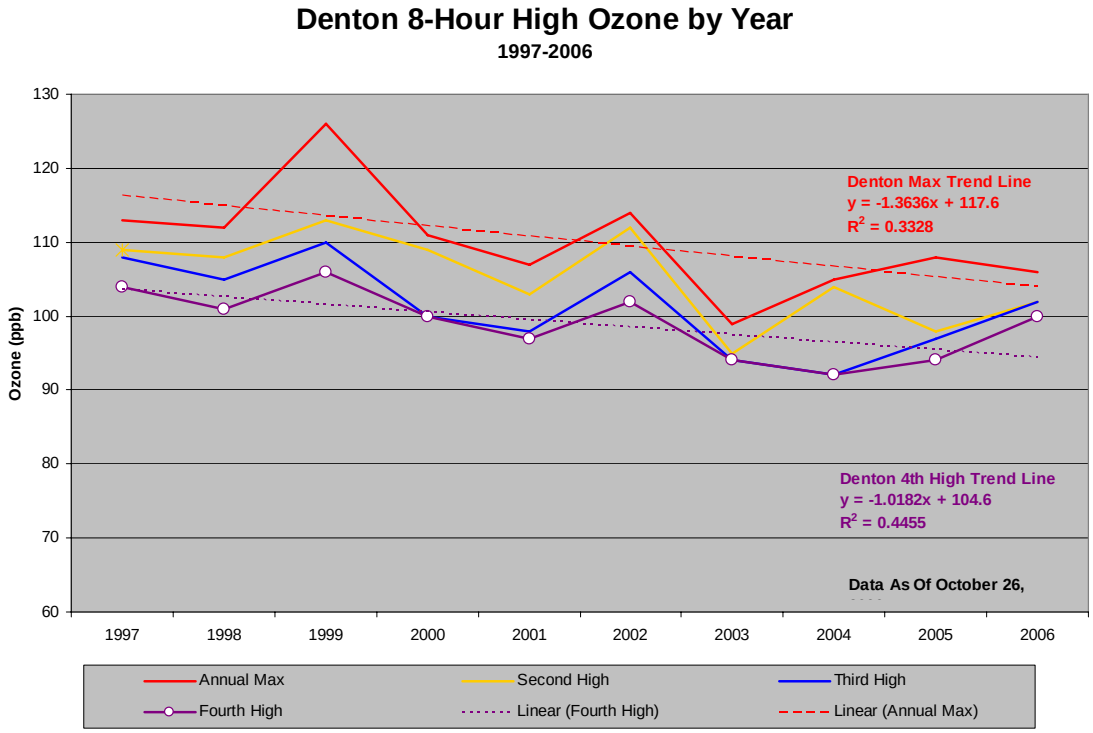


Figure 3-6: Denton Eight-Hour Ozone Trends

Table 3-1: *DFW Eight-Hour Ozone Trends* shows the period of record, the slope of the 4th highest ozone, and the correlation coefficient for each monitor.

Table 3-1: DFW Eight-Hour Ozone Trends

Ozone 4th High Trend Line Summary			
Site Name	Years	Slope (ppb/yr)	Correlation
Frisco	1997-2006	-1.3818	0.4405
Denton	1997-2006	-1.0182	0.4455
Grapevine	2000-2006	0.8929	0.0481
FtW NW	1997-2006	0.2000	0.0117
Keller	1997-2006	0.7273	0.1092
Eagle Mtn	2000-2006	0.2143	0.0112

Table 3-1: *DFW Eight-Hour Ozone Trends* shows that while trends at the Frisco and Denton monitors are decreasing, the slopes at Grapevine, Fort Worth NW, Keller, and Eagle Mountain appear to be increasing slightly. However, the correlation coefficients for those monitors account for only one to five percent of the variance, so the trend lines are not conclusive.

Future design values cannot be calculated for the Grapevine and Eagle Mountain sites because the monitors were not operating in 1997, 1998, and 1999. Nor can baseline design values be calculated for those sites for this SIP revision. Nevertheless, computer simulated ozone values for Grapevine and Eagle Mountain base and future years are available, allowing TCEQ to calculate Relative Reduction Factor (the average of the daily RRFs for each site).

Table 3-2: *Relative Reduction Factors (RRFs) for New Monitors* shows the average RRF for each new monitor in the DFW area between 1999 and 2009 (including the Combination 4 control package). The table shows that the modeled values at both the Eagle Mountain Lake and

Grapevine locations decrease significantly over the period. The RRFs calculated for those sites are .858 and .895 respectively, indicating that in 2009 (with the addition of the proposed control package), the model predicts ozone reductions of 10-14% at those two sites. This indicates that implementation of this SIP revision's control strategies would help move toward measuring attainment at the sites.

Table 3-2: Relative Reduction Factors (RRFs) for New Monitors

New Monitor Analysis			
Site Name	Start Date	2006 DV	Daily RRF
Anna C68*	1-Nov-99	---	0.865
Sunnyvale C74**	14-Nov-00	83**	0.895
Granbury C73	9-May-00	84.0	0.844
Cleburne C77	10-May-00	87.0	0.880
Kaufman C71	11-Sep-00	75.0	0.874
Weatherford C76	26-Jul-00	88.0	0.858
Rockwall C69	8-Aug-00	80.0	0.872
Eagle Mtn C75	6-Jun-00	96.0	0.858
Grapevine C70	4-Aug-00	93.0	0.895
Waco C5010***	---	---	0.850
Temple C651****	31-Jul-05	---	0.890

Design Values Calculated as of 10/26/06
* Anna - Deactivated Sept 29, 2004, Only 1 year of recent data
** Sunnyvale - Deactivated March 30, 2006, only 2 years of recent data
*** Waco - Meteorology Only
**** Temple - Only one year of data

3.2 NO_X AND VOC TRENDS

NO_X and VOC trends support that emissions are decreasing in the DFW area. Anthropogenic NO_X and VOC emissions fall into the four following categories: point source, on-road mobile sources, non-road mobile sources, and area sources. The NO_X and VOC emissions data used for the trend analyses described in this section were from various data sources. The point source emission inventory (EI) data were collected from annual emission inventories provided by the companies located in the DFW area. The Texas Transportation Institute prepared the on-road mobile source data for the TCEQ. The TCEQ prepared the area and the non-road mobile source data for 2002 using EPA approved models and techniques. The Environ Corporation, under contract with the TCEQ, prepared all other emissions inventory data for non-point sources located outside of Texas.

The annual reported NO_X emissions by source from 1999 in the DFW area are shown in Figure 3-7: *1999 Anthropogenic NO_x Emissions by Source Category in the DFW Area* and the annual reported VOC emissions from 1999 in the DFW area are shown in Figure 3-8: *1999 Anthropogenic VOC Emissions by Source Category in the DFW Area*. The pie chart in Figure 3-7 shows that on-road mobile source emissions contribute over half of the NO_X emissions in the DFW area. The pie chart in Figure 3-8 shows that point sources contribute a much lower percentage than do other sources to the VOC emissions in the DFW area. Like the NO_X emissions, the largest contributors to VOC emissions in the DFW area are on-road mobile sources.

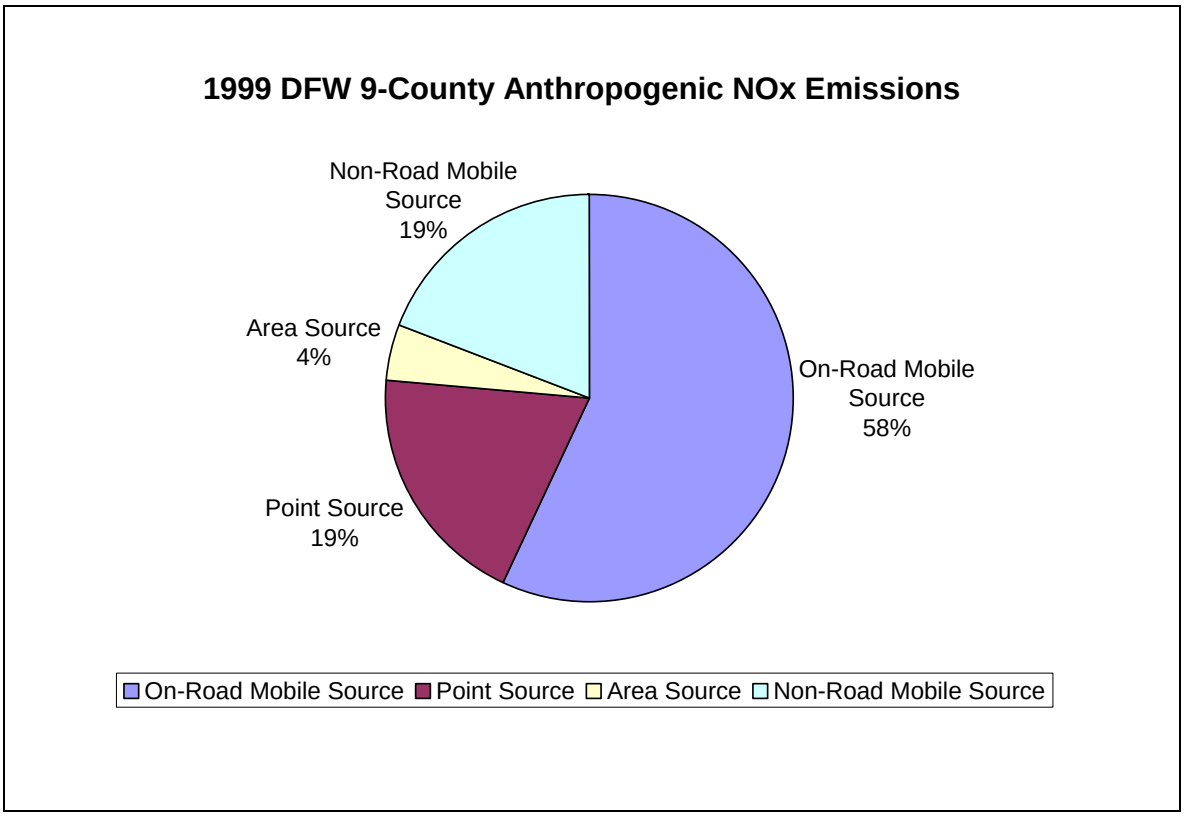


Figure 3-7: 1999 Anthropogenic NO_X Emissions by Source Category in the DFW Area

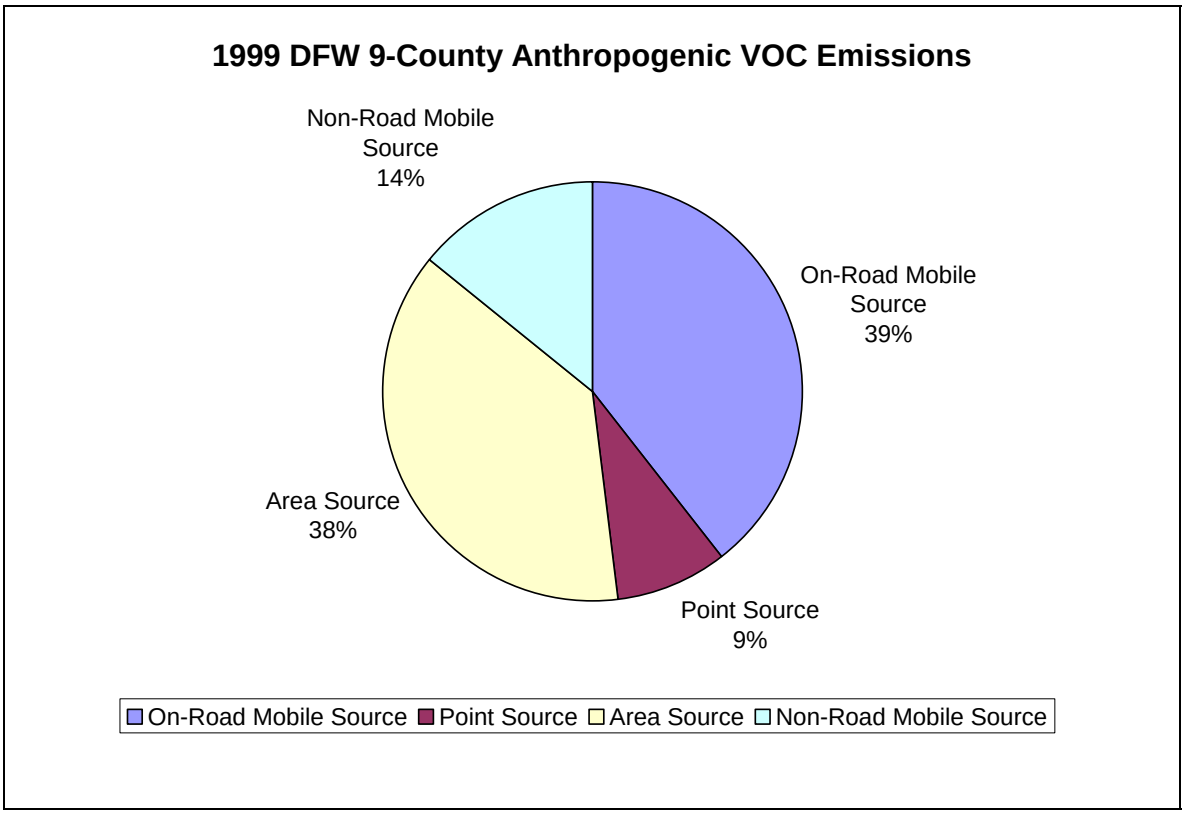


Figure 3-8: 1999 Anthropogenic VOC Emissions by Source Category in the DFW Area

Figure 3-9: *NO_X Emission Inventory Trend in the DFW Area from 1990 to 2003* shows the NO_X emission inventory trend by source category for the DFW area from 1990 to 2003. The trends in the total DFW area NO_X emissions appear to depend on the trends in the NO_X emissions from on-road mobile sources, a source that the TCEQ does not have the authority to regulate directly. Even though the population and the vehicle miles traveled have increased, the NO_X trends from on-road mobile sources, as well as the total NO_X emissions, have been decreasing since 1999[1], due largely to fleet turnover and to the implementation of programs such as the Vehicle Inspection and Maintenance (I/M) program in the DFW area. The one-hour ozone SIP NO_X measures also came into effect after adoption in December 1999. The NO_X emissions from point sources, which the TCEQ has the authority to regulate directly, showed a decrease of 44 percent from 1990 to 2003. The non-road mobile source and the area source NO_X emissions had an increase of 16 percent and 51 percent, respectively.

The decreasing trend in the reported NO_X emissions is corroborated by the ambient NO_X data. The measured NO_X concentrations in the DFW area also decreased from during a similar time (1995 to 2005). All of the monitors in the DFW area show decreasing trends in the NO_X median and the 95th percentile, except for Midlothian Tower and Denton Airport South. Preliminary analysis from the TCEQ shows that the increasing NO_X at the Midlothian Tower site could be due to a change in quarry mining operations. In 2000, the quarry began mining closer to the monitor's location and switched to a process that uses heavy-duty diesel machinery instead of blasting. Because Denton Airport South is located closer to the urban core, the increase in the NO_X there is likely due to the transport of NO_X from the urban core of the DFW area.

Figure 3-10: *VOC Emission Inventory Trend in the DFW Area from 1990 to 2003* shows the VOC emission inventory trends by source category in the DFW area from 1990 to 2003. The VOC emissions in the DFW area come primarily from area sources and on-road mobile sources. The reported VOC emissions inventory trends have shown statistically significant decreases of about 30 percent over the past 14 years. While the on-road mobile sources, point sources, and non-road mobile sources have decreased over the past 14 years by 52 percent, 37 percent, 38 percent, respectively, the area sources have increased by 34 percent over that same time.

The ambient VOC concentrations in the DFW area have also decreased. The DFW area has two monitors that continuously measure VOC concentrations. These monitors are automated gas chromatographs (auto-GCs) located at the Hinton St. monitor in Dallas and the Northwest monitor sites in Fort Worth. VOC data is available for the Hinton St. Monitor from 1996 to 2005 and for the Fort Worth Northwest site from 2003 to 2005. Because of the short timeframe of data at the Fort Worth Northwest monitor, the trend analysis investigation was limited to the Dallas Hinton St. Monitor. The average total VOC concentration at the Hinton monitor in Dallas has been significantly decreasing from 1996 to 2004.

Because background ozone is a large portion of the maximum ozone, the emission trends outside of the DFW area were also investigated. While emissions in the DFW area are dominated by on-road mobile sources, point sources contribute the largest amount to the emissions outside of the DFW area. Emissions from point sources located outside of the DFW area have decreased by large amounts from 1990 to 2003.

[1] Mobile source emissions in Figure 4-5 and Figure 4-6 were calculated using the Mobile 5 model. Mobile Source emissions from the Mobile 6 model, which is an updated version of the Mobile 5 mode, are available after 1999.

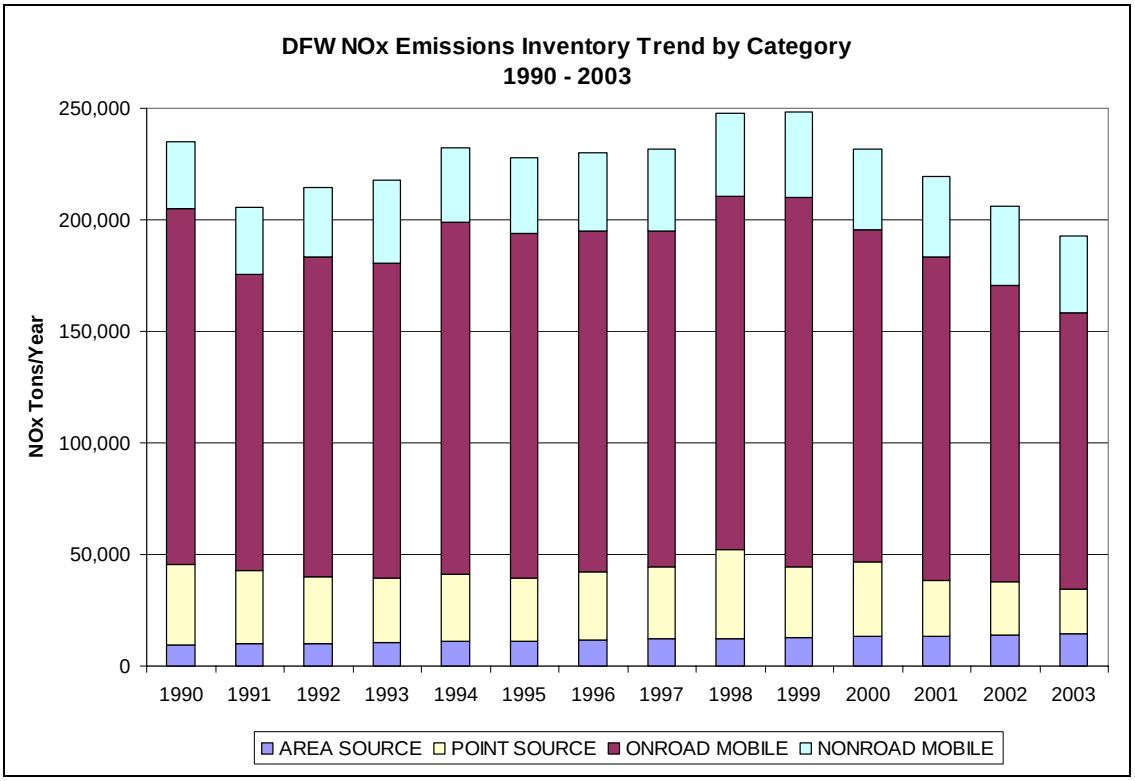


Figure 3-9: NO_X Emission Inventory Trend in the DFW Area from 1990 to 2003

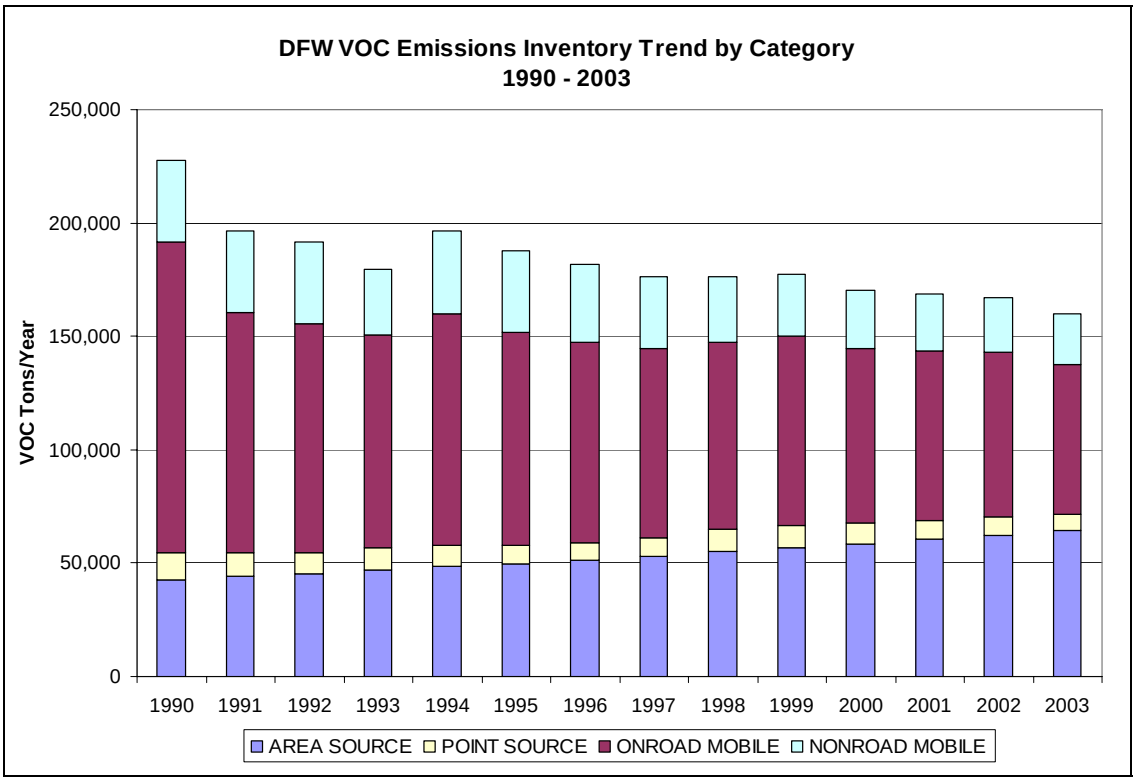


Figure 3-10: VOC Emission Inventory Trend in the DFW Area from 1990 to 2003

3.3 VOC AND NO_X LIMITATIONS ANALYSIS

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 and which controls (VOC or NOx) are likely to be most effective in controlling ozone. A NO_X limited region occurs where the radicals from VOC oxidation are abundant, and therefore the ozone formation is more sensitive to (and limited by) 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 (and responsive) to changes in the radicals from VOC oxidation present in the atmosphere. In VOC limited regions, controlling VOCs 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 Measurement-based Analysis of Preferences in Planned Emission Reduction (MAPPER) program uses a smog production (SP) algorithm to estimate where and when the ozone formation VOC or NO_X limited. The advantage of using the MAPPER program is that is does not need measured VOC concentrations in order to calculate the VOC and NO_X limitations. MAPPER calculates the extent of reaction (E), which describes how far the reactions proceed before running out of precursor chemicals, and E is what determines if the area is VOC or NO_X limited. If E is less than 0.6, the air mass is described as VOC limited. If E is greater than 0.9, the air mass is considered NO_X limited. If E falls between 0.6 and 0.9, the air mass is considered transitional (Chinkin, Main, and Roberts). The SP algorithm uses "true" NO_X to calculate the extent of reaction. Most air quality monitors, however, measure NO_X plus fractions of NO_X reaction products (Blanchard, Ladner, Roberts, and Tanenbaum). These reaction products tend to overestimate the "true" concentration of NO_X, causing an underestimate of the "true" extent of reaction.

The top five days with the highest ozone concentrations in DFW for each year from 1998 to 2004 were selected for MAPPER analysis. Then, the five hours surrounding the peak ozone were then chosen for each site and each day. Next, the five hours from the five highest ozone days were then used to calculate the median extent of reaction for each site for each year. Lastly, the five median extent of reaction for each year were averaged together to obtain a mean limitation for each monitoring site.

The MAPPER results show that, on high ozone days from 1998 to 2002, the area around Denton Airport was NO_x limited, but in the past two years the area has moved into the transitional range. The results also show that, on high ozone days from 2001 to 2002, the area around Midlothian Tower was strongly NO_x limited, but in 2003 and 2004 it changed to transitional and is approaching VOC limited conditions. All other sites showed transitional conditions.

Figure 3-11: *Spatial Patterns of the Extent of Reaction in the DFW Area* shows the spatial distribution of the mean extent of reaction in the DFW area from 1998 to 2004. The urban core of the DFW area is in the transitional range but is closer to VOC limited conditions while the more rural areas are closer to NO_X limited conditions. Although VOC reductions appear to possibly be helpful in the urban core, biogenic VOC emissions are present in sufficient amounts to carry reactions forward. The focus remains on controlling NO_X emissions outside of the urban core.

The analysis shows that on average, the DFW urban core is transitional and will respond to both NO_X and VOC reductions. However, the wind direction and therefore source alignments change every day, so that on some days the urban core may respond better to VOC reductions, and on other days, it will respond better to NO_X reductions. The areas further from the urban core are also transitional, but tend to be relatively more responsive to NO_X controls.

However, the areas downwind of the city (especially Denton) are NO_X limited and therefore respond best to NO_X reductions. Since these downwind areas have the highest measured ozone concentrations and are the most difficult to bring into attainment, a reduction strategy that emphasizes NO_X reductions is appropriate for the DFW area.

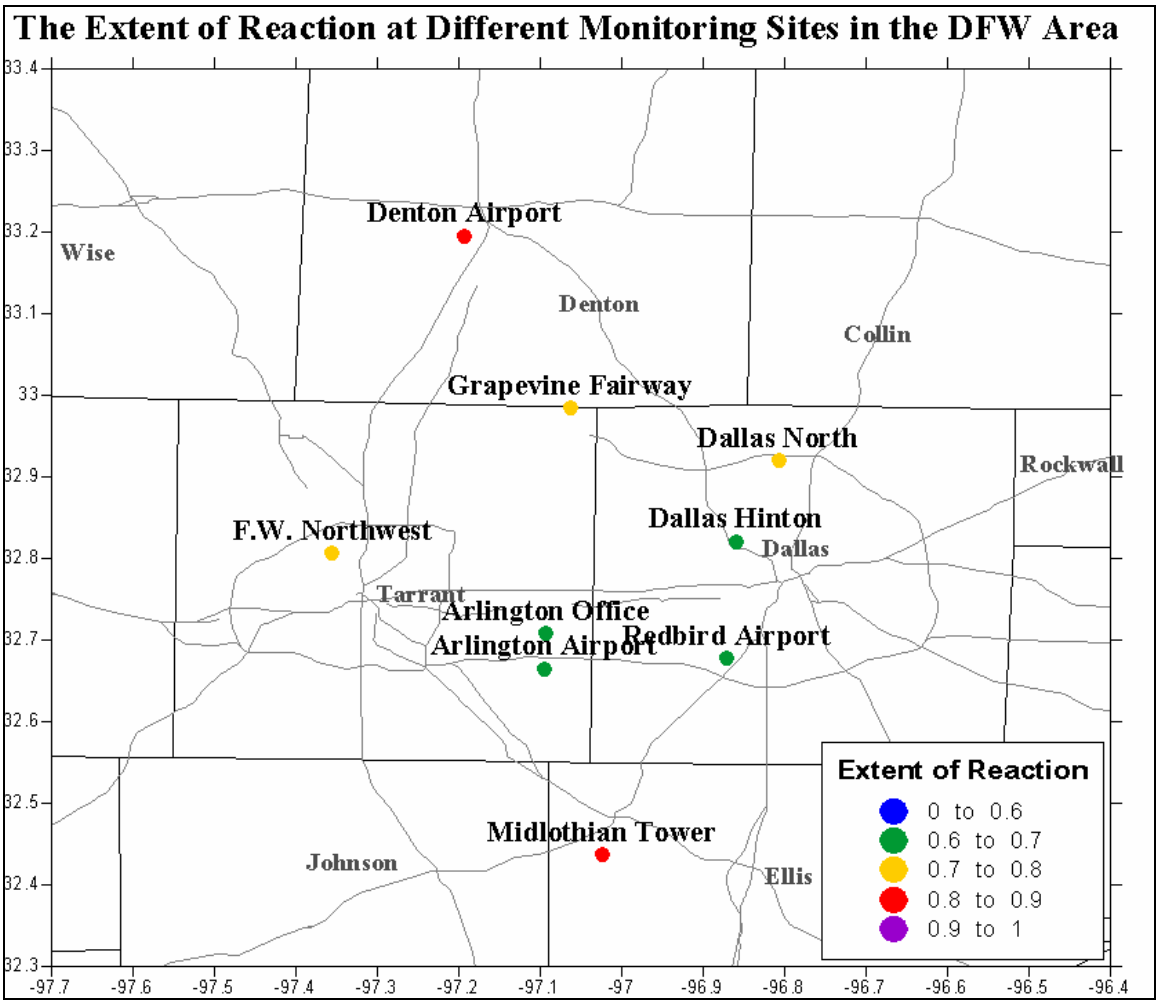


Figure 3-11: Spatial Patterns of the Extent of Reaction in the DFW Area.

3.4 CONCLUSIONS

Despite a continuous increase in the population of the 9-county area and other factors such as increases in the vehicle miles traveled, the Dallas-Fort Worth area is experiencing decreasing trends for ozone and its precursors, NO_X and VOC. The one-hour and the eight-hour ozone design values both show decreasing trends over the past 15 years. The one-hour decreasing trend is about 10.7 percent, the eight-hour ozone trend is about 9.5 percent lower than in 1991. In 2005, the peak one-hour ozone design value reduced to 125 ppb, while the peak eight-hour ozone design value reduced to 95 ppb.

The trends in total NO_X emissions appear to be dependent on the trends in NO_X emissions from on-road mobile sources, a source that the TCEQ is federally preempted from setting emission standards, and therefore has limited ability to control. Current activities, such as fleet turnover from older to newer vehicles and equipment and the implementation of programs such as the Vehicle Inspection and Maintenance program in the DFW and outlying areas have been beneficial. The NO_X emissions from point sources, a source that the TCEQ directly regulates,

have decreased 44 percent over the past 14 years. The trends in reported emissions are corroborated by the measured ambient NO_X data, which confirms the reported decrease in the measured NO_X concentrations in the DFW area over the past 15 years.

The VOC emissions in the DFW 9-county area are primarily from area sources and on-road mobile sources, and have decreased by about 30 percent in the past 14 years. The measured ambient VOC concentrations in the DFW area have also decreased in the last nine years.

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 the ozone concentrations. Applications of the smog production (SP) algorithm indicated that the urban core of the DFW area is transitional but close to VOC limited conditions, while the more rural parts of the DFW area are transitional but closer to NO_X limited conditions. The analysis shows that on average, the DFW urban core is transitional, and will respond to both NOx and VOC reductions. However, the wind direction and therefore source alignments change every day, so that on some days the urban core may respond better to VOC reductions, and on other days, it will respond better to NO_X reductions. The areas further from the urban core are also transitional, but tend to be relatively more responsive to NO_X controls. As NOx, VOC, and the trends discussed in this Chapter indicate, existing and future controls will continue to further progress in the DFW area towards attaining the eight-hour standard.

Because photochemical modeling is an evaluation tool and not an absolute prediction of future ozone concentrations, additional data must be considered in order to draw conclusions about the validity of the final predicted design value and whether the attainment demonstration satisfies the requirements of the Federal Clean Air Act (FCAA).

In addition to the photochemical modeling, this SIP provides trends analyses and supplementary data to demonstrate that the DFW nine-county nonattainment area is on a path to attain the 0.08 ppm eight-hour ozone standard.

The Weight of Evidence (WoE) portion of this SIP consists of the corroborative analysis in Chapter 3, along with analysis of additional control strategies described Chapter 4 that were not included in the modeling. The additional analysis in the WoE portions of this SIP support a conclusion that this DFW SIP demonstrates attainment of the eight-hour ozone NAAQS.

3.5 REFERENCES

1. Nielsen-Gammon, John W., James Tobin, and Andrew McNeel. "A Conceptual Model for Eight-Hour Ozone Exceedances in Houston, Texas. Part I: Background Ozone Levels in Eastern Texas." Center for Atmospheric Chemistry and the Environment, Texas A&M University, 2004, p. 16-17.
2. Blanchard, Charles L., and Shelley Tanenbaum. "Weekday/Weekend Differences in Ambient Concentrations of Primary and Secondary Pollutants in Atlanta, Baltimore, Chicago, Dallas-Fort Worth, Denver, Houston, New York, Phoenix, Washington, and Surrounding Areas". Albany, CA: Envair, 2005, pp. 1-118.
3. Chinkin, Lyle, Hilary Main, and Paul Roberts. *PAMS Data Analysis Workshops, Illustrating the use of PAMS Data to Support Ozone Control Programs*. (Accessed November 21, 2005). http://www.epa.gov/oar/oaqps/pams/analysis/index.html#preface
4. Balnchard, Charles L., Donna Ladner, Paul Roberts, and Shelley Tanenbaum. "Enhancement of Measurement-Based Analysis of Preferences in Planned Emission Reductions (Ozone MAPPER) and Application to Data From the Baeumont-Port Arthur, Dallas-Fort Worth, El Paso, and Houston Metropolitan Areas, 1994-1999." Envair and Sonoma Technology Inc., 1999, pp. 7.

CHAPTER 4: REQUIRED CONTROL STRATEGY ELEMENTS

4.1 OVERVIEW OF EXISTING CONTROL STRATEGIES

Since the Dallas-Fort Worth (DFW) area was initially designated as nonattainment for ozone in 1991, the Texas Commission on Environmental Quality (TCEQ) has consistently taken steps to bring the area into attainment. The TCEQ and DFW area local governments have implemented numerous control measures to help improve DFW air quality. Emission reductions from federal measures have also helped the area. The control strategies implemented so far have significantly improved air quality in the DFW area. In the past 15 years, the area's one-hour ozone design value has decreased from 140 parts per billion (ppb) in 1990 to 125 ppb in 2005. The area's eight-hour ozone design value shows a similar trend, decreasing from 105 ppb in 1990 to 95 ppb in 2005. Ozone design values have decreased despite a steady increase in the area's population. Tables 4-1: *Existing Dallas-Fort Worth SIP NO_X Control Strategies*, and 4-2: *Existing Voluntary Mobile Emission Reduction Programs (VMEP) in the DFW SIP*, summarizes the state, local, and federal NO_X strategies currently in effect in the DFW area.

Table 4-1: Existing Dallas-Fort Worth SIP NO_X Control Strategies

Measure	tpd*	Description	Area(s) Affected	Start Date(s)
State Measures				
Point source controls	129.1	Reductions from industrial boilers. Reductions from utility boilers	4-county area	March 31, 2002 May 1, 2003-May 1, 2005
East and Central Texas Electric Generating Facility controls	375	Sets emission limits for boilers and turbines	East and Central Texas	May 1, 2003-May 1, 2005
East and Central Texas Cement Kiln Controls	10.6	Sets emission limits for cement kilns	East and Central Texas	May 1, 2003
Vehicle Inspection/ Maintenance	54.5	Yearly treadmill-type testing for pre-1996 vehicles and computer checks for 1996 and newer vehicles. ▪ Begin May 1, 2002 in 4 core counties ▪ Begin May 1, 2003 in 5 perimeter counties	9-county area	May 1, 2002 May 1, 2003
Texas Emission Reduction Plan (TERP)	22.2	Provides grant funds for heavy-duty diesel engine replacement/retrofit. Replaces construction restrictions and Tier 2/3 accelerated purchase.	9-county area	Jan 2002
Speed Limit Reduction	5.4	This rule reduces all posted speed limits of 65 and 70	9-county area	Sept 1, 2001

		mph by 5 mph.		
Cleaner Diesel	3.5	Requires all diesel for both on-road and non-road use to have a lower aromatic content and a higher cetane number	110 East Texas counties	January 31, 2006
Airport Ground Support Equipment	6.1	TCEQ agreements with American, Delta, Southwest, DFW International Airport, City of Dallas, and City of Fort Worth.	DFW area airports	Phased in through Dec 31, 2005
California Gasoline Engines	1.8	California standards for non-road large spark-ignition gasoline engines 25 hp and larger.	Statewide	Dec 31, 2004
Gas-Fired Water Heaters, Process Heaters and Small Boilers	0.5	Previously adopted statewide rule limiting NO_X emissions from these small-scale residential and industrial sources	Statewide	July 1, 2002 phased in through 2007
Lean-Burn Rich Burn Engines	1.87	Sets emission limits for gas-fired lean-burn engines Sets emission limits for gas-fired rich and lean-burn engine	4-county area 9-county area	March 31, 2002 June 15, 2007
Energy Efficiency	0.72	Implementation of International Residential Code and International Energy Conservation Code	Statewide	Jan. 1, 2002
Local Measures				
VMEP	3.9	Thirteen voluntary measures administered by the NCTCOG (see separate summary for details).	4-county area to 12-county area (vary by program)	Through 2007
Transportation Control Measures	4.7	Various transportation control measures.	4-county area	Through 2007

*NO_X reductions in tons per day (tpd) by 2007

Note:

- *"4-county area" or "core counties" refer to Collin, Dallas, Denton, and Tarrant counties.*
- *"9-county area" refers to the above counties plus Ellis, Johnson, Kaufman, Parker, and Rockwall counties. These are also known as the "five perimeter counties."*
- *"12-county area" refers to all the above counties plus Henderson, Hood, and Hunt counties.*

Table 4-2: Existing Voluntary Mobile Emission Reduction Programs (VMEP) in the DFW SIP

Measure	Description	NO_X Reduction (tpd)
Tier II Locomotive Engines	Only Tier II locomotive engines in the DFW area by 2005.	0 – 0.3
Non-Road Ozone Season Reductions	Survey work, public outreach and possibly some funding towards encouraging deferring emission causing activities until after 10 am during ozone season. Actual daily emission reductions are minimal so no credit is taken.	-
Sustainable Development	Program to favor sustainable development in each stage of the transportation planning, programming and construction process. Benefits are not quantified or claimed as of the most recent SIP revision.	-
Public Education Campaign/Ozone Season Fare Reduction	Public education campaign conducted by the North Texas Clean Air Coalition (NTCAC). Ozone action day announcements are made by NCTCOG throughout the region.	0.15
Alternative Fuel Program	NCTCOG provides up to 80% the incremental cost of an alternative fueled vehicle (AFV).	0.18
Employee Trip Reduction	Employers in the region with over 100 employees reduce employee commute vehicle trips through implementation of programs including vanpools, telecommuting, flexible work hours, transit pass subsidies, bicycling and other strategies.	0.53
Off-Road Heavy Duty Diesel Engine Retrofits	NCTCOG to survey and encourage the voluntary retrofit of diesel engines for non-road equipment in the 4-county region.	-
Vehicle Retirement Program/Vehicle Maintenance	Use of subsidies and direct acquisitions to remove high emission vehicles from the road.	0.77
Total		**1.63 – 1.93**

Despite the significant decreases in one-hour ozone design value and NO_X and VOC emissions in the DFW area, the increased stringency of the eight-hour ozone standard requires further reductions to bring the area into attainment of the eight-hour standard by 2009.

The VOC emissions in the DFW 9-county area come primarily from area sources and on-road mobile sources. The VOC emissions have decreased by about 62 percent in the past 14 years, mostly due to the continuing fleet turnover to cleaner vehicles. Point source VOC emissions have also been reduced in the four-county area due to rules in Chapter 115 implementing RACT (as detailed in Table 4-11). The ambient VOC concentrations in the DFW area have also decreased in the last nine years.

4.2 NO_X AND VOC CONTROL MEASURES

Table 4-3: DFW Modeled NO_x Reduction Estimates

August 17, 1999 Base Case Emissions Inventory	1999 Baseline Emissions (tpd)	2009 Future Year Base Inventory (tpd)	2009 Future Year Control Inventory (tpd)
Area sources	34	44	40
Non-road sources	148	107	100
Point Sources	134	59	35
On-road mobile sources	430	184	174
Biogenic sources	52	52	51
TOTALS	**747**	**447**	**400**

Table 4-4: Summary of Control Strategies NO_x Reduction Estimates for the DFW Attainments Demonstration

TCEQ-PROPOSED RULES	Estimated NO_x Reductions in 2009 (tpd)
DFW Industrial, Commercial, and Institutional Sources Rule	12.7
DFW Electric Generating Units Rule	2.0
DFW Minor Source Rule	4.5
Cement Kiln Rule	11.0
East Texas Combustion Source Rule	37[1]

[1]- This control strategy applies to 39 of the 61 counties within or traversed by the 200 km perimeter from DFW and the 2009 emissions reductions from the East Texas Combustion rule, as proposed, are estimated at approximately 37 tpd. The modeling control strategy sensitivity run (Combination 4), assumes the rule applies to all 61 counties within 200 km and reduces NO_X by 40.9 tpd.

DFW LOCAL INITIATIVES	Estimated NO_x Reductions in 2009 (tpd)
VMEP in 9 counties	2.63[2]
TCMs in 9 counties	0.26

[2]-The modeling control strategy sensitivity run (Combination 4) is based on NCTCOG's initial VMEP estimates and assumes VMEP will reduce NO_X emission by 16.3 tpd. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect any updates prior to adoption of this SIP revision.

FEDERAL MEASURES	Estimated NO_x Reductions in 2009 (tpd)
On-Road Measures	217.52
Non-Road Measures	21.49

4.2.1 VOC Control Measures

In April 2005, the commission adopted the DFW Five Percent Increment of Progress (IOP) SIP in order to demonstrate progress towards attainment and transition from the previous one-hour ozone standard to the eight-hour ozone standard. The VOC rules for Stage I vapor recovery and for surface coating processes were extended to Ellis, Johnson, Kaufman, Parker, and Rockwall Counties at that time.

The remaining applicable VOC rules were adopted on November 15, 2006, to meet the RACT requirements. The VOC RACT rules subject VOC-emitting sources located in Ellis, Johnson,

Kaufman, Parker, and Rockwall Counties to the same control, monitoring, testing, recordkeeping, and reporting requirements that sources in the other four counties in the DFW nonattainment area are subject.

4.2.2 NO_X Control Measures

4.2.2.1 Major Source NO_X Reductions

Industrial, Commercial, and Institutional (ICI) Sources

Proposed new division 30 TAC Chapter 117, Subchapter B: Combustion Control at Major Industrial, Commercial, and Institutional Sources in Ozone Nonattainment Areas; Division 4: Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Major Sources (§§117.400-117.456), would require owners or operators of major sources of NO_X in the DFW area to reduce NO_X emissions by March 1, 2009. The proposed emission specifications for industrial, commercial, or institutional (ICI) boilers and gas turbines; duct burners used in turbine exhaust ducts; process heaters and furnaces; stationary internal combustion engines; metallurgical heat treating and reheat furnaces; and incinerators are consistent with current emission specifications effective in the HGB ozone nonattainment area.

New emission specifications are proposed for certain source categories in the DFW eight-hour ozone nonattainment area that currently have no known emission specifications established. These source categories, proposed to be newly regulated under Chapter 117, include brick and ceramic kilns; lime kilns; electric arc furnaces used in steel production; lead smelting blast (cupola) and reverberatory furnaces; glass melting furnaces; fiberglass and mineral wool fiber melting furnaces; fiberglass and wool fiber curing and forming ovens; natural gas-fired heaters, ovens, and dryers used in organic solvent, printing ink, ceramic tile, clay, and brick drying, and calcining and vitrifying.

Proposed new emission specifications vary by unit type and size. To achieve the proposed emission specifications, owners or operators of subject units may be required to maintain good engineering and combustion practices, install available NO_X controls, replace older units with those capable of complying with emission specifications, or utilize combinations of these compliance methodologies.

The proposed new NO_X emission specifications for gas-fired boilers are 0.020 pounds per million British thermal units of heat input (lb/MMBtu) for units with a maximum rated capacity greater than or equal to 100 million British thermal units per hour (MMBtu/hr), 0.030 lb/MMBtu for units with a capacity greater than or equal to 40 MMBtu/hr but less than 100 MMBtu/hr, and 0.036 MMBtu/hr (or alternately, 30 parts per million by volume (ppmv) at 3.0 percent oxygen (O_2) dry basis) for units with a capacity less than 40 MMBtu/hr. Proposed new NO_X emission specifications for liquid-fired boilers are 2.0 pounds per 1,000 gallons of liquid burned.

The proposed new NO_X emission specifications for process heaters are 0.025 lb/MMBtu for units with a maximum rated capacity greater than or equal to 40 MMBtu/hr, and 0.036 lb/MMBtu (or alternately, 30 ppmv at 3.0 percent O_2 dry basis) for units with a capacity less than 40 MMBtu/hr. The proposed new NO_X emission specification for gas-fired ovens and heaters, and organic solvent, printing ink, clay, brick, and ceramic tile, calcining, and vitrifying dryers is 0.036 lb/MMBtu.

Proposed new NO_X emission specifications for stationary gas turbines and duct burners used in turbine exhaust ducts are 0.032 lb/MMBtu for units rated at 10 megawatts (MW) or greater, 0.15 lb/MMBtu for units rated at greater than 1.0 MW but less than 10 MW, and 0.26 lb/MMBtu for units rated at less than 1.0 MW.

The proposed new NO_X emission specifications for metallurgical furnaces are 0.087 lb/MMBtu for heat treating furnaces, 0.10 lb/MMBtu for reheat furnaces, 0.30 pound per ton (lb/ton) of

product for electric arc furnaces, and 0.45 lb/ton of product for lead smelting blast (cupola) and reverberatory furnaces used in conjunction.

The proposed new NO_X emission specifications for incinerators are 0.030 lb/MMBtu or 80 percent reduction from their reported calendar year 2000 emission inventory. The proposed new emission specification for lime kilns is 3.1 lb/ton of calcium oxide produced. The proposed new NO_X emission specification for brick and ceramic kilns is 0.175 lb/ton of product.

The proposed new NO_X emission specifications for glass and fiberglass melting furnaces are 1.30 lb/ton of glass pulled for container glass melting furnaces, 1.45 lb/ton of product pulled for mineral wool-type electric fiberglass melting furnaces and mineral wool-type fiberglass regenerative furnaces. The proposed new NO_X emission specification for gas-fired curing and forming ovens used for the production of mineral wool-type or textile-type fiberglass is 0.036 lb/MMBtu.

In April 2005, the commission adopted the DFW Five Percent IOP SIP in order to demonstrate progress towards attainment and transition from the previous one-hour ozone standard to the eight-hour ozone standard. A portion of the Five Percent IOP was achieved through NO_X reductions from stationary gas-fired reciprocating internal combustion engines. Emission specifications were adopted in §117.206(b)(3) for stationary gas-fired engines rated 300 horsepower (hp) or greater at major sources of NO_X in the DFW eight-hour ozone nonattainment area. Lean burn engines are limited to 2.0 grams per horsepower-hour (g/hp-hr). Rich burn engines installed, modified, reconstructed, or relocated before January 1, 2000, are limited to 2.0 g/hp-hr. Rich burn engines installed, modified, reconstructed, or relocated on or after January 1, 2000, are limited to 0.50 g/hp-hr.

Compliance with these emission standards is determined based on the current monitoring, testing, reporting, and recordkeeping procedures for major sources in the DFW ozone nonattainment area. Initial compliance with the emission specifications is determined through stack testing using EPA test methods or EPA approved test methods. The compliance date for owners or operators to comply with the IOP emission specifications and other associated requirements, is June 15, 2007.

Under the proposed new emission specifications for stationary engines, owners or operators of lean burn and rich burn stationary internal combustion engines that are fired on landfill gas must comply with the proposed emission specification of 0.6 g/hp-hr. All other gas-fired and dual-fuel stationary internal combustion engines must limit their emissions to 0.50 g/hp-hr. In addition, the 300 hp exemption will no longer apply and engines less than 300 hp will be required to meet the same emission specifications.

Many existing diesel-fueled internal combustion engines may currently be operating within the proposed new emission specification of 11.0 g/hp-hr or have the capacity to do so. Proposed emission specifications for diesel engines placed into service on or after June 1, 2007, range from 2.8 to 5.0 g/hp-hr, depending on the year of installation and engine rating. Since the NO_X emission specifications are derived from the EPA Tier standards for diesel engines, owners or operators would be required either to purchase new manufactured units compliant with the proposed emission specifications or to retrofit a relocated existing engine. A stationary diesel engine operated less than 100 hours per year, based on rolling 12-month average, would be exempt if the engine was placed into service before June 1, 2007, and not modified, reconstructed, and relocated on or after June 1, 2007. Any new, modified, reconstructed, or relocated stationary diesel placed into service on or after June 1, 2007, that operates less than 100 hours per year, based on a rolling 12-month average, in other than emergency situations would also be exempt provided the engine meets the corresponding emission standards in 40 CFR §89.112(a), Table 1 (October 23, 1998), in effect at the time of installation, modification, reconstruction, or relocation. This requirement ensures that as older diesel engines are replaced, the engine will be replaced with newer and cleaner model engines.

An additional control requirement that applies to stationary diesel engines as well as stationary dual-fuel engines is the prohibition on starting or operating engines for testing or maintenance purposes between 6:00 a.m. and noon. This measure delays NO_X emissions from the engines primarily used as back-up engines until after noon to help limit ozone formation. Testing requiring a run over 18 consecutive hours recommended by the manufacturer, to verify reliability of emergency equipment immediately after unforeseen repairs, and firewater pumps for emergency response training from April 1 through October 31 would be exempt from this prohibition.

These proposed emission specifications for attainment demonstration are equivalent to or more stringent than any RACT requirement that might be applied to applicable source categories in the five new counties of the DFW eight-hour ozone nonattainment area. Therefore, a separate rulemaking expanding the existing RACT emission specifications in existing §117.205 to the five new counties is not necessary.

Compliance with these emission standards is determined based on monitoring, testing, reporting, and recordkeeping procedures consistent with the current requirements for ICI sources in the HGB ozone nonattainment area. A continuous emissions monitoring system (CEMS) or predictive emissions monitoring system (PEMS) for NO_X is required for units with a maximum rated capacity of 100 MMBtu/hr or greater, stationary gas turbines with a MW rating equal to or greater than 30 MW, units that use a chemical reagent to control NO_X, units that comply on a 30-day rolling average, and on any kiln subject to the proposed rule. For units not required to have NO_X CEMS or PEMS, initial compliance with the proposed emission specifications is determined through stack testing using EPA test methods or EPA approved test methods. In addition, similar to requirements for major sources in the HGB ozone nonattainment area, biennial (or within 15,000 hours of operation) testing and quarterly checks for NO_X and carbon monoxide (CO) are required. Carbon monoxide testing and monitoring procedures consistent with other ozone nonattainment areas are required. Ammonia monitoring using the same procedures required in the HGB ozone nonattainment area is required for units that use ammonia or urea injection for NO_X control.

Electric Generating Utility Sources

Proposed new 30 TAC Chapter 117 Subchapter C: Combustion Control at Major Utility Electric Generation Sources in Ozone Nonattainment Areas, Division 4: Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Utility Electric Generation Sources (§§117.1300-117.1356), establishes a unit-by-unit emission rate for compliance with the existing emission specifications for utility boilers, auxiliary steam boilers, stationary gas turbines, and duct burners used in turbine exhaust ducts and introduces a new efficiency, or output based, emission specification for utility boilers used in an electric power generating system owned or operated by a municipality or a public utility commission (PUC) regulated utility, or any of their successors, regardless of whether the successor is a municipality or is regulated by the PUC; or an electric cooperative, independent power producer, municipality, river authority, or public utility located within the DFW eight-hour ozone nonattainment area, with a March 1, 2009 compliance date.

The proposed new specifications for the regulation of NO_X emissions from electric generating units for the DFW eight-hour ozone attainment demonstration would retain the existing heat input based emission specifications, however, the proposal would remove the system-wide plant emission specifications or system cap method of compliance. Under the proposal, affected units would comply with the proposed emission specifications on a unit-by-unit basis. The proposed specifications would include a new efficiency, or output based (lb NO_X per megawatt-hour (lb/MW-hr)), compliance option. The proposed emission specification for utility boilers that are part of a small utility system is 0.06 lb/MMBtu heat input on a 24-hour rolling average basis from March through October and on a 30-day rolling average basis from November through February. Proposed emission specifications for utility boilers that are part of a large utility system are 0.033

lb/MMBtu heat input on a 24-hour rolling average basis from March through October, and on a 30-day rolling average basis from November through February; or 0.50 lb/MW-hr output on an annual average basis.

To satisfy RACT requirements for the five new counties, the existing RACT emission specifications from existing §117.105 that apply in the DFW ozone nonattainment area are proposed as emission specifications for attainment demonstration for the DFW eight-hour ozone nonattainment area. The proposed NO_X emission specifications for auxiliary steam boilers are 0.26 lb/MMBtu heat input on a 24-hour rolling average basis and 0.20 lb/MMBtu heat input on a 30-day rolling average basis while firing natural gas or a combination of natural gas and waste oil, 0.30 lb/MMBtu heat input on a 24-hour rolling average basis while firing fuel oil only, or the heat input weighted average of the applicable emission specifications on a 24-hour rolling average basis while firing a mixture of natural gas and fuel oil.

For stationary gas turbines with a MW rating greater than or equal to 30 MW and an annual electric output in MW-hr of greater than or equal to the product of 2,500 hours and the MW rating of the unit, proposed NO_X emission specifications are 42 ppmv while firing natural gas; and 65 ppmv while firing fuel oil used for peaking service with an annual electric output in MW-hr of less than the product of 2,500 hours and the MW rating of the unit NO_X emissions in excess of a one-hour block average of 0.20 lb/MMBtu heat input while firing natural gas; and 0.30 lb/MMBtu heat input while firing fuel oil.

For utility boilers or auxiliary steam boilers, CO limit of 400 ppmv (or alternatively, 0.30 lb/MMBtu heat input for gas-fired units and 0.31 lb/MMBtu heat input for oil-fired units) is being proposed, based on a one-hour average for units not equipped with a CEMS or PEMS for CO or a 24-hour rolling average for units equipped with CEMS or PEMS for CO and for any stationary gas turbine with a MW rating greater than or equal to 10 MW, CO emissions in excess of a one-hour block average of 132 ppmv. Proposed new ammonia limits, for units that inject urea or ammonia for NO_X control, are 10 ppmv for boilers and stationary gas turbines (including duct burners used in turbine exhaust ducts), based on a one-hour block average for units not equipped with a CEMS or PEMS for ammonia; or a 24-hour rolling average for units equipped with CEMS or PEMS for ammonia; and for all other units, 20 ppmv based on a one-hour block average.

Compliance with these proposed emission standards is determined based on monitoring, testing, reporting, and recordkeeping procedures consistent with the current requirements for utility electric generation sources in the DFW ozone nonattainment area. In addition, for sources for that owner or operator elects to use the output based emission standard of 0.50 lb/MW-hr, parameter monitoring of the gross energy production of the unit in megawatt-hours is proposed. Carbon monoxide testing and monitoring procedures consistent with other ozone nonattainment areas are required. Ammonia monitoring using the same procedures required in the HGB ozone nonattainment area is required for units that use ammonia or urea injection for NO_X control.

Cement Kilns

On April 15, 2005, a settlement agreement was entered into by the TCEQ and Blue Skies Alliance, et al. to resolve a lawsuit brought by the Blue Skies Alliance, et al., against the EPA. The settlement agreement required the TCEQ to conduct a study of technologies for controlling NO_X emissions from cement kilns, in consultation with the parties to the settlement. The report, entitled "Assessment of NO_X Emissions Reduction Strategies for Cement Kilns--Ellis County: Final Report," was submitted to the TCEQ on July 14, 2006, and is available on the commission's web site at *www.tceq.state.tx.us/implementation/air/sip/BSA_settle.html*.

The study evaluated the applicability, availability, and cost effectiveness of potential NO_X control technologies for cement kilns located in the DFW eight-hour ozone nonattainment area that could provide additional NO_X reductions beyond the current requirements of Chapter 117. The report primarily focused on three active types of control technologies for cement kilns: selective

catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and low temperature oxidation (LoTOx). Based on the results of this study, the TCEQ conducted modeling sensitivity studies at two levels of control to evaluate the potential ozone reduction benefit from possible cement kiln control strategies. The first control level modeling run was performed based on 35 – 50 percent control, and the second control level modeling run was performed based on 80 – 85 percent control.

After reviewing the final report of the control technology study, modeling sensitivity run results, and all other available information, the TCEQ has determined that the 35 – 50 percent control level is the most appropriate control level for this proposed rulemaking. This control level is based on using SNCR controls on cement kilns. SNCR control technology is applicable to both dry preheater-precalciner or precalciner kilns and long wet kilns. While SCR and LoTOx control technologies may be applicable to cement kilns, these control technologies are not as well established for cement kilns as SNCR control.

To implement this proposed control strategy, the TCEQ is proposing a source cap approach to establish a maximum NO_X emission cap for each account in Ellis County. This approach provides maximum flexibility for owners or operators to achieve the reductions modeled for this control strategy. A source cap allows an owner or operator to choose the most applicable and cost effective control technology available to a particular kiln while still achieving the overall reductions modeled for the DFW eight-hour ozone attainment demonstration. Owners or operators may use any of the control technologies identified in the final report of the control technology study to reduce emissions for compliance with the source cap. Before an increase in NO_X emissions from a change in operation from one unit or the installation of a new kiln could occur, a corresponding and equivalent decrease in NO_X emission would be required from another existing unit. Depending on the control options selected by the owner or operator, the source cap would not necessarily impact production.

Compliance with the proposed source cap would be on a 30-day rolling average basis. The 30-day rolling average basis for the source cap provides flexibility to account for the inherent variability in NO_X emissions from cement kilns. Owner or operators would demonstrate compliance with the source cap using proposed new monitoring, testing, reporting, and recordkeeping requirements in the proposed rule. The TCEQ estimates that this proposed rule will result in approximately 11 tons per day (tpd) in NO_X emission reductions.

4.2.2.2 Minor Source NO_X Reductions

Proposed amendments to 30 TAC Chapter 117, Subchapter D: Division 2--Combustion Control at Minor Sources in Ozone Nonattainment Areas, Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Minor Sources (§§117.2100-117.2145), would require owners or operators of minor sources of NO_X in the DFW eight-hour ozone nonattainment area to reduce NO_X emissions from affected boilers, process heaters, stationary internal combustion engines, and gas turbines (including duct burners). These amendments would regulate units at sites including small businesses and industries, hospitals, hotels, public and private office and administrative buildings, and school districts that were previously unregulated.

The TCEQ has identified approximately 2,769 boilers with a capacity less than 100 MMBtu/hr in the DFW eight-hour ozone nonattainment area, of which 1,712 are expected to be exempt from the rule because they are smaller than the minimum subject capacity of 2.0 MMBtu/hr, leaving about 1,057 boilers that would be subject to the proposed requirements. Gas-fired boilers and process heaters are anticipated to meet the proposed new emission specification of 0.036 lb/MMBtu heat input via combustion modifications and low NO_X burners (LNB). Liquid-fired boilers and process heaters are also anticipated to become compliant with the proposed new emission specification of 0.072 lb/MMBtu heat input using combustion modifications and LNB.

The TCEQ has identified approximately 207 stationary engines in the DFW eight-hour ozone

nonattainment area that are expected to be subject to the proposed new emission specifications. Of these, 61 are estimated to be lean-burn engines and 146 are estimated to be rich-burn engines. Rich-burn engines are anticipated to comply with the rule using NSCR and a secondary catalyst module. Lean-burn engines are likely to comply with either exhaust gas recirculation (EGR) plus NSCR or exhaust gas recirculation plus SCR.

Proposed new emission specifications are 0.60 g/hp-hr for stationary, gas-fired, reciprocating internal combustion engines fired on landfill gas and 0.50 g/hp-hr for all other reciprocating internal combustion engines. The proposed new emission specification is 5.83 g/hp-hr for stationary, dual-fuel, reciprocating internal combustion engines. The proposed new emission specification for stationary gas turbines (including duct burners) is 0.15 lb/MMBtu.

The proposed new emission specifications for stationary, diesel, reciprocating internal combustion engines are the lower of 11.0 g/hp-hr or the emission rate established by testing, monitoring, manufacturer's guarantee, or manufacturer's other data for units placed into service before June 1, 2007, that have not been modified, reconstructed, or relocated on or after June 1, 2007. For engines not subject to the above, the proposed new emission specifications are 5.0 g/hp-hr for units with a hp rating of 50 – 99 hp, installed, modified, reconstructed, or relocated on or after June 1, 2007, but before January 1, 2008; 3.3 g/hp-hr for units with a hp rating of 50 – 99 hp installed, modified, reconstructed, or relocated on or after January 1, 2008; 2.8 g/hp-hr for units with a hp rating of 100 – 749 hp, installed, modified, reconstructed, or relocated on or after June 1, 2007; and 4.5 g/hp-hr for units with a hp rating of 750 hp or greater installed, modified, reconstructed, or relocated on or after June 1, 2007. A stationary diesel engine operated less than 100 hours per year, based on rolling 12-month average, would be exempt if the engine was placed into service before June 1, 2007, and not modified, reconstructed, and relocated on or after June 1, 2007. Any new, modified, reconstructed, or relocated stationary diesel placed into service on or after June 1, 2007, that operates less than 100 hours per year, based on a rolling 12-month average, in other than emergency situations would also be exempt provided the engine meets the corresponding emission standards in 40 CFR §89.112(a), Table 1 (October 23, 1998), in effect at the time of installation, modification, reconstruction, or relocation. This requirement ensures that as older diesel engines are replaced, the engine will be replaced with newer and cleaner model engines.

An additional control requirement that applies to stationary diesel engines as well as stationary dual-fuel engines is the prohibition on starting or operating engines for testing or maintenance purposes between 6:00 a.m. and noon. This measure delays NO_X emissions from the engines primarily used as back-up engines until after noon to help limit ozone formation. Testing requiring a run over 18 consecutive hours recommended by the manufacturer, to verify reliability of emergency equipment immediately after unforeseen repairs, and firewater pumps for emergency response training from April 1 through October 31 would be exempt from this prohibition.

Stationary, dual-fuel, reciprocating internal combustion engines are anticipated to comply with the proposed new emission specification of 5.83 g/hp-hr using combustion modifications. Engines placed into service before January 1, 2007, that have not been modified, reconstructed, or relocated after January 1, 2007, would be limited to the lower of 11.0 g/hp-hr or the emission rate established by testing, monitoring, manufacturer's guarantee, or manufacturer's other data.

Compliance with these proposed emission standards is determined based on monitoring, testing, reporting, and recordkeeping procedures similar to the current requirements for minor sources in the HGB ozone nonattainment area. Initial compliance with the proposed emission specifications is determined through stack testing using EPA test methods or EPA approved test methods. In addition, similar to requirements for major sources in the HGB ozone nonattainment area, biennial (or within 15,000 hours of operation) testing and quarterly checks for NO_X and CO are required for stationary engines.

4.2.2.3 East Texas Combustion Source NO_X Reductions

Proposed amendments to 30 TAC Chapter 117, Subchapter E: Division 4--Multi-Region Combustion Control, East Texas Combustion (§§117.3300-3345), would require owners and operators of stationary, gas-fired, reciprocating internal combustion engines located in certain designated affected counties of the northeast Texas region, unless exempted, to meet NO_X emission specifications and other requirements to reduce NO_X emissions and ozone air pollution transport into the DFW area. The counties proposed to be included in this rulemaking are: Anderson, Bosque, Brazos, Burleson, Camp, Cass, Cherokee, Cooke, Franklin, Freestone, Grayson, Gregg, Grimes, Harrison, Henderson, Hill, Hood, Hopkins, Hunt, Lee, Leon, Limestone, Madison, Marion, Morris, Nacogdoches, Navarro, Panola, Rains, Robertson, Rush, Shelby, Smith, Somervell, Titus, Upshur, Van Zandt, Wise, and Wood Counties. Lean-burn gas-fired internal combustion engines would be required to comply with the proposed new emission specifications of 1.5 g/hp-hr for new engines placed into service on or after June 1, 2007, and 2.0 g/hp-hr for existing engines placed into service before June 1, 2007. These lean-burn gas-fired engines may require EGR plus NSCR, or low emission combustion (LEC) in order to comply with the proposed emission specifications. An emission specification of 1.0 g/hp-hr is proposed for rich-burn gas-fired internal combustion engines with a maximum rated capacity less than 500 hp. While no rich-burn engines fired on landfill gas were specifically identified in the proposed affected counties, landfill gas-fired engines, if any, are anticipated to use combustion modifications or engine replacement to comply with the proposed new emission specification of 0.60 g/hp-hr. All other rich-burn engines would be required to comply with an emission specification of 0.5 g/hp-hr using NSCR and a secondary catalyst module, if necessary.

According to the TCEQ's emissions inventory and studies conducted or funded by the TCEQ, NO_X reductions from sources outside the DFW area are instrumental for the DFW area to demonstrate attainment of the NAAQS for ozone. Results of photochemical modeling performed by the TCEQ show that stationary gas-fired engines in attainment counties in east Texas contribute a substantial portion of NO_X emissions that impact the DFW area.

The commission estimates that approximately 985 point source and area source stationary, gas-fired engines would be subject to this rule. While this rulemaking is proposed as part of the DFW attainment demonstration for the eight-hour NAAQS for ozone, the Northeast Texas Early Action Compact area in east Texas will also benefit from NO_X reductions resulting from this rule.

Compliance with these proposed emission standards is determined based on monitoring, testing, reporting, and recordkeeping procedures similar to the current requirements for minor sources in the HGB ozone nonattainment area. Initial compliance with the proposed emission specifications is determined through stack testing using EPA test methods or EPA approved test methods. In addition, similar to requirements for major sources in the HGB ozone nonattainment area, the proposed rule requires biennial (or within 15,000 hours of operation) testing and quarterly checks for NO_X and CO.

The modeling control strategy sensitivity run (Combination 4), assumes the rule applies to all 61 counties within 200 km and reduces ozone by 40.9 tpd. This control strategy applies to 39 of the 61 counties within or traversed by the 200 km perimeter from DFW. The 39 counties were selected to focus controls on those regions where gas-fired stationary engines are predominately located within the 200 km perimeter range, and where reductions of NO_X from these engines would benefit the DFW area. The 2009 emissions reductions from the East Texas Combustion rule, as proposed, are estimated at approximately 37 tpd. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision.

4.2.2.4 Water Heater Rule Revision

Proposed amendments to 30 TAC Subchapter E: Division 3--Multi-Region Combustion Control, Water Heaters, Small Boilers, and Process Heaters (§§117.3200-3215), would repeal the current

statewide emission standard of 10 nanograms NO_X per Joule heat input (ng/J) due to comments received and uncertainties in the capabilities of water heater manufacturers to produce units compliant with the current rule (rule project 2006-034-117-ED). Under the adopted rules, manufacturers, distributors, retailers, and installers of natural gas-fired water heaters with a maximum rated capacity of no more than 75,000 British thermal units per hour (Btu/hr), designated as a "Type 0 unit" in the adopted rules, manufactured, distributed, sold, or installed on or after July 1, 2002, but no later than December 31, 2004, are required to meet an emission limit of 40 ng/J. Type 0 units manufactured, distributed, sold, or installed on or after January 1, 2007, were required to meet a 10 ng/J heat input limit. The proposed rules repeal these standards and reinstate the 40 ng/J emission limit in force since July 1, 2002.

House Bill 965, from the 79th Texas Legislative Session, authorized this amendment and required emission reductions to offset the loss of SIP credits due to the potential repeal of the proposed rule. The TCEQ proposes to use reductions included in the DFW Five Percent IOP SIP submittal dated April 27, 2005, that were in excess of the five percent to offset the 0.5 tpd shortfall in the DFW four-county ozone nonattainment area. The DFW Five Percent IOP SIP provided information and control measures to provide for a five percent increment of progress from the area's 2002 emissions baseline in addition to federal measures and state measures already approved by EPA. Table 4-5: *DFW Five Percent Increment of Progress reductions*, shows that the DFW Five Percent IOP SIP contained 3.35 tpd VOC reductions that exceeded the five percent requirement. Because percent of this, the TCEQ proposes to use 0.5 tpd of reductions in NO_X emissions from the nine-county lean-burn and rich-burn engine rule to offset the shortfall. According to the DFW Five Percent IOP SIP, the nine-county engine rule will reduce NO_X emissions by 1.87 tpd by June 15, 2007, which is sufficient to offset the 0.5 tpd shortfall. If 0.5 tpd of reductions from the engine rule were removed from the DFW Five Percent IOP SIP, the reduction requirement for that SIP would still be met. The reduction requirement for the DFW Five Percent IOP SIP is based on total NO_X and VOC emissions combined; therefore, adjustment to the DFW Five Percent IOP SIP should not be necessary.

Table 4-5: DFW five percent Increment of Progress reductions

	Five Percent IOP SIP	
	April 27, 2005	
	TPD NO_X	TPD VOC
Adjusted Baseline Inventory	622.22	470.8
Percent Target Reduction	4.6	0.4
Target Reduction	28.62	1.88
Source of reductions	TPD NO_X	TPD VOC
Eligible existing measures		
Alcoa (within 200 km radius)	3.9	
TERP	22.2	
Energy efficiency	0.72	
Portable fuel containers (nine-county area)		2.79
Portable fuel containers (within 100 km radius)		0.63
Subtotal	26.82	3.42
Control measures requiring rulemaking		
Nine county lean-burn and rich-burn engine rule	1.87	
Expand surface coating rule to five counties		0.3
Lower Stage I exemption throughput to 10,000 gal/mo. in five counties (same as in four core counties)		1.49
Subtotal	1.87	1.79
TOTAL IDENTIFIED REDUCTIONS	28.69	5.21
Minimum reductions required to meet five%	28.69	1.86
REDUCTIONS BEYOND FIVE PERCENT IOP	0.00	3.35

4.2.3 Transportation Control Measures

Transportation control measures (TCM) are transportation projects and related activities that are designed to reduce on-road mobile source emissions and are included as control measures in the SIP. Allowable types of TCM are listed in §7408 (Air Quality Criteria and Control Techniques) of the FCAA, 42 USC, 1970, as amended, and defined in the federal transportation conformity rule found in Title 40 CFR, Part 93 (Determining Conformity of Federal Actions to State or Federal Implementation Plans). In general, a TCM is a transportation related project that attempts to reduce vehicle use, change traffic flow, or reduce congestion conditions. A project that adds single-occupancy-vehicle roadway capacity or is based on improvements in vehicle technology or fuels is not eligible as a TCM.

The North Central Texas Council of Governments (NCTCOG) has identified TCMs that have been or will be implemented in the nine-county nonattainment area. By July 2009, these TCMs will reduce NO_X emissions in the nonattainment area by 1.53 tpd and VOC emissions by 1.61 tpd. Table 4-6: *Total 2009 Estimated Emission Reductions by TCM Program* summarizes the 2009 emission reductions by type of TCM. The description below Table 4-4: *Summary of Control Strategies NO_x Reduction Estimates for the DFW Attainments Demonstration* shows how each program improves air quality. The region's transportation policy body (the Regional Transportation Council) approved and identified funding for these local commitments. In addition to the information provided in the SIP about TCM commitments, the federal transportation conformity rule requires that timely implementation of TCM be demonstrated.

Table 4-6: Total 2009 Estimated Emission Reductions by TCM Program

TCM Program	Commitments (Jan 2000 – July 2009)		July 2009 NO_X Benefits (lbs/day)		July 2009 VOC Benefits (lbs/day)	
	Modeled	**Post-Processed**	**Modeled**	**Post-Processed**	**Modeled**	**Post-Processed**
Bicycle/Pedestrian Projects	0.0 Miles	15.4 Miles	0.00	14.98	0.00	9.51
Grade Separation Projects	82 Locations	2 Locations	350.35	4.26	898.44	51.40
HOV/Managed Lane Projects	70.0 Miles	0.0 Miles	1,584.92	0.00	881.50	0.00
Intersection Improvement Projects	0 Locations	655 Locations	0.00	293.76	0.00	786.87
Park and Ride Projects	1,465 Spaces	820 Spaces	55.30	30.95	35.11	19.65
Rail Transit Projects	70.2 Miles	0.0 Miles	568.55	0.00	419.17	0.00
Vanpool Projects	0 Vanpools	216 Vanpools	0.00	168.99	0.00	113.11
Total Pounds/Day			**2,559.12**	**512.94**	**2,234.22**	**980.54**
Total Tons/Day			**1.27**	**0.26**	**1.12**	**0.49**

**All of the listed projects are commitments, have been approved by the transportation policy body (Regional Transportation Council), and are funded.*

***The project listing for each program area; with associated emission reductions and methodology will be accounted for in the subsequent Transportation Conformity Document(s).*

To avoid double counting emission reductions, the NCTCOG provided separately, the reductions accounted for in the photochemical model and the reductions that are calculated after the photochemical modeling work is complete, i.e., post-processed. Reductions accounted for in photochemical modeling are reflected in the on-road emissions inventory. Post-processed reductions are not reflected in the emissions inventory but are subtracted from the inventory to establish the motor vehicle emissions budget.

Bicycle/Pedestrian Projects

Projects that create and/or enhance bicycle/pedestrian pathways throughout the region serve to link individuals to alternative methods of transportation, other than driving a single occupancy vehicle. By doing so, the automobile emissions that would otherwise be released from the automobile are removed completely. In the North Central Texas region, a veloweb has been designed for use primarily by fast-moving bicyclists. The veloweb is also designed to encourage concurrent pedestrian transportation use. NCTCOG has identified 15.4 miles of veloweb projects that will be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

Grade Separation Projects

By separating a road or railroad track from a crossroad, idling time that would otherwise be created by intersection blockage is eliminated. With this elimination of idling, grade separations increase the efficiency of traffic flow thereby improving travel time and minimizing delay. Thus, vehicle emissions and fuel consumption are reduced. NCTCOG has identified 84 project locations to be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

High Occupancy Vehicle (HOV) Projects

High occupancy vehicle projects promote carpooling thereby removing single occupancy vehicles and the associated vehicle emissions released from the roadway. The increase in flow of HOV lanes offers incentive for drivers to carpool. NCTCOG has identified 70.0 lane miles of HOV projects that will be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

Intersection Improvement Projects
Improvements to intersections including left and/or right hand turn lanes decrease the amount of time automobiles are left idling at intersections. This decrease in idling reduces fuel consumption and vehicle emissions. NCTCOG has identified 655 intersection improvement locations that will be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

Park and Ride Projects
Park and ride facilities promote carpooling and vanpooling. With each occupied parking space at these locations, the emissions from the parked vehicle are reduced. Park and ride lots that also serve as transit stations are not accounted for in the analysis as it is assumed the majority of these park and ride lots contain transit riders that are then captured in Rail Transit Projects. NCTCOG has identified new location(s) to provide 2,285 additional new parking spaces in Park and Ride projects. These projects will be implemented by July 2009.

Rail Transit Projects
Rail projects involve implementation of new or expanded transit services or facilities. The improvements may be accomplished for all transit modes such as buses, rail, and paratransit. The three main components of improved transit are: system/service expansion projects, system/service operational improvements, and inducements. By improving regional transit systems, an increase in opportunity is created for new passengers as well as an increase in air quality benefits. NCTCOG has identified 70.2 miles of rail projects that will be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

Vanpool Projects
Vanpool projects include a group of six to fifteen commuters who travel to and from the same area, have similar work hours, share the costs of operating the van, and usually meet at a Park and Ride lot at a centralized location. These projects remove the extra vehicles that would otherwise be commuting by consolidating travelers into one automobile, there by reducing air pollution, traffic congestion, and helping conserve fuel. NCTCOG has identified 216 vanpools that will be implemented in the DFW eight-hour ozone nonattainment area by July 2009.

Projects in this section are described and documented in Appendix F: *Transportation Control Measures for the DFW Eight Hour SIP*. Appendix F, Table 1: *Completed Projects without Applicable Benefits* covers projects that have been implemented but the associated emission benefits are not applicable in this SIP Revision. Appendix F, Table 2: *Completed Projects with Applicable Benefits* covers projects that have been implemented as well as their emission benefits. Appendix F, Table 3: *Projects with Applicable Benefits* is a summary table including the original commitments, completed commitments, and remaining commitments for each category with associated NO_X and VOC emission benefits.

4.2.4 Voluntary Mobile Source Emission Reduction Programs (VMEP)
The 1990 Clean Air Act Amendments increased the states' responsibility to demonstrate progress toward attainment of the NAAQS. Voluntary mobile source measures have the potential to contribute, in a cost-effective manner, emission reductions needed for progress toward attainment and maintenance of the NAAQS.

Historically, federal mobile source control strategies have focused primarily on reducing emissions per mile through vehicle and fuel technology improvements. Tremendous strides have been made resulting in new light-duty vehicle emission rates that are 70 to 90 percent less than that for the 1970 model year. However, transportation emissions continue to be a significant cause of air pollution due to population and employment growth as well as an increase in daily vehicle miles traveled (VMT) per person. Therefore, mobile source strategies that attempt to complement existing regulatory programs through voluntary, nonregulatory changes in local transportation sector activity levels or changes in vehicle and engine fleet composition are being explored and developed.

A number of voluntary mobile source and transportation programs have already been initiated at the state and local level in response to increasing interest by the public and business sectors in creating alternatives to traditional emission reduction strategies. Some examples include economic and market-based incentive programs, trip reduction programs, growth management strategies, ozone action programs, and targeted public outreach. These programs attempt to gain additional emissions reductions beyond mandatory Clean Air Act programs by engaging the public to make changes in activities that will result in reducing mobile source emissions.

Table 4-7: *NCTCOG Voluntary Mobile Emission Reductions* summarizes the new DFW voluntary commitments under this SIP revision. The estimated benefits listed are calculated for the year 2009 only and may not be forecasted to estimate emission reductions for any other year. VMEP strategies are limited to nine percent or less of the total emissions reductions required. NCTCOG anticipates that the proposed VMEP emissions reductions will comply with this limitation.

NCTCOG identified seven voluntary programs that will aid in the improvement of the North Texas region's air quality. NCTCOG, as the regional metropolitan transportation planning agency for the DFW area, commits to make a good faith effort to implement the projects and/or programs outlined in this document. NCTCOG will be responsible for monitoring and reporting the emission reductions to the TCEQ. Any VMEP shortfall (of the total 2.63 tpd NO_X committed) will be covered by supplementing additional Transportation Emission Reduction Measures (TERMs). The program areas that may be used to remedy this shortfall are Traffic Signal Improvements; Intelligent Transportation Systems (ITS); and/or Freeway and/or Arterial Bottleneck Removal. These programs would be surplus to those already credited in the SIP.

More information on each of the VMEP commitments can be found in Appendix H: *Voluntary Mobile Source Emission Reduction Programs for the DFW Eight-Hour SIP*.

The modeling control strategy sensitivity run (Combination 4) is based on NCTCOG's initial VMEP estimates and assumes VMEP will reduce NOx emissions by 16.3 tpd. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision.

Table 4-7: NCTCOG Voluntary Mobile Emission Reductions

NORTH CENTRAL TEXAS STATE IMPLEMENTATION PLAN VOLUNTARY MOBILE EMISSION REDUCTION PROGRAM (VMEP) EMISSION BENEFITS BY PROGRAM TYPE				
PROGRAM TYPE	**2009 NOx BENEFITS (tons per day)**		**2009 VOC BENEFITS (tons per day)**	
	Modeled	**Post-Processed**	**Modeled**	**Post-Processed**
Clean Vehicle Program	0.00	0.24	0.00	0.05
Employee Trip Reduction	0.43	0.00	0.28	0.00
Locally Enforced Idling Restriction	0.00	0.62	0.00	0.02
Diesel Freight Idling Reduction Program	0.00	0.33	0.00	0.01
SmartWay Transport Demonstration Project	0.00	0.00	0.00	0.00
Public Agency Policy for Construction Equipment	0.00	0.06	0.00	0.01
Aviation Efficiencies	0.00	0.95	0.00	0.24
TOTAL BENEFITS (tons per day)	**0.43**	**2.20**	**0.28**	**0.33**

(1) NOx = Nitrogen Oxides, VOC = Volatile Organic Compounds

4.2.5 Other State and Local Programs:

4.2.5.1 Energy Efficiency

In the 77th Texas Legislative Session in 2001, the Energy Systems Laboratory (ESL), part of Texas Engineering Experiment Station, Texas A&M University System, was mandated as part of the TERP under Texas Health and Safety Code § 388.003(e) to provide an annual report on energy efficiency and renewable energy (EE/RE) efforts in the state. With TCEQ guidance, ESL produced an annual report detailing these efforts (*Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP))*. The report:

- provides quantification of energy savings and NO_X reductions resulting from building energy code compliance in new residential and commercial construction in the 41 affected counties;
- describes methodologies developed to enable the commission to substantiate energy and emission reduction credits from energy efficiency and wind and other renewable energy initiatives to the EPA, including development of a web-based emissions calculator; and
- outlines progress by ESL in advancing EE/RE methodologies for documenting pollution reduction credit in the SIP.

The DFW five Percent IOP included emission reduction credits of 0.72 tpd for EE/RE programs in the DFW eight-hour ozone nonattainment area. Energy efficiency reductions for 2007 were included in the DFW five Percent IOP SIP, based on electricity and natural gas usage reductions expected to occur following implementation of Texas Building Energy Performance Standards for single and multi-family residences adopted in September 2001. These calculations also included reductions in energy use from energy efficiency measures implemented by local governments and utilities and reported to the State Energy Conservation Office and the PUC.

Legislation passed during the regular session of the 79th Texas Legislature directed the ESL to collaborate with the commission to develop a methodology for computing emission reductions attributable to use of renewable energy (primarily wind) and for the ESL to quantify annually such emission reductions for inclusion in the SIP. House Bill 2921 directed the Texas Environmental Research Consortium to utilize the Texas Engineering Experiment Station to develop this methodology.

The ESL documents methods used to develop current estimates of energy savings and NO_X emissions reductions resulting from reductions in natural gas consumption and displaced power from conventional electric generating units (EGUs). The ESL used EPA's Emissions and Generation Resource Integrated Database to spatially allocate energy use and emission reductions among EGUs. For natural gas reductions, the ESL used AP-42 emissions factors to calculate emissions reductions.

The Texas Health and Safety Code sections 389.002 and 389.003 contain requirements that the PUC, the State Energy Conservation Office, and the ESL report to the TCEQ all emission reductions resulting from EE/RE projects in Texas. Current estimates of EE/RE related NO_X reductions in the DFW area are based on six types of EE/RE projects or programs:

Residential Building Code

The state residential building code (i.e. Texas Building Energy Performance Standards) for single family and multi-family housing, as adopted by the 77th Texas Legislature. See Texas Health and Safety Code Section 388.003.

Commercial Building Code

The state commercial building code for commercial buildings, known as Texas Building Energy Performance Standards, as adopted by the 77th Texas Legislature. See Texas Health and Safety Code Section 388.003.

Federal Facilities 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 most recent energy bill passed in August 2005) to reduce energy use. The ESL compiled energy reductions data for the federal EE/RE projects in Texas.

Political Subdivisions Projects
Political subdivisions in nonattainment and affected counties are required by SB 5 of the 77th Texas Legislature to report EE/RE projects to the State Energy Conservation Office. See Texas Health and Safety Code Sections 388.005 and 388.005. 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 5 and SB 7 of the 77th Texas Legislature to report these projects to PUC. See Texas Health and Safety Code Section 386.205 and Section 39.905 of the Texas Utilities Code. These projects are typically air conditioner replacements, ventilation duct tightening, and commercial and industrial equipment replacement.

Wind Power Projects
Measured electric power derived from wind power EGUs in the Electric Reliability Council of Texas service area.

Due to uncertainties in the data and methods used, emission reduction estimates have been reduced using a discounting formula. For example, the ESL estimates for building codes projects have been discounted 20 percent and the State Energy Conservation Office reported projects have been discounted 60 percent. Original emissions reductions estimates were also reduced a further five percent per year to account for systems degradation.

According to projections by the ESL, the nine-county DFW area is estimated to reduce NO_X in 2009 by 2.12 tpd from the six types of EE/RE measures and projects implemented from January 1, 2000, through December 31, 2009. Emissions reductions estimated as a result of energy efficiency were not explicitly included in the photochemical modeling because local efficiency efforts may not result in local emissions reductions.

4.2.5.2 Texas Emission Reduction Plan (TERP) NO_X Reductions
Future TERP funds, if appropriated by the Texas Legislature, would result in additional NO_X reductions and would be used to help meet the NCTCOG emission reduction goals, if necessary.

4.2.6 Additional Measures
In addition to the control strategies discussed and quantified above, several programs already in place in the DFW nine-county area will reduce NO_X emissions and will help bring the area into attainment of the eight-hour ozone standard. These programs include EPA's SmartWay program, additional energy efficiency measures, EPA's Blue SkyWays program, and TCEQ's Clean School Bus program, the use of Texas Low Emission Diesel (TxLED) by locomotive switcher engines in the DFW area, stationary diesel and dual-fuel engine control measures. Although these programs were not accounted for in the photochemical modeling, they will benefit air quality and help bring the DFW area into attainment of the eight-hour ozone standard.

4.2.6.1 EPA SmartWay and Blue SkyWays Programs
Among its various efforts to improve air quality in Texas, the TCEQ is currently promoting two voluntary programs in cooperation with the EPA: the SmartWay Transport Partnership and the Blue Skyways Collaborative.

The SmartWay Transport Partnership is a collaborative, voluntary program between the EPA and the freight transport industry that promotes strategies and technologies to help improve fleet efficiency while also reducing air emissions. Fleets participating in the SmartWay Transport Partnership commit to implementing these voluntary measures over three years, providing the EPA with annual updates of their progress throughout that period.

SmartWay carriers will typically commit to integrating fuel savings strategies and technologies into their fleet including: improved aerodynamics, single-wide tires, lighter wheels and rims, idle reduction, automatic tire inflation systems, driver training, and advanced powertrain technologies.

Unfortunately, the transient nature of freight transportation makes it difficult to isolate emissions reductions to a certain region, or even a certain state. As a result, any estimates of the impact of these technologies will largely rely on estimates of accumulated reductions based on estimated levels of overall fleet integration. These estimates are possible because through their ongoing research, and in conjunction with the more than 300 companies already committed as SmartWay partners, the EPA has identified a variety of technologies, and quantified the potential fuel savings and emissions reductions from those technologies.

Rolling resistance is estimated to account for as much as 13 percent of a heavy-duty vehicle's fuel consumption. By reducing rolling resistance as well as vehicle weight, the EPA believes that single-wide tires will help to improve fuel economy and reduce NO_X emissions by an average of five percent. On the other hand, aerodynamic drag accounts for most of a long-haul truck's energy losses at highway speeds. As a result, the EPA estimates that improving the aerodynamics of both a long-haul truck and its trailer can help to improve fuel economy and reduce NO_X emissions by five percent.

The extended periods of idling typically associated with long-haul trucks consume an average of one gallon of fuel per hour, while also generating the associated emissions. New technologies such as auxiliary power units (APU) and truck stop electrification (TSE) reduce vehicle idling by providing power for air conditioning, heating, and onboard electrical accessories, even when the vehicle is not in operation. The EPA estimates that, assuming typical idling levels, idling reduction technologies such as APU and TSE can reduce NO_X emissions by approximately ten percent.

The Blue Skyways Collaborative is a related effort, spearheaded by the EPA Region 6 office in Dallas, and the Region 7 office in Kansas City, Missouri.

Partnering with the EPA through this effort are the environmental and energy agencies from the ten states along the I-35 corridor, including Texas, New Mexico, Louisiana, Arkansas, Oklahoma, Kansas, Missouri, Nebraska, Iowa, and Minnesota. In implementing the Blue Skyways Collaborative, the EPA and the participating states recognize that because air quality is often a regional concern, greater reductions are possible through cooperative efforts as opposed to individual efforts initiated independently in each state.

The primary objective of the Blue Skyways Collaborative is to improve air quality in these states by promoting innovative technologies in a variety of sectors. In addition to promoting reduction strategies through the SmartWay Partnership for freight transportation via air, water, and rail, Blue Skyways also focuses on promoting emissions reduction strategies for other on-road sources, non-road sources, and highway fueling and idling reduction infrastructure, while also promoting renewable, efficient, and alternative energy sources.

In order to complete these objectives, the collaborative will develop partnerships among international, federal, state, and local governments, as well as non-profits, environmental groups and private industries. These partnerships will reduce emissions along the key transportation corridors by sharing technology and leveraging financial resources from a variety of sources.

4.2.6.2 Other Energy Efficiency Measures

Local governments may have enacted measures beyond what has been reported to SECO and the PUCT. The commission 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 via legislatively mandated mechanisms. The commission has attempted to include all known surplus, quantifiable, enforceable, and permanent NO_X emissions reduction measures in the SIP.

4.2.6.3 Clean School Bus Program

The 79th Texas Legislature passed House Bill 3469 which established the Clean School Bus Program as part of the Texas Emissions Reduction Plan (TERP). The new program is codified in Chapter 390 of the Texas Health and Safety Code Chapter and implemented through Title 30 Texas Administrative Code §§114.640 – 114.648.

The program is based on the EPA guidance documents, *Improving Air Quality with Economic Incentive Programs* (EPA-452/R-01-001) and *Diesel Retrofits: Quantifying and Using Their Benefits in SIPs and Conformity* (EPA-420-B-06-005). Under the Economic Incentive Program guidance, the TCEQ is using the Financial Mechanism option, which is described as subsidies targeted at promoting pollution-reducing activities or products. The Clean School Bus Program will operate under the same general provisions as apply to other TERP incentive programs.

The Clean School Bus Program was established to provide monetary incentives for school districts in the state by reducing emissions of diesel exhaust in school buses. Eligible technologies include catalysts, particulate filters, qualifying fuels, and other emissions reducing add-on or retrofit equipment that will reduce emissions. Some of the technologies eligible for funding under the program will result in reductions in NO_X emissions. When those projects take place in the eligible counties, NO_X emissions reductions will be available for SIP credit.

The Clean School Bus Program meets the requirements for SIP credit under the guidance documents, including the standards outlined below.

Surplus

An activity is not eligible if it is required by any state or federal law, rule, or regulation, memorandum of agreement, or other legally binding document.

Enforceable

Contracts will contain provisions that allow the state to recapture grant money for the failure to reduce emissions. Furthermore, if the performing party fails to comply with the requirements of the contract, the TCEQ may require that all or a portion of the reimbursement funds be returned or repaid.

Quantifiable

Emission reductions through TERP will be quantified. The methodology will include consideration of baseline NO_X emissions, reduced NO_X emissions, percentage of usage in eligible counties, and annual usage data.

Permanent

Environmental benefit from projects associated with TERP will occur for at least the life of the project, as enforced under the grant contract. The project life will be the time period during which the grant recipient must commit to using the grant-funded vehicle in the eligible counties. Under HB 3469, the minimum project life will be at least five years and the commission may extend the required period to a longer commitment.

For information on recent TERP activities, please visit the following web site: http://www.terpgrants.org.

4.2.6.4 Texas Low Emission Diesel

NO_X reductions from locomotive switcher engines in the nine-county area using TxLED were not included in the 2009 future case inventory. Although not accounted for in the modeling, they will reduce NO_X emissions not accounted for in the modeling and help bring the DFW area closer toward attainment of the eight-hour ozone standard.

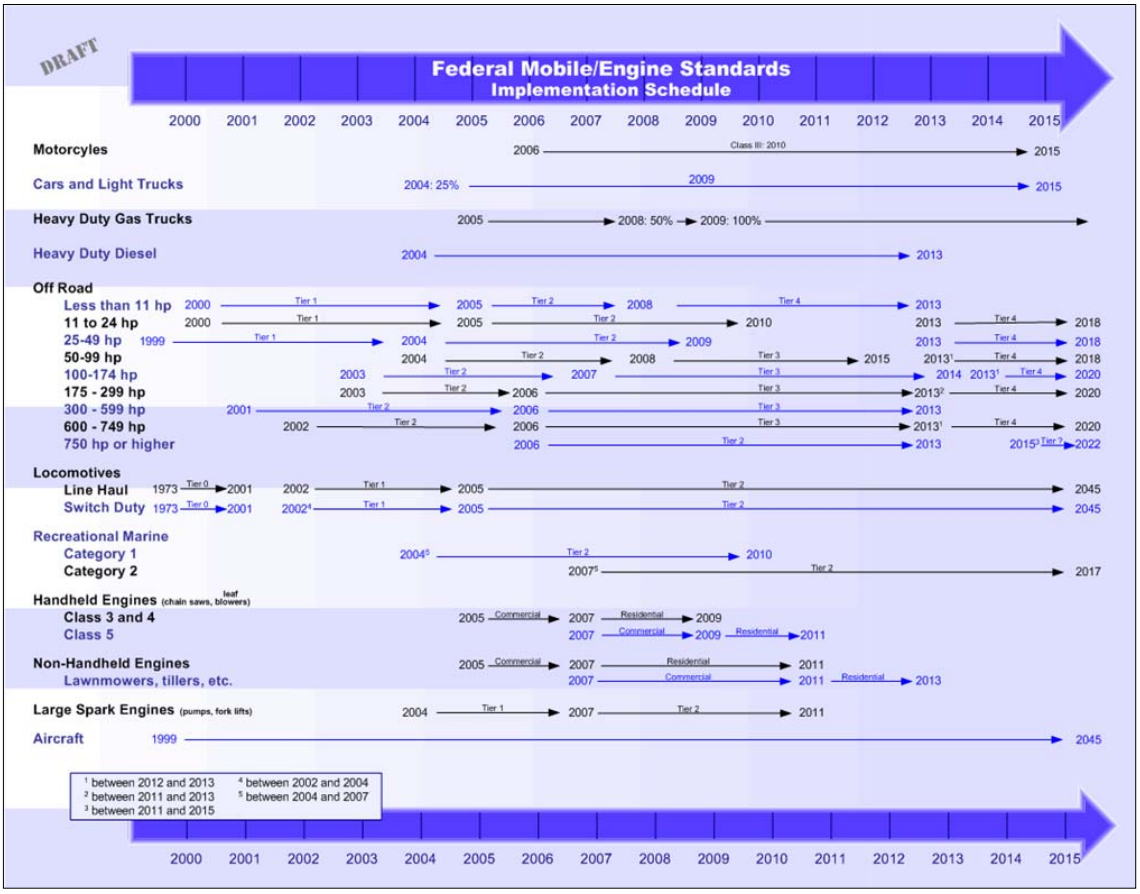
4.2.6.5 Stationary Diesel and Dual-Fuel Engine Control Measures

As discussed in Sections 4.5.2.1 and 4.5.2.3, the proposed rules for ICI major and minor sources in the DFW area would establish new requirements on stationary diesel engines used less than 100 hours per year in other than emergency situations and that were placed into service, modified, relocated, or reconstructed after on or after June 1, 2007. These engines, which are primary back-up engines, would be required to meet the emission standards in 40 CFR §89.112(a), Table 1 (October 23, 1998), in effect at the time of installation, modification, reconstruction, or relocation. This requirement ensures that as older diesel engines are replaced, the engines will be replaced with newer and cleaner model engines. An additional control requirement that applies to stationary diesel engines as well as stationary dual-fuel engines is the prohibition on starting or operating engines for testing or maintenance purposes between 6:00 a.m. and noon, except for certain situations. This measure delays NO_X emissions from the engines primarily used as back-up engines until after noon to help limit ozone formation. Both of these measures are similar to control measures implemented for the HGB one-hour ozone attainment demonstration. These control measures are not accounted for in the modeling but are estimated to reduce emissions by approximately 0.9 tpd of NO_X in the DFW area.

4.3 POST-2009

In addition to the control strategies and programs currently in place in the DFW nine-county area that will help bring the area into attainment of the eight-hour ozone standard, the continued implementation of federal engine standards for both on-road and non-road mobile measures will be critical for the area to maintain NAAQS attainment after 2009. See Table 4-8: *Federal Mobile/Engine Standards Implementation Schedule* for more information.

Table 4-8: Federal Mobile/Engine Standards Implementation Schedule



4.4: ON-ROAD EMISSION INVENTORY TRENDS FOR NINE-COUNTY DFW FROM 1999 TO 2012

During 2004 and 2005, NCTCOG submitted on-road emission inventories for the earlier referenced ozone episode to the TCEQ for the Nine-County DFW area for 1999, 2007, and 2009. For each of these years, NCTCOG provided benefits of State-issued control strategies.

The results of these analyses for the "representative" Tuesday, August 17 episode day are summarized below in Table 4-9: *Tuesday, August 17 On-Road Emission Trends for Nine-County DFW From 1999-2012*.

A 2012 on-road emission inventory for this episode is under development by NCTCOG, but not yet complete. TCEQ estimated approximate 2012 totals for on-road NO_X, VOC, and CO by modifying the 2009 MOBILE6.2 input files for 2012 application, along with increasing the 2009 vehicle miles traveled (VMT) estimates at an annual rate of 2 percent. Similar to the 2007 and 2009 inventories, the benefits State issued control strategies. The estimated changes that will occur in on-road emissions from 2009 to 2012 are summarized below in Table 4-10: *Change in On-Road Emissions for Tuesday, August 17 in Nine-County DFW From 1999-2012*.

Table 4-9: Tuesday, August 17 On-Road Emission

Trends for Nine-County DFW From 1999-2012

Calendar Year	***Weekday VMT***	***Weekday Emissions*** *(tons per day)*		
		NO_X	*VOC*	*CO*
1999	138,299,779	438.86	183.58	2,271.67
2007	173,065,387	219.50	110.27	1,512.84
2009	187,988,303	193.42	99.68	1,157.68
2012	199,494,691	129.88	79.03	974.66

Table 4-10: Change in On-Road Emissions for Tuesday, August 17 in Nine-County DFW From 1999-2012

On-Road Change From 2009 to 2012	***Weekday VMT***	***Weekday Emissions*** *(tons per day)*		
		NO_X	*VOC*	*CO*
Difference	11,506,388	-63.54	-20.65	-183.02
Relative Change	6.12%	-32.85%	-20.71%	-15.81%

As shown, even though VMT is expected to increase over six percent from 2009 to 2012, NO_X, VOC, and CO are expected to decrease by 33 percent, 21 percent, and 16 percent, respectively. Since State issued control strategy benefits are included in both the 2009 and 2012 inventory totals, the expected drop in emissions is due solely to fleet turnover effects where the use of "older" high-emitting vehicles is discontinued, while only "newer" low-emitting vehicles enter the fleet. These changes in the on-road fleet are shown graphically in Figure 4-1: *Weekday On-Road Emission Inventory Trends in Nine-County DFW From 1999-2012*.

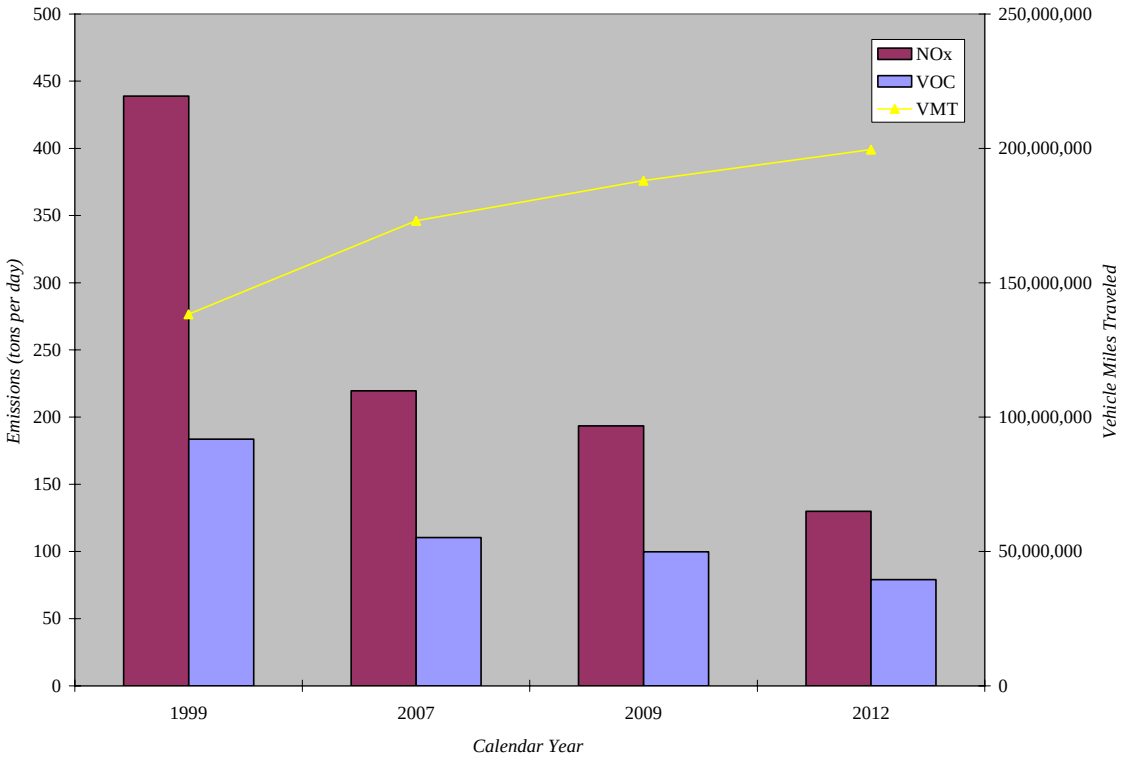


Figure 4-1: Weekday On-Road Emission Inventory Trends in Nine-County DFW From 1999-2012

4.5 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT) ANALYSIS

4.5.1 INTRODUCTION

Under the former one-hour ozone NAAQS, the four-county DFW area, consisting of Collin, Dallas, Denton, and Tarrant Counties, was classified as a serious nonattainment area. The new eight-hour ozone NAAQS classifies the nine-county DFW area, consisting of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties, as a moderate nonattainment area. Under the eight-hour ozone standard, the nine-county DFW area is required to meet the RACT mandates of the FCAA under sections §172(c)(1), §182(b)(2) and §182(f).

According to EPA's Final Rule to Implement the Eight-Hour Ozone NAAQS – Phase 2 (40 CFR §51.912, November 29, 2005), areas classified as moderate nonattainment or higher must demonstrate, by revision to their SIP, that their current rules fulfill eight-hour RACT for all Control Technique Guidelines (CTG) categories and all non-CTG major sources of NO_X and VOC. Such demonstrations can be made with either a new RACT determination or a certification that previously required RACT controls represent RACT for the eight-hour ozone standard. Areas may rely on previous analyses prepared for the one-hour ozone plans and EPA guidance documents.

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 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 maximum achievable control technology (MACT) required for major sources of hazardous air pollutants.

This RACT SIP submittal demonstrates that the RACT requirements for the DFW eight-hour ozone nonattainment area have been fulfilled by identifying all CTG and non-CTG major source categories of VOC and NO_X emissions within the DFW area; listing the state regulation that implements or exceeds RACT for that category; detailing the basis for concluding that these regulations fulfill RACT through comparison with established RACT requirements described in the CTG and Alternative Control Technique (ACT) guidance documents and rules developed by other state and local agencies; and submitting negative declarations where there are no major sources within the DFW area.

4.5.2 VOC RACT Demonstration

EPA proposed to approve RACT for all major sources of VOC in the four-county DFW one-hour ozone nonattainment area on November 18, 2001, and received no comments (66 FR 4756). On August 22, 2006, EPA proposed to approve the DFW 5 percent Increment of Progress (IOP) SIP and stated their intention to finalize approval of the DFW 5 percent IOP SIP and the one-hour RACT in the same rulemaking (71 FR 48870). The DFW 5 percent IOP SIP extended the applicability of certain RACT requirements to include all nine counties in the DFW eight-hour ozone nonattainment area. On November 15, 2006, the TCEQ adopted rules extending the applicability of the remaining control, monitoring, testing, recordkeeping, and reporting requirements in 30 TAC Chapter 115 to include all nine counties in the DFW eight-hour ozone nonattainment area. With the adoption of these rules the new five counties are subject to the same rules EPA has proposed to approve as RACT for the original four-county DFW area.

The only comment the TCEQ received regarding additional controls was a suggestion that thermal oxidizers be used to control VOC emissions from cement kilns. As discussed in the preamble to the adopted rule to be considered on November 15, 2006, the use of thermal oxidizers does not represent RACT for control of VOC emissions from cement kilns because it is not economically reasonable. In addition, since modeling discussed in Chapter 2 of this proposed

SIP revision indicates the reduction of VOC emissions has less benefit in reducing ozone levels than reduction in NO_X emissions, the level of control required by the rules in 30 TAC Chapter 115 continues to represent RACT for the nine-county DFW area.

The TCEQ reviewed EPA CTG and ACT documents to verify the 30 TAC Chapter 115 rules still satisfy the RACT requirements for all applicable major source types. The TCEQ reviewed the emission inventory (EI) database for emission sources that reported 50 tons per year (tpy) or more of VOC emissions in 2002 to determine if there are major sources of VOC emissions not covered by a CTG. A major source of VOC emissions in the DFW area is one with the potential to emit 100 tpy or more of VOC, but because the EI reports actual emissions rather than potential to emit, the TCEQ looked at sources with as few as 50 tpy of actual emissions. Since any major sources of VOC emissions are required to have a Title V operating permit, the TCEQ also reviewed the Title V database to ensure there were no additional sources of VOC emissions with Title V permits or applications pending.

4.5.3 NO_X RACT Demonstration

The emission specifications for attainment demonstration established in 30 TAC Chapter 117, Subchapter B, Division 4 (relating to Combustion Control at Major Industrial, Commercial, and Institutional Sources in Nonattainment Areas; Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area) regulate all major sources of NO_X emissions in the area and consistently contain lower NO_X emission limits than those established by CTG and ACT documents, EPA guidelines and policies, and those technologies and methodologies currently considered RACT by the EPA and other affected states.

Due to the significant NO_X emissions reductions necessary to demonstrate ozone attainment in the region, the proposed eight-hour emissions specifications are more stringent than those generally considered RACT. To ensure the proposed DFW eight-hour emission specifications fulfill the RACT requirements for all applicable major source types, the specifications in the rules have been compared to and are more stringent than the controls contained in the CTG and ACT guidance documents and current control technologies and methodologies implemented as RACT in other moderate nonattainment areas.

4.5.4 Conclusion

The State adopted rules fulfilling the VOC RACT requirements for all nine counties in the DFW eight-hour ozone nonattainment area. Table 4-11: *DFW VOC RACT Analysis Table 1* notes the state rules addressing the RACT requirements for sources in the CTG and ACT documents. A negative declaration is provided in the table for source types described within the EPA guidance documents that do not exist in the DFW area. Table 4-12: *DFW VOC RACT Analysis Table 2* lists the major VOC sources in the new five counties of the DFW area and the relevant RACT requirement.

The proposed 30 TAC Chapter 117 DFW eight-hour ozone NO_X emission specifications for attainment demonstration are equal to or lower than the emission limits associated with the controls contained in the CTG and ACT guidance documents and current control technologies and methodologies implemented as RACT in other moderate nonattainment areas.

Table 4-13: *DFW NO_X RACT Analysis Table* provides the state specifications addressing the RACT requirements for sources in the CTG and ACT documents or generally recognized major NO_X emission sources considered in the RACT analysis of other moderate nonattainment regions. A negative declaration is provided in the table for source types described within the EPA guidance documents or generally recognized major NO_X emission sources considered in the RACT analysis of other regions that do not exist in the DFW eight-hour area. For CTG and ACT categories that are not regulated under the proposed eight-hour ozone DFW rules, there are either no sources in the area subject to these CTG and ACT categories, or sources exist but are not major and are not required to demonstrate RACT compliance.

Table 4-11: DFW VOC RACT Analysis Table 1

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Aerospace	Guideline Series: Control of Volatile Organic Compound Emissions from Coating Operations at Aerospace Manufacturing and Rework Operations, EPA-453/R-97-004, EPA-68/D1-00115, EPA-453/D-96-016, December 1997 (see 59 FR 29216, June 6, 1994)	§§115.420 – 429
Agricultural Pesticides (not a category for which Texas is required to adopt RACT rules)	Control of Volatile Organic Compound Emissions from the Application of Agricultural Pesticides, EPA-450/R-92-011, March 1993	ACT document does not give presumptive RACT controls
Architectural and Industrial Maintenance Coatings	Reduction of Volatile Organic Compound Emissions from Application of Traffic Markings, EPA-450/3-88-007, August 1988 (Note – the Architectural and Industrial Maintenance coatings national rule issued in 1998 includes limits for traffic coatings and superseded the ACT)	National rule
Automobile Coating	The Reduction of Volatile Organic Compound Emissions from Automobile Refinishing, EPA-450/3-88-009, October 1988, NTIS No PB-89-148-282	§§115.420 – 429
Automobile Refinishing	Alternative Control Techniques Document: Automobile Body Refinishing, EPA-453/R-94-031, April 1994 (Note: a national rule for auto-body refinishing was issued in 1998 after the ACT)	§§115.420 – 429
Batch Processes	Alternative Control Techniques Document: Control of Volatile Organic Compound Emissions from Batch Processes, EPA-453/R-93-017 or EPA 453/R-93-020, February 1994	No existing major sources in the DFW eight-hour ozone area (SIC 2821, 2833, 2834, 2861, 2865, 2869, and 2879)
Bulk Gasoline Plants	Control of Volatile Organic Emissions from Bulk Gasoline Plants, EPA-450/2-77-035, December 1977	§§115.211 – 219
Cleaning Solvents	Alternative Control Techniques Document: Industrial Cleaning Solvents, EPA-453/R-94-015, February 1994	§§115.412 – 419 and §§115.420 – 429
Commercial Bakeries	Alternative Control Techniques Document: Bakery Ovens, EPA-453/R-92-017, December 1992	§§115.120 – 129
Cutback Asphalt	Control of Volatile Organic Compounds from Use of Cutback Asphalt, EPA-450/2-77-037, December 1977	§§115.510 – 519
Ethylene Oxide Sterilization/	Alternative Control Technology Document: Ethylene Oxide Sterilization/Fumigation	Covered by MACT per §113.200

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Fumigation Operations	Operations, EPA-450/3-89-007, March 1989	
Fugitive Emissions	Fugitive Emission Sources of Organic Compounds – Additional Information on Emissions, Emission Reductions, and Costs, EPA-450/3-82-010, April 1982	§§115.352 – 359
Gasoline Service Stations	Design Criteria for Stage I Vapor Control Systems - Gasoline Service Stations, November 1975	§§115.221 – 229
Graphic Arts	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VIII: Graphic Arts - Rotogravure and Flexography, EPA-450/2-78-033, December 1978	§§115.430 – 439
Graphic Arts	Control of Volatile Organic Compound Emissions from Offset Lithographic Printing, September 1993	§§115.440 – 449
Graphic Arts	Alternative Control Technology Document: Offset Lithographic Printing, EPA-453/R-94-054, June 1994	§§115.440 – 449
Industrial Wastewater	Control Techniques for Industrial Wastewater, EPA-453/D-93-056, September 1992 [ACT: April 1994, consists of cover memo with option tables and CTG]	§§115.140 – 149
Ink and Paint Manufacturing	Alternative Control Technology Document: Control of Volatile Organic Compounds from Ink and Paint Manufacturing, EPA-453/3-92-013	No existing major sources in the DFW eight-hour ozone area (SIC 2842 and 2851)
Leather Tanning and Finishing Operations	Alternative Control Technology Document: Leather Tanning and Finishing Operations, EPA-453/R-93-025	No existing major sources in the DFW eight-hour ozone area (SIC 3111)
Metal Furniture	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume III: Surface Coating of Metal Furniture, EPA-450/2-77-032, December 1977	§§115.420 – 429
Natural Gas/Gasoline Processing	Control of Volatile Organic Compound Equipment Leaks from Natural Gas/Gasoline Processing Plants, EPA-450/2-83-007, December 1983	§§115.352 – 359
Petroleum Dry Cleaners	Control of Volatile Organic Compound Emissions from Large Petroleum Dry Cleaners, EPA-450/3-82-009, September 1982	Contingency Measures: §§115.552 – 553 §§115.555 – 557 §115.559
Petroleum Liquid Storage	Control of Volatile Organic Emissions from Storage of Petroleum Liquids in Fixed Roof Tanks, EPA-450/2-77-036, December 1977	§§115.112 – 119
Petroleum	Control of Volatile Organic Emissions from	§§115.112 – 119

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Liquid Storage	Petroleum Liquid Storage in External Floating Roof Tanks, EPA-450/2-78-047, December 1978	
Petroleum Liquid Storage	Alternative Control Techniques Document: Volatile Organic Liquid Storage in Floating and Fixed Roof Tanks, EPA-453/R-94-001, January 1994	§§115.112 – 119
Plywood Veneer Dryers	Control Techniques for Organic Emissions from Plywood Veneer Dryers, EPA-450/3-83-012, May 1983	No existing major sources in the DFW eight-hour ozone area (SIC 2435 and 2436)
Process Vents	Alternative Control Technology Document: Organic Waste Process Vents, EPA-450/3-91-007, December 1990	Covered by the general vent gas rule §§115.120 – 129
Refineries	Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds, EPA-450/2-77-025, October 1977	§§115.311 – 319 and §§115.131 – 139
Refineries	Control of Volatile Organic Compound Leaks from Petroleum Refinery Equipment, EPA-450/2-78-036, June 1978	§§115.352 – 359
Rubber Tires	Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires, EPA-450/2-78-030, December 1978	No existing major sources in the DFW eight-hour ozone area (SIC 3011)
Shipbuilding and Ship Repair	Control Technique Guidelines for Shipbuilding and Ship Repair Operations, EPA-453/R-94-032, April 1994	No existing major sources in the DFW eight-hour ozone area (SIC 3731)
Shipbuilding and Ship Repair	Control Technique Guidelines for Shipbuilding and Ship Repair Surface Coating Operations, 61 FR 44050, August 27, 1996	No existing major sources in the DFW eight-hour ozone area (SIC 3731)
Solvent Cleaning	Control of Volatile Organic Emissions from Solvent Metal Cleaning, EPA-450/2-77-022, November 1977	§§115.412 – 419 and §§115.420 – 429
Solvent Cleaning	Alternative Control Technology Document: Halogenated Solvent Cleaners, EPA-450/3-89-030, August 1989	§§115.412 – 419
Stationary Sources	Control Techniques for Volatile Organic Compound Emissions from Stationary Sources, EPA-453/R-92-018, December 1992	Basic reference – does not contain control requirements for specific sources
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume I: Control Methods for Surface Coating Operations, EPA-450/2-76-028, November 1976	§§115.420 – 429
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks, EPA-	§§115.420 – 429

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
	450/2-77-008, May 1977	
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume IV: Surface Coating for Insulation of Magnet Wire, EPA-450/2-77-033, December 1977	Covered by rules for miscellaneous metal parts and products in §§115.420 – 429
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume V: Surface Coating of Large Appliances, EPA-450/2-77-034, December 1977	§§115.420 – 429
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VI: Surface Coating of Miscellaneous Metal Parts and Products, EPA-450/2-78-015, June 1978	§§115.420 – 429
Surface Coating	Control of Volatile Organic Emissions from Existing Stationary Sources, Volume VII: Factory Surface Coating of Flat Wood Paneling, EPA-450/2-78-032, June 1978	§§115.420 – 429
Surface Coating	Alternative Control Techniques Document: Surface Coating of Automotive/Transportation and Business Machine Plastic Parts, EPA-453/R-94-017, February 1994	§§115.420 – 429
Synthetic Organic Chemical Manufacturing Industry	Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products, 450/2-78-029, December 1978	§§115.531 – 539
Synthetic Organic Chemical Manufacturing Industry	Control of Volatile Organic Compound Emissions from Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins, EPA-450/3-83-008, November 1983	§§115.120 – 129
Synthetic Organic Chemical Manufacturing Industry	Control of Volatile Organic Compound Fugitive Emissions from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment, EPA-450/3-83-006, March 1984	§§115.352 – 359
Synthetic Organic Chemical Manufacturing Industry	Control of Volatile Organic Compound Emissions from Air Oxidation Processes in Synthetic Organic Chemical Manufacturing Industry, EPA-450/3-84-015, December 1984	§§115.120 – 129
Synthetic Organic Chemical Manufacturing Industry	Polystyrene Foam Manufacturing, EPA-450/3-90-020, 1990	§§115.120 – 129
Synthetic	Control of Volatile Organic Compound	§§115.120 – 129

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Organic Chemical Manufacturing Industry	Emissions from Reactor Processes and Distillation Operations in Synthetic Organic Chemical Manufacturing Industry, EPA-450/4-91-031, August 1993	
Tank Trucks	Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals, EPA-450/2-77-026, December 1977	§§115.211 – 219 or §§115.221 – 229
Tank Trucks	Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems, EPA-450/2-78-051, December 1978	§§115.211 – 219 and §§115.234 – 239
Vegetable Oil Manufacturing	Control of Volatile Organic Emissions from Manufacture of Vegetable Oils, EPA-450/2-78-035, June 1978	No existing major sources in the DFW eight-hour ozone area (SIC 2046 and 2076)
Wood Furniture Manufacturing	Guideline Series: Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations, EPA-453/D-95/002	§§115.420 – 429
Wood Furniture Manufacturing	Guidelines Series: Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations, EPA-453/R-96-007, April 1996 (see also 61 FR 25223, and, 61 FR 50823, September 27, 1996)	§§115.420 – 429

Table 4-12: DFW VOC RACT Analysis Table 2
VOC Emissions from Point Sources in Ellis, Johnston, Kaufman, Parker, and Rockwall Counties
Accounts with VOC Emissions > 50 tons per year Based on 2002 EI

ACCOUNT		SIC	VOC tons/yr	Source category or description	Covered by RACT	Com-ment
ED0099J	HOLCIM TEXAS LIMITED PARTNERSHIP	3241	626.67	Cement kilns	yes	1
ED0168P	DARTCO OF TEXAS LP	3089	539.65	Foam containers	yes	2
ED0011D	CHAPARRAL STEEL MIDLOTHIAN LP	3312	339.59	Iron/steel foundry electric arc furnaces	yes	3
JH0025O	JOHNS MANVILLE INTERNATIONAL INC	3296	219.30	Fiberglass curing	yes	4
ED0051O	OWENS-CORNING WAXAHACHIE PLANT	3296	137.50	Fiberglass forming and curing	yes	5
KB0015U	VISTAWALL ARCHITECTURAL PRODUCTS	3354	112.37	Aluminum coating	yes	6
PC0001E	ACME BRICK BENNETT PLANT	3251	90.59	Brick kiln	yes	7
PC0013U	ENBRIDGE GATHERING SPRINGTOWN GAS PLANT	1321	91.90	Gas plant (including fugitives, storage tanks)	yes	8
ED0332D	MIDLOTHIAN ENERGY LP	4911	77.39	Gas-fired combustion turbines	yes	9
KB0073G	MADIX INC SKYLINE MFG FACILITY	2542	63.49	Surface coating misc. metal parts	yes	6
ED0018M	ELK CORPORATION OF TEXAS	2952	59.66	Asphalt roofing	yes	10
ED0032S	G.S. ROOFING PRODUCTS	2952	51.27	Asphalt roofing	yes	10

Comments

1 Control of VOC emissions is not economically reasonable.

2 VOC emissions are controlled per BACT in NSR Permit No. 18505. Additional control for RACT is not economically reasonable.

3 VOC emissions are controlled per BACT in NSR Permit No. 1635, 3026, 5983, 8097, 8099. Further control may be required by MACT.
Additional control for RACT is not economically reasonable.

4 VOC emissions are controlled per BACT in NSR Permit No. 946A, 1218. Additional control for RACT is not economically reasonable.

5 VOC emissions are controlled per BACT in NSR Permit No. 6093. Additional control for RACT is not economically reasonable.

6 Surface coating operations are covered by RACT in Chapter 115, Subchapter E, Division 2.

7 VOC emissions are controlled per BACT in NSR Permit No. 25937. Additional control for RACT is not economically reasonable.

8 VOC emissions from equipment leak fugitives are covered in 115 Sub D Div 3; from storage tanks by Sub B Div 1.

9 VOC emissions arise from natural gas combustion; control is not economically reasonable.

10 VOC emissions are controlled per BACT in NSR Permits. Additional control for RACT is not economically reasonable.

Table 4-13: DFW NO_X RACT Analysis

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Brick & Ceramic Manufacturing	Non-CTG Major NO_X Source	§117.410(b)(7)(B)
Cement Manufacturing	NO_X Emissions from Cement Manufacturing, EPA-453/R-94-004, March 1994 (Updated September 2000)	Existing §117.265 and proposed new §117.3110(a) – (f) & §117.3123
Coke, Wood, Rice, and Other Biomass-Fired Boilers	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Fiberglass Manufacturing	Non-CTG Major NO_X Source	§117.410(b)(10) & (11)
Fuel Switching	Fuel Switching to Meet NO_X RACT for NO_X, EPA Memorandum, July 30, 1993	Chapter 117 Subchapter B, Division 4 & Subchapter C, Division 4 contain NO_X emission limits for all fuel sources used in DFW
Glass Manufacturing	NO_X Emissions from Glass Manufacturing, EPA-453/R-94-037, June 1994	§117.410(b)(10) & (11)
Hot Mix Asphalt Plants	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Incinerators	Non-CTG Major NO_X Source	§117.410(b)(9)
Industrial, Commercial, and Institutional Boilers	NOx Emissions from Industrial, Commercial & Institutional Boilers, EPA-453/R-94-022, March 1994	§117.410(b)(1) & (2)
Iron and Steel	NO_X Emissions from Iron and Steel, EPA-453/R-94-065, September 1994	§117.410(b)(8)
Lead Smelting	Non-CTG Major NO_X Source	§117.410(b)(8)
Lightweight Aggregate Kilns	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Lime Manufacturing	Non-CTG Major NO_X Source	§117.410(b)(7)(A)
Magnesium Chloride Fluidized Bed Dryers	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Natural Gas-Fired Dryers, Heaters, and Ovens at Major Sources	Non-CTG Major NO_X Source	§117.410(b)(12) & (13)
Nitric and Adipic Acid Manufacturing	NO_X Emissions from Nitric and Adipic Acid Manufacturing Plants, EPA-453/3-91-026, December 1991	Chapter 117, Subchapter F, Divisions 1, 2, & 3 contain Acid Manufacturing NO_X limits
Oilfield Drilling Operations	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Other Minerals	Non-CTG Major NO_X Source	No existing major sources

CTG/ACT Source Category	CTG/ACT Reference Document	30 TAC Specification Fulfilling RACT Requirements
Processing Kilns		in DFW eight-hour ozone area
Petroleum Refining Operations	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Process Heaters	NO_X Emissions from Process Heaters, EPA-453/R-93-034, revised September 1993	§117.410(b)(3)
Pulping Liquor Recovery Furnaces	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Pyrolysis Reactors	Non-CTG Major NO_X Source	No existing major sources in DFW eight-hour ozone area
Stationary Internal Combustion Engines	NO_X Emissions from Stationary Internal Combustion Engines, EPA-453/R-93-032, July 1993 (Updated September 2000)	§117.410(a) & (b)(4)
Stationary Turbines	NO_X Emissions from Stationary Combustion Turbines, EPA-453/R-93-007, January 1993	§117.410(b)(5)
Utility Auxiliary Steam Boilers	Non-CTG Major NO_X Source	§117.1310(a)(2) (expanding existing §117.105 RACT limit to nine-county area)
Utility Boilers	NO_X Emissions from Utility Boilers, EPA-453/R-94-023, March 1994	§117.1310(a)(1)
Utility Stationary Gas Turbines	Non-CTG Major NO_X Source	§117.1310(a)(3) (expanding existing §117.105 RACT limit to nine-county area)

4.6 REASONABLY AVAILABLE CONTROL MEASURES (RACM) ANALYSIS

4.6.1 Introduction

Section 172(c)(1) of the FCAA requires states to "provide for implementation of all reasonably available control measures as expeditiously as practicable" and to include RACM analyses in the SIP. In the General Preamble for implementation of the FCAA Amendments (57 FR 13498), the EPA interprets Section 172(c)(1) as a requirement that states incorporate all reasonably available control measures that would advance a region's attainment date into their SIP. However, regions are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances. In the preamble, EPA provided guidelines to help states determine which measures should be considered reasonably available:

> *If it can be shown that one or more measures are unreasonable because emissions from the sources affected are insignificant (i.e. de minimis), those measures may be excluded from further consideration...the resulting available control measures should then be evaluated for reasonableness, considering their technological feasibility and the cost of control in the area to which the SIP applies...In the case of public sector sources and control measures, this evaluation should consider the impact of the reasonableness of the measures on the municipal or other government entity that must bear the responsibility*

for their implementation.

On July 2, 2002, the U.S. Court of Appeals upheld EPA's definition of RACM, including the consideration of economic and technological feasibility, the ability to cause substantial widespread and long-term adverse impacts, the collective ability of the measures to advance a region's attainment date, and whether an intensive or costly effort will be required to implement the measures.

4.6.2 Control Strategy Development

The TCEQ contracted with the North Central Texas Council of Governments (NCTCOG) to evaluate and quantify potential control measures for the DFW eight-hour ozone SIP. The NCTCOG subcontracted with two consultants, Environ International (Environ) and the Sierra Nevada Air Quality Group (SNAQG), to perform the strategy development work.

The NCTCOG and consultants first compiled a master list of potential control strategies by consulting a number of sources. These sources included the South Coast Air Quality Management District (SCAQMD) 2003 Air Quality Management Plan, EPA ozone Early Action Compact (EAC) control measures, the Port of Long Beach (POLB), control strategies developed for the 2000 DFW SIP revision, control strategies developed in 2004 by the Texas Transportation Institute (TTI), the Port of Los Angeles (POLA), the Lake Michigan Air Directors' Consortium (LADCO), the Ozone Transport Commission (OTC), and various other sources. For a complete list of the control strategy sources of the NCTCOG master list, please refer to Appendix I, Part I-1: *NCTCOG Control Strategy Sources*.

The initial master list consisted of 1,050 potential control strategies. Of these strategies, 176 applied to area sources; 628 applied to on-road mobile sources; 86 of them applied to non-road mobile sources; and 106 applied to point sources. There were an additional 54 strategies that fell under the category "Policy/Outreach," that were later bundled into the other four categories during the evaluation process. For the control strategy master list, please refer to Appendix I, Part I-2: *NCTCOG Control Strategy Master List*.

The NCTCOG, Environ, and the SNAQG evaluated the master list of strategies using a two-phase methodology. In phase one, each control strategy was systematically screened against the four EPA SIP criteria (permanent, quantifiable, enforceable, and surplus). In the second phase, the strategies meeting the EPA criteria were evaluated against a second set of criteria (practicality, likely public acceptance, emissions benefit, and cost effectiveness). Each strategy was given a score of one (low) to four (high) for each of the criteria. The strategies with a high total score were then placed on a draft short list that was taken out for public comment during stakeholder meetings in September 2005. To see the information presented at the stakeholder meetings, please refer to Appendix I, Part I-3: *NCTCOG Stakeholder Presentations*.

Based on public comment received at the September 2005 meetings, the NCTCOG, Environ, and the SNAQG revised their draft short list and created a final short list of control measures, then quantified reductions associated with these measures. The NCTCOG submitted the quantified control strategy short list along with accompanying documentation to the TCEQ in January 2006. Please refer to Appendix I, Part I-4: *NCTCOG Final Control Strategy Short List*, specifically Part I-4a: *Letter and Control Strategy Summary Table.*

The EPA submitted a list of potential control strategies to the TCEQ for possible inclusion in the DFW SIP. Please refer to Appendix I, Part I-5: *EPA Control Strategies.* This list included NO_X and VOC strategies for stationary and area sources, non-road and on-road sources, energy efficiency and renewable energy measures, and longer-term measures. The TCEQ compared the strategies on the EPA list to the strategies on the NCTCOG master list and final short list.

The NCTCOG actively sought public comment throughout the entire control development

process. A series of public meetings were held in the DFW region during June and September 2005. Public stakeholder meetings were held in Fort Worth, Arlington, and Richardson in September and December 2005. In addition, control strategy development was discussed at public meetings of the North Texas Clean Air Steering Committee from June 2005 to January 2006. The NCTCOG Regional Transportation Council and Surface Transportation Technical Committee also discussed control strategy development at several of their meetings. Additionally, public comment was sought at a meeting of the Clean Cities Technical Coalition in July 2005 and at a meeting of the Houston Regional Air Quality Planning Committee in October 2005. The public was provided with numerous opportunities to provide input in the control strategy development process.

4.6.3 Evaluation Criteria

Consistent with the U.S. District Court's opinion and EPA guidance, the TCEQ has defined specific criteria for the evaluation of potential RACM measures in the DFW eight-hour ozone nonattainment area. In order for an individual measure to be considered RACM, the measure must meet the following criteria.

- The measure will reduce emissions in the DFW area prior to the beginning of the 2009 ozone season.
- The measure can be implemented before January 1, 2009.
- The measure is enforceable.
- The measure is technically feasible.
- The measure is economically feasible.
- The measure would not create substantial or widespread adverse impacts within the region.
- Emissions from the source being controlled exceed a de minimis threshold.

Collectively, any RACM measures must meet the following criteria.

- The measures will enable the region to reduce ozone below 85 ppb prior to the beginning of the 2009 ozone season.
- The measures can be implemented without intensive or costly effort.

4.6.4 Point and Area Source RACM Analysis

The criteria discussed above were used to evaluate all suggested control measures. Appendix I, Part I-6: *Point and Area Source NO_X RACM Analysis for the Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area* and Appendix I, Part I-7: *Point and Area Source VOC RACM Analysis for the Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area* contain the RACM analysis of all suggested point and area source control measures. The analysis includes a brief description of each control measure, a determination as to whether or not the measure will advance the attainment date, and either justification for not implementing the control measure or the proposed state rule that would implement the control measure. For additional analysis and quantification of control measures considered, please refer to Appendix I, Part I-4: *NCTCOG Final Control Strategy Short List*, specifically Part I-4b: *Analysis of Short List Strategies.*.

4.6.5 Mobile Source RACM Analysis

The NCTCOG and its subcontractors analyzed and quantified 11 non-road mobile strategies. The non-road strategies considered were: aircraft emission standards, California portable engine rule, emission reduction contract incentives with public funding, enhanced TERP, freight rail infrastructure improvements, hybrid-electric locomotives, a lawn mower replacement program, limitations on idling of heavy-duty construction equipment, locomotive idling restrictions, rail efficiency, and Tier II.

The NCTCOG and its subcontractors analyzed and quantified 32 on-road mobile strategies. The on-road strategies considered were: 1974 and older model year vehicles I/M exemption, additional taxi fleet emissions testing, AirCheck Texas repair and replacement assistance

program, bicycle and pedestrian programs, California low-emitting vehicle II standards, CARB 2007 on-highway diesel engine standards, carsharing, congestion (value) pricing, drive-thru service restrictions, enhanced AirCheck Texas repair and replacement assistance program, best workplaces program, carpooling, transit subsidy programs, vanpooling, expanded I/M to include diesel vehicles, expanded I/M to surrounding counties, fare-free transit—system-wide on ozone action days, freeway and arterial bottleneck programs, heavy-duty idling restriction, higher vehicle occupancies, idle reduction infrastructure, intelligent transportation systems, light-duty vehicle idling restrictions, lower Reid vapor pressure, military ground equipment emissions testing, parking cash-out, pay-as-you-drive, speed limit decrease for heavy-duty diesel trucks, stricter I/M enforcement, traffic signal improvements, transit, and transit off-peak pass.

For an analysis of each mobile measure considered for analysis and quantification, please refer to Appendix I, Part I-4: *NCTCOG Final Control Strategy Short List*. The NCTCOG selected a list of mobile measures to implement. The measures committed to by NCTCOG are found in Chapter 4 of this SIP submittal under Transportation Control Measures and Voluntary Mobile Emission Reduction Measures. Appendix I, Part I-8: *NCTCOG Final Submittal of On-Road and Non-Road Emissions Benefits* contains the letter dated September 15, 2006, from Mr. Michael Morris, Director of NCTCOG Transportation, to Ms. Theresa Pella, Manager of the TCEQ Air Quality Planning Section, detailing the commitment to these measures.

4.7 MOTOR VEHICLE EMISSIONS BUDGET (MVEB)

The motor vehicle emissions budget 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 the estimated emissions from transportation plans, programs, and projects do not exceed the motor vehicle emissions budget. The attainment budget represents the on-road mobile source emissions that have been modeled for the attainment demonstration. The budget reflects all of the on-road control measures reflected in that demonstration. The motor vehicle emissions budget is shown in Table 4-14: *2009 Attainment Demonstration Motor Vehicle Emissions Budget for the Nine-County DFW Area*. For additional detail, see *Appendix H: Voluntary Mobile Source Emission Reduction Programs for the DFW Eight-Hour SIP*.

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Table 4-12: 2009 Attainment Demonstration Motor Vehicle Emissions Budget for the Nine-County DFW Area

Nine-County DFW Area	**Total Emissions** (tpd)	
	NO_x	**VOC**
DFW motor vehicle emissions budget	178.65	91.33

The modeling control strategy sensitivity run (Combination 4) is based on NCTCOG's initial VMEP estimates and assumes VMEP will reduce NOx emission by 16.3 tpd. NCTCOG's refined estimate is 2.63 tpd of NO_X reductions. The modeling control strategy sensitivity run will be corrected to reflect this change prior to adoption of this SIP revision. Upon final enactment of this SIP revision, which will occur after a public comment period and finalization of the strategies and modeling, the MVEB will be adjusted to reflect the final on-road emission reductions commitment from the region's transportation policy board.

4.8 CONTINGENCY MEASURES

Contingency measures that were put in place for the one-hour ozone standard were never triggered, and as such, they will remain in place for the eight-hour ozone standard. See the TCEQ VOC rules on Off-set Lithographic Printing §115.449(c), Degassing or Cleaning of Stationary, Marine, and Transport Vessels §115.549(b), and Petroleum Dry Cleaning §115.559(a).

Appendices are available upon request. Please contact:

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