TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

AGENDA ITEM REQUEST

for Proposed Revision to the State Implementation Plan

AGENDA REQUESTED: October 17, 2012

DATE OF REQUEST: September 28, 2012

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

CAPTION: Docket No. 2012-0845-SIP. Consideration for publication and hearing on the proposed Houston-Galveston-Brazoria (HGB) 1997 Eight-Hour Ozone Standard Nonattainment Area Motor Vehicle Emissions Budgets (MVEB) Update State Implementation Plan (SIP) Revision.

The proposed SIP revision would update the March 2010 HGB attainment demonstration and reasonable further progress SIP revisions for the 1997 eight-hour ozone standard to replace the on-road mobile source emissions inventories for nitrogen oxides (NO_X) and volatile organic compounds (VOC) based on the United States Environmental Protection Agency's (EPA) MOBILE model with those based on the EPA's MOVES model. The 2008, 2011, 2014, 2017, and 2018 NO_X and VOC MVEBs and the contingency analyses would also be updated using the MOVES-based emissions inventories. The updated MVEBs would help the HGB area meet transportation conformity requirements of the Federal Clean Air Act. The proposed revision also includes a review of emissions inventory data, photochemical modeling, and the quantitative and qualitative corroborative analyses used as weight of evidence supporting the March 2010 HGB attainment demonstration. (Lola Brown, John Minter) (SIP Project No. 2012-002-SIP-NR)

Steve Hagle
Deputy Director

David Brymer
Division Director

Joyce Spencer-Nelson
Agenda Coordinator

Copy to CCC Secretary? NO

Texas Commission on Environmental Quality
Interoffice Memorandum

To: Commissioners **Date:** September 28, 2012

Thru: Bridget C. Bohac, Chief Clerk
Zak Covar, Executive Director

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

Docket No.: 2012-0845-SIP

Subject: Commission Approval for the Proposed Houston-Galveston-Brazoria (HGB) 1997 Eight-Hour Ozone Standard Nonattainment Area Motor Vehicle Emissions Budgets (MVEB) Update State Implementation Plan (SIP) Revision

HGB MVEB Update SIP Revision
SIP Project No. 2012-002-SIP-NR

Background and reason(s) for the SIP revision:
On March 10, 2010, the commission adopted two revisions to the Texas SIP for the HGB 1997 eight-hour ozone National Ambient Air Quality Standard (NAAQS) nonattainment area. The *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision) includes an analysis to demonstrate attainment of the 1997 eight-hour ozone NAAQS by the June 15, 2019, attainment deadline as well as other SIP elements required by the Federal Clean Air Act (FCAA), including an MVEB for 2018. The *Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan for the 1997 Eight-Hour Ozone Standard* (2010 HGB RFP SIP Revision) demonstrates reasonable further progress toward attainment of the 1997 eight-hour ozone NAAQS by showing FCAA-required incremental reductions in nitrogen oxides (NO_X) and volatile organic compounds (VOC) from the base year to attainment of the standard. The HGB RFP SIP revision includes MVEBs for the milestone years 2008, 2011, 2014, 2017, and 2018.

The MVEBs included in both SIP revisions were developed using on-road mobile source emissions inventories established with the United States Environmental Protection Agency's (EPA) MOBILE model (MOBILE6.2), a mobile source emissions estimation model. MVEBs are used by local metropolitan planning organizations (MPO) in nonattainment areas for transportation conformity analyses. The EPA found the MOBILE6.2-based MVEBs in the 2010 SIP revisions adequate for use in transportation conformity, effective February 9, 2011, as published in the *Federal Register* on January 25, 2011 (76 FR 4342).

On March 2, 2010, the EPA officially released a new mobile source emissions estimation model, the Motor Vehicle Emission Simulator (MOVES) model, to replace the MOBILE model for SIP applications. Beginning March 2, 2013, transportation conformity must be conducted by local MPOs using the MOVES model. This SIP revision would facilitate future MOVES-based transportation conformity determinations because MOVES-based estimated emissions determined for conformity would be directly comparable to MOVES-based MVEBs established herein. This SIP revision would provide the EPA updated MVEBs based on the latest version of the MOVES model, MOVES2010a, for the eight-county (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller) HGB nonattainment area, which is classified severe under the 1997 eight-hour ozone NAAQS.

Scope of the SIP revision:

A.) Summary of what the SIP revision will do:

This SIP revision would update the 2010 HGB AD SIP Revision and the 2010 HGB RFP SIP Revision to replace the on-road mobile source emissions inventories for NO_X and VOC based on the EPA's MOBILE6.2 model with those based on the EPA's MOVES2010a model. The MVEBs would be updated using the MOVES2010a-based emissions inventories.

This SIP revision would include technical analysis to support the modification of the HGB MVEBs. The technical analysis update included in this SIP revision shows that the effects of replacing MOBILE6.2 with MOVES2010a are significant; however, the projected 2018 design value is expected to be within the EPA's recommended threshold for corroborative weight of evidence to be used in an attainment demonstration.

This SIP revision would also update the contingency analyses. The 2010 HGB AD SIP Revision includes a commitment to address additional measures to meet the 3% contingency requirement in a mid-course review (MCR) submittal; however, this SIP revision would fulfill this commitment. The updated on-road mobile source emissions inventories and control strategy reduction estimates developed with MOVES2010a demonstrate more than the required 3% contingency reduction requirement; therefore, an additional SIP revision to address contingency measures is not needed.

The 2010 HGB AD SIP Revision included a commitment to provide an MCR by December 2013, to coincide with a SIP revision submittal date for the EPA's proposed 2010 ozone standard. The EPA changed course in reconsidering the 2008 eight-hour ozone standard and the proposed 2010 eight-hour ozone standard was not finalized. Instead, the EPA promulgated designations for the 2008 eight-hour ozone standard effective July 20, 2012. The HGB area was designated nonattainment with a marginal classification. Further, the 1997 eight-hour ozone standard will be revoked effective July 20, 2013. Given these changes to the circumstances surrounding submittal of an MCR, the Texas Commission on Environmental Quality has focused its review on specific elements that bear the most relevance for supporting the previously submitted attainment demonstration regarding the 1997 eight-hour ozone standard. This SIP revision meets the primary obligations of the MCR commitment by demonstrating that the 3% contingency requirement is fulfilled, evaluating photochemical modeling, and reviewing and updating the weight of evidence analysis and inventory data.

Re: Docket No. 2012-0845-SIP

This SIP revision would satisfy the EPA's MOVES implementation policy guidance[1] concerning updating an attainment demonstration with MOVES, which indicates that states must: (1) demonstrate that the updated plan continues to meet all attainment demonstration requirements; and (2) document that growth and control strategy assumptions for all other source categories (area, non-road mobile, and stationary point) continue to be valid and any minor updates would not change the conclusions of the attainment demonstration. Updates to the MVEBs in the 2010 HGB AD SIP Revision and 2010 HGB RFP SIP Revision meet both these requirements. Growth and control strategy assumptions continue to be valid for the stationary point, area, and non-road mobile source categories in the 2010 HGB AD SIP Revision and 2010 HGB RFP SIP Revision. Minor updates have occurred to these source categories since the 2010 HGB AD SIP Revision and 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB AD SIP Revision and 2010 HGB RFP SIP Revision. Therefore, updates to the stationary point, area, and non-road mobile source categories are not being included in this SIP revision. Emission inventory updates for all source categories will be included as part of the emissions inventory submittal for the 2008 eight-hour ozone standard, which is anticipated to be submitted to the EPA by July 20, 2014.

B.) Scope required by federal regulations or state statutes:
An MVEB is the on-road mobile source allocation of the total allowable emissions for each applicable criteria pollutant or precursor, as defined in the SIP. Transportation conformity determinations must be performed using the budget test once the EPA determines the budget adequate for transportation conformity purposes. To pass the budget test, areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB for the established year. Transportation conformity is required by FCAA, §176(c) to ensure that the effects of emissions from all on-road sources conform to the purpose of the SIP. Conforming to the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS. The EPA's conformity rule, 40 Code of Federal Regulations §51.390 and Part 93 Subpart A, requires that "conformity determinations must be based on the latest emission estimation model available."

C.) Additional staff recommendations that are not required by federal rule or state statute:
A recent United States Ninth Circuit Court of Appeals decision [Association of Irritated Residents, et. al. v. United States Environmental Protection Agency, 2012 WL 251912 (C.A.9)] addressed the requirements for transportation control measures (TCM) in SIPs for severe nonattainment areas. In light of the recent court decision, the EPA has determined that additional analysis is needed to demonstrate that the vehicle miles traveled (VMT) increase does not trigger additional TCMs for the HGB area. On August 30, 2012, the EPA

[1] EPA, 2009. "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes." Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-B-09-046, December 2009.

released guidance on how to address this requirement and sent the TCEQ a revised model (MOVES2010bROP) to conduct the necessary analysis. The TCEQ did not receive the guidance and model in time to incorporate the demonstration into this proposed SIP revision; however, the TCEQ is now evaluating the guidance and model, and the commission will consider providing the analysis at adoption of this revision in order to submit to the EPA for consideration.

Statutory authority:
The authority to propose and adopt the SIP revision is derived from the FCAA, 42 United States Code, §7410, which requires states to submit SIP revisions that contain enforceable measures to achieve NAAQS and other general and specific authority in Texas Water Code, Chapters 5 and 7 and Texas Health and Safety Code, Chapter 382.

Effect on the:
A.) Regulated community:
The local transportation planning entities will benefit by being able to proceed with planning and initiating congestion-reducing transportation projects should MOVES2010a-based MVEBs facilitate a conformity demonstration.

B.) Public:
The public could benefit from improved air quality if transportation improvement projects decrease traffic congestion and emissions.

C.) Agency programs:
This SIP revision would have no new effect on agency programs.

Stakeholder meetings:
There have been no stakeholder meetings because there are no new rules proposed with this SIP revision.

Potential controversial concerns and legislative interest:
The HGB area must frequently update its transportation plan to incorporate highway, transit, and funding changes and to pursue congestion-relief transportation projects that mitigate further increases in emissions. Beginning March 2, 2013, transportation conformity must be conducted by local MPOs using the MOVES model. The development of new transportation projects will be extremely limited in the HGB area until MOVES-based MVEBs are found adequate by the EPA and all transportation projects are found to conform to the MVEBs in the SIP.

Some stakeholders and the EPA may not agree that an MCR is no longer needed or that this submittal meets all of the MCR commitments. For example, the Houston-Galveston Area Council has expressed a desire to update TCMs in the MCR and environmental advocacy groups may want to have a full review of the inputs and modeling to discuss further controls or reductions.

Re: Docket No. 2012-0845-SIP

The EPA published final designations and classifications for the 2008 ozone standard in the May 21, 2012, *Federal Register* (77 FR 30088). The HGB area was designated nonattainment under the 2008 ozone standard and classified as marginal. According to the May 21, 2012, *Federal Register* (77 FR 30160), the EPA will revoke transportation conformity requirements under the 1997 eight-hour ozone standard effective July 20, 2013. To ensure backsliding does not occur, areas designated nonattainment for the 2008 ozone standard that have adequate or approved SIP MVEBs for either the 1997 eight-hour ozone standard or the one-hour ozone standard must continue to use such budgets in transportation conformity determinations until budgets for the 2008 ozone standard are found adequate or approved.

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

What are the consequences if this SIP revision does not go forward? Are there alternatives to this SIP revision?
The HGB area must frequently update its transportation plan to incorporate highway, transit, and funding changes and to pursue congestion-relief transportation projects that mitigate further increases in emissions. Beginning March 2, 2013, transportation conformity must be conducted by local MPOs using the MOVES model. The development of new transportation projects will be extremely limited in the HGB area until MOVES-based MVEBs are found adequate by the EPA and all transportation projects are found to conform to the MVEBs in the SIP.

Key points in the proposal SIP revision schedule:
Anticipated proposal date: October 17, 2012
Anticipated Texas Register publication date: November 2, 2012
Public hearing date: November 19, 2012
Public comment period: October 19, 2012 – November 26, 2012
Anticipated adoption date: April 24, 2013

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

HOUSTON-GALVESTON-BRAZORIA 1997 EIGHT-HOUR OZONE STANDARD NONATTAINMENT AREA

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

HOUSTON-GALVESTON-BRAZORIA 1997 EIGHT-HOUR OZONE STANDARD NONATTAINMENT AREA MOTOR VEHICLE EMISSIONS BUDGETS UPDATE STATE IMPLEMENTATION PLAN REVISION

Project Number 2012-002-SIP-NR

Proposal
October 17, 2012

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EXECUTIVE SUMMARY

On March 10, 2010, the Texas Commission on Environmental Quality (TCEQ or the commission) adopted the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision), Project No. 2009-017-SIP-NR, and the *Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB RFP SIP Revision), Project No. 2009-018-SIP-NR. These state implementation plan (SIP) revisions were required by the United States Environmental Protection Agency (EPA) to demonstrate that the Houston-Galveston-Brazoria (HGB) severe nonattainment area (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties) would meet the 1997 eight-hour ozone National Ambient Air Quality Standard (NAAQS) by the June 15, 2019, attainment deadline. The 2010 HGB AD SIP Revision includes an analysis to demonstrate attainment of the 1997 eight-hour ozone NAAQS as well as other SIP elements required by the Federal Clean Air Act (FCAA), including a nitrogen oxides (NO_X) motor vehicle emissions budget (MVEB) and a volatile organic compounds (VOC) MVEB for 2018. The 2010 HGB RFP SIP Revision demonstrates reasonable further progress toward attainment of the 1997 eight-hour ozone NAAQS by showing FCAA-required, incremental reductions in NO_X and VOC from the base year to attainment of the standard. The HGB RFP SIP Revision includes MVEBs for the milestone years 2008, 2011, 2014, 2017, and 2018.

The MVEBs included in both SIP revisions were developed using on-road mobile source emissions inventories established with the EPA's MOBILE (MOBILE6.2) model, a mobile source emissions estimation model. MVEBs are used by local metropolitan planning organizations (MPO) in nonattainment areas for transportation conformity analyses. The EPA found the MOBILE6.2-based MVEBs in the 2010 SIP revisions adequate for use in transportation conformity effective February 9, 2011, as published in the *Federal Register* on January 25, 2011 (76 FR 4342).

On March 2, 2010, the EPA officially released a new mobile source emissions estimation model, the Motor Vehicle Emission Simulator (MOVES) model, to replace the MOBILE model for SIP applications. Beginning March 2, 2013, transportation conformity must be conducted using the MOVES model. To demonstrate transportation conformity, a nonattainment area must show that its metropolitan transportation plans, transportation improvement programs, and projects funded by the Federal Highway Administration or the Federal Transit Administration conform to the MVEBs established in the SIP. Conformity must be demonstrated before area transportation plans can be approved or funded by the United States Department of Transportation or the MPO. Updating MVEBs using MOVES-based on-road mobile emissions inventories requires a SIP revision. This SIP revision would facilitate future MOVES-based transportation conformity determinations by providing MVEBs based on the latest version of the MOVES model, MOVES2010a.

This proposed SIP revision would update the 2010 HGB AD SIP Revision and the 2010 HGB RFP SIP Revision to replace the on-road mobile source emissions inventories for NO_X and VOC based on the EPA's MOBILE6.2 model with those based on the EPA's MOVES2010a model. The MVEBs would also be updated using the MOVES2010a-based emissions inventories.

This SIP revision would also include technical analysis to support the modification of the HGB MVEBs. The technical analysis update shows that the effects of replacing MOBILE6.2 with MOVES2010a are significant; however, the projected 2018 design value (DV) is expected to be within the EPA's recommended threshold for corroborative weight of evidence, i.e., ≤ 87 parts per billion (ppb), to be used in an attainment demonstration. Chapter 3: *Photochemical*

Modeling includes an episodic model performance assessment showing that the additional NO_X emissions with MOVES increased overall ozone concentrations. In a number of cases, however, this caused the daily peak ozone concentrations to decrease, particularly in areas where fresh NO_X from motor vehicles is prevalent.

With MOVES2010a, the three monitors—Deer Park (DRPK, CAMS 35), Bayland Park (BAYP, CAMS 53) and Wallisville Road (WALV, CAMS 617)—that were projected to have a 2018 DV greater than 84 ppb in the 2010 HGB AD SIP Revision were also projected to have a 2018 DV greater than 84 ppb in this proposed update. Table ES-1: *Comparison of RRFs and DV18s with MOVES2010a and with MOBILE6.2* depicts the change in the Relative Response Factor (RRF), which is combined with the 2006 base year design values (DVb_{06}) to calculate the projected 2018 DV for each of these monitors. Comparing the RRFs and 2018 DVs for the current modeling with MOVES2010a (MOVES 2010a RRF and MOVES 2010a DV_{18}s) to the 2010 HGB AD SIP Revision modeling with MOBILE6.2 (MOBILE 6.2 RRF and MOBILE 6.2_{18}s) indicates that the RRF and 2018 DV for DRPK (CAMS 35) and WALV (CAMS 617) decreased slightly. The RRF and 2018 DV for BAYP (CAMS 53) increased, projecting it to be the HGB DV monitor in 2018.While the 2018 HGB DV is projected to be greater than 84 ppb, it is expected to be within the EPA's recommended threshold for corroborative weight of evidence to be used in an attainment demonstration.

Table ES-1: Comparison of RRFs and DV18s with MOVES2010a and with MOBILE6.2

Monitoring Site Code	DVb_{06}s (ppb)	MOBILE6.2 RRFs	MOBILE6.2 DV_{18}s	MOVES2010a RRFs	MOVES2010a DV_{18}s
DRPK – C35	92.0	0.939	86.4	0.937	86.2
BAYP – C53	96.7	0.884	85.4	0.900	87.0
WALV – C617*	92.0	0.938	86.3	0.936	86.2

* The WALV (CAMS 617) monitor is a non-regulatory monitor.

This proposed SIP revision would incorporate the strategy outlined in an October 13, 2011, letter to the EPA and satisfy the EPA's MOVES implementation policy guidance[1] concerning updating MVEBs in attainment demonstrations, which indicates that states must (1) demonstrate that the updated plan continues to meet all attainment demonstration requirements and (2) document that growth and control strategy assumptions for all other source categories (area, non-road mobile, and stationary point) continue to be valid and any minor updates would not change the conclusions of the attainment demonstration. Growth and control strategy assumptions continue to be valid for the point, area, and non-road mobile source categories in the 2010 HGB AD and RFP SIP Revisions. Minor updates have occurred to these source categories since the 2010 revisions; however, these updates would not change the overall conclusion of the 2010 HGB AD and RFP SIP Revisions. Therefore, updates to the point, area, and non-road mobile source categories are not being included in this SIP revision. Updates to these source categories will be addressed as part of the emissions inventory submittal to the EPA for the 2008 eight-hour ozone standard, which is anticipated to be submitted to the EPA by July 20, 2014.

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[1] EPA, 2009. "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes." Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-B-09-046, December 2009.

This proposed SIP revision would also update the contingency analysis. The 2010 HGB AD SIP Revision includes a commitment to address additional measures to meet the 3% contingency requirement in a mid-course review (MCR) submittal; however, these additional measures are no longer required. The updated on-road mobile source emissions inventories and control strategy reduction estimates developed with MOVES2010a demonstrate more than the required 3% contingency reduction requirement; therefore, the attainment demonstration contingency requirement for the 1997 eight-hour ozone standard is fulfilled for the HGB area.

In the 2010 HGB AD SIP Revision, the commission included a commitment to provide an MCR by December 2013, to coincide with a SIP revision submittal date for the EPA's proposed 2010 ozone standard. The EPA changed course in reconsidering the 2008 eight-hour ozone standard and the proposed 2010 eight-hour ozone standard was not finalized. Instead, the EPA promulgated designations for the 2008 eight-hour ozone standard effective July 20, 2012. The HGB area was designated nonattainment with a marginal classification. Further, the 1997 eight-hour ozone standard will be revoked effective July 20, 2013. Given these changes to the circumstances surrounding submittal of an MCR, the TCEQ, has focused its review on specific elements that bear the most relevance for supporting the previously submitted attainment demonstration regarding the 1997 eight-hour ozone standard. This SIP revision meets the primary obligations of the MCR commitment by demonstrating that the 3% contingency requirement is fulfilled, evaluating photochemical modeling, and updating the weight of evidence analysis and inventory data.

A recent United States (U.S.) Ninth Circuit Court of Appeals decision [Association of Irritated Residents, et. al. v. United States Environmental Protection Agency, 2012 WL 251912 (C.A.9)] addressed the requirements for transportation control measures (TCM) in SIPs for severe nonattainment areas. In light of the recent U.S. Ninth Circuit Court of Appeals decision, the EPA has determined that additional analysis is needed to demonstrate that the vehicle miles traveled (VMT) increase does not trigger additional TCMs for the HGB area. On August 30, 2012, the EPA released guidance on how to address this requirement and sent the TCEQ a revised model (MOVES2010bROP) to conduct the necessary analysis. The TCEQ did not receive the guidance and model in time to incorporate the demonstration into this proposed SIP revision; however, the TCEQ is now evaluating the guidance and model, and the commission will consider providing the analysis at adoption of this revision in order to submit to the EPA for consideration.

SECTION V-A: LEGAL AUTHORITY

A. General

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

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

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

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

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

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

B. Applicable Law

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

Statutes

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

TEXAS HEALTH & SAFETY CODE, Chapter 382	September 1, 2011
TEXAS WATER CODE	September 1, 2011

Chapter 5: Texas Natural Resource Conservation Commission

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

Chapter 7: Enforcement

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

Rules

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

Chapter 7: Memoranda of Understanding, §§7.110 and 7.119
December 13, 1996 and May 2, 2002

Chapter 19: Electronic Reporting — March 15, 2007

Chapter 35: Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions	July 20, 2006
Chapter 39: Public Notice, §§39.402(a)(1) - (6), (8), and (10) - (12), 39.405(f)(3) and (g), (h)(1)(A) - (4), (6), (8) - (11), (i) and (j), 39.407, 39.409, 39.411(a), (e)(1) - (4)(A)(i) and (iii), (4)(B), (5)(A) and (B), and (6) - (10), (11)(A)(i) and (iii) and (iv), (11)(B) - (F), (13) and (15), and (f)(1) - (8), (g) and (h), 39.418(a), (b)(2)(A), (b)(3), and (c), 39.419(e), 39.420 (c)(1)(A) - (D)(i)(I) and (II), (D)(ii), (c)(2), (d) - (e), and (h), and 39.601 - 39.605	June 24, 2010
Chapter 55: Requests for Reconsideration and Contested Case Hearings; Public Comment, §§55.150, 55.152(a)(1), (2), (5), and (6) and (b), 55.154(a), (b), (c)(1) - (3), and (5), and (d) - (g), and 55.156(a), (b), (c)(1), (e), and (g)	June 24, 2010
Chapter 101: General Air Quality Rules	April 19, 2012
Chapter 106: Permits by Rule, Subchapter A	May 15, 2011
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter	February 16, 2012
Chapter 112: Control of Air Pollution from Sulfur Compounds	July 16, 1997
Chapter 113: Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants	May 14, 2009
Chapter 114: Control of Air Pollution from Motor Vehicles	September 13, 2012
Chapter 115: Control of Air Pollution from Volatile Organic Compounds	December 29, 2011
Chapter 116: Permits for New Construction or Modification	August 16, 2012
Chapter 117: Control of Air Pollution from Nitrogen Compounds	April 19, 2012
Chapter 118: Control of Air Pollution Episodes	March 5, 2000
Chapter 122: §122.122: Potential to Emit	December 11, 2002
Chapter 122: §122.215: Minor Permit Revisions	June 3, 2001
Chapter 122: §122.216: Applications for Minor Permit Revisions	June 3, 2001
Chapter 122: §122.217: Procedures for Minor Permit Revisions	December 11, 2002
Chapter 122: §122.218: Minor Permit Revision Procedures for Permit Revisions Involving the Use of Economic Incentives, Marketable Permits, and Emissions Trading	June 3, 2001

SECTION VI: CONTROL STRATEGY

TABLE OF CONTENTS

LIST OF ACRONYMS

ABY	adjusted base year
AFFP	Alternative Fueling Facilities Program
AGS	Automated Gate Systems
APCA	Anthropogenic Precursor Culpability Assessment
ARD	Acid Rain Database
Auto-GC	automated gas chromatograph
BAYP	Houston Bayland Park Monitor (CAMS 53)
BPA	Beaumont-Port Arthur
BYWC	Baytown Wetland Center Monitor (CAMS 552)
C35C	Clinton Monitor (CAMS 403/CAMS 113/CAMS304)
CAIR	Clean Air Interstate Rule
CAMx	Comprehensive Air Model with Extension
CARS	Car Allowance Rebate System
CB05	2005 version of the Carbon Bond chemical mechanism
CEMS	Continuous Emission Monitoring System
CFR	Code of Federal Regulations
CNR2	Conroe Relocated Monitor (CAMS 78)
CSAPR	Cross State Air Pollution Rule
CTG	Control Technique Guidelines
CTT	Clean Transportation Triangle
DERA	Diesel Emission Reduction Act
DIAL	Differential Absorption Lidar
DFW	Dallas-Fort Worth
DNCG	Danciger Non-Regulatory, Industry-Sponsored Monitor (CAMS 618)
DRE	destruction and removal efficiency
DRPK	Deer Park Monitor (CAMS 35/CAMS 139)
DV	design value
DV_B	baseline year ozone design value
DV_F	future design value
EAC	emissions control area
EE/RE	Energy Efficiency and Renewable Energy
EGU	electric generating unit
ENVIRON	ENVIRON International Corporation

EPA	United States Environmental Protection Agency
EPS3	Emissions Processing System
ETH	ethylene
FCAA	Federal Clean Air Act
FMVCP	Federal Motor Vehicle Control Program
FY	Fiscal Year
g/hr	grams per hour
GALC	Galveston Airport Monitor (CAMS 34/CAMS 109/CAMS 154)
GRVL	Greenville Monitor (CAMS 1006)
GSE	ground support equipment
HALC	Aldine Monitor (CAMS 8)
HCHV	Channelview Monitor (CAMS 15/CAMS 115)
HCQA	Croquet Monitor (CAMS 409)
HECT	Highly-Reactive Volatile Organic Compound Emissions Cap and Trade
H-GAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria
HLAA	Lang Monitor (CAMS 408)
HNWA	Northwest Harris County Monitor (CAMS 26)
HO3H	Haden Road Non-Regulatory, Industry-Sponsored Monitor (CAMS 603)
HOEA	Houston East Monitor (CAMS 1)
HOT	high occupancy toll
HOV	high occupancy vehicle
HPMS	Highway Performance Monitoring System
HROC	TCEQ Houston Regional Office (CAMS 81)
HRVOC	highly reactive volatile organic compounds
HSMA	Swiss Monroe Monitor (CAMS 406)
HTCA	Houston Texas Avenue Monitor (CAMS 411)
HWAA	North Wayside Monitor (CAMS 405)
IMO	International Maritime Organization
I/M	inspection and maintenance
IOLE	olefins with internal double bonds
LACT	Livingston Monitor (CAMS 1027)
LDAR	leak detection and repair
LIP	local initiative projects

LIRAP	Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program
LKJK	Lake Jackson Monitor (CAMS 1016)
LYNF	Lynchburg Ferry Monitor (CAMS 1015)
MACP	Manvel Croix Park Monitor (CAMS 84)
MARPOL	International Convention for the Prevention of Pollution from Ships
MATS	Modeled Attainment Test Software
MECT	Mass Emissions Cap and Trade
MNB	Mean Normalized Bias
MNGE	Mean Normalized Gross Error
MOVES	Motor Vehicle Emission Simulator model
MPO	metropolitan planning organizations
MSS	maintenance, startup, and shutdown
MSTG	Mustang Bayou Non-Regulatory, Industry-Sponsored Monitor (CAMS 619)
MVEB	motor vehicle emissions budget
NAAQS	National Ambient Air Quality Standard
NLEV	National Low Emission Vehicle
NO	nitric oxide
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
OCR	Optical Character Recognition
OGV	oceangoing vessels
OLE	olefins
OSAT	Ozone Source Apportionment Technology
OSD	ozone season day
PBR	Permit by Rule
PHA	Port of Houston Authority
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
ppb	parts per billion
ppbC	parts per billion carbon
ppm	parts per million
psia	pounds per square inch absolute
QA/QC	quality assurance and quality control

QQ	Quantile-Quantile
r^2	Correlation Coefficient
RACT	Reasonably Available Control Technology
RFG	reformulated gasoline
RFP	reasonable further progress
RIA	regulatory impact analysis
RRF	Relative Response Factor
RRF_D	Relative Response Factor Denominator
RRF_N	Relative Response Factor Numerator
SAGA	San Augustine Monitor (CAMS 0646)
SB	Senate Bill
SBFP	Seabrook Friendship Park Monitor (CAMS 45)
SHWH	Shell Westhollow Monitor (CAMS 410)
SI	spark ignition
SIP	state implementation plan
SO_2	sulfur dioxide
SP	Standard Permit
TAC	Texas Administrative Code
TACB	Texas Air Control Board
TATU	TCEQ Attainment Test for Unmonitored Areas
TCAA	Texas Clean Air Act
TCEQ	Texas Commission on Environmental Quality (commission)
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
TNGVGP	Texas Natural Gas Vehicle Grant Program
TNRCC	Texas Natural Resource Conservation Commission
tpd	tons per day
tpy	tons per year
TXCT	Texas City Non-Regulatory, Industry-Sponsored Monitor (CAMS 620)
TxDOT	Texas Department of Transportation
TxLED	Texas Low Emission Diesel
TTI	Texas Transportation Institute

UMA	unmonitored area
UPA	Unpaired Peak Accuracy
U.S.	United States
VMT	vehicle miles traveled
VOC	volatile organic compounds
WALV	Wallisville Non-Regulatory, Industry-Sponsored Monitor (CAMS 617)

IDENTIFICATION OF PREVIOUSLY ADOPTED SIP REVISIONS

This document references state implementation plan (SIP) revisions and their associated appendices that were previously adopted by the commission and submitted to the United State Environmental Protection Agency (EPA). The following list identifies how these SIP revisions are referenced in this document and contains the project number, adoption date, full title, and a hyperlink for each SIP revision and appendix.

2010 HGB AD SIP Revision (TCEQ Project No. 2009-017-SIP-NR, adopted March 10, 2010) Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_completeNarr_ado.pdf)

- Appendix B: Emissions Modeling for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_ado_Appendix_B.pdf)
- Appendix C: Photochemical Modeling for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_ado_Appendix_C.pdf)

2010 HGB RFP SIP Revision (TCEQ Project No. 2009-018-SIP-NR, adopted March 10, 2010) Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09018SIP_ado.pdf)

- Appendix 1: HGB Reasonable Further Progress Demonstration Calculations Spreadsheet (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09018SIP_APP1_ado.pdf)
- Appendix 9: Houston-Galveston-Brazoria 1997 Eight-Hour Ozone Nonattainment Area Reasonable Further Progress On-Road Mobile Source Emissions Inventories (http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09018SIP_APP9_ado.pdf)

2011 HGB RACT Update SIP Revision (TCEQ Project No. 2010-028-SIP-NR, adopted December 7, 2011) Houston-Galveston-Brazoria Reasonably Available Control Technology Analysis Update State Implementation Plan for the 1997 Eight-Hour Ozone Standard (http://www.tceq.texas.gov/airquality/sip/HGB_eight_hour.html)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1: GENERAL (UPDATED)

1.1 BACKGROUND (NO CHANGE FROM 2011 HGB RACT UPDATE SIP REVISION)

1.2 INTRODUCTION (UPDATED)

This chapter includes updates to the eight-hour ozone National Ambient Air Quality Standard (NAAQS) state implementation plan (SIP) history since the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision), adopted in March 2010, and *Houston-Galveston-Brazoria Reasonably Available Control Technology Analysis Update State Implementation Plan* (2011 HGB RACT Update SIP Revision), adopted in December 2011. This chapter also includes a brief summary of this SIP revision. This chapter is an update to Chapter 1: *General* of the 2010 HGB AD SIP Revision and 2011 HGB RACT Update SIP Revision.

1.2.1 One-Hour Ozone National Ambient Air Quality Standard (NAAQS) History (No change from 2010 HGB AD SIP Revision)

1.2.2 Eight-Hour Ozone NAAQS History (Updated)

On March 12, 2008, the United States Environmental Protection Agency (EPA) lowered the primary and secondary eight-hour ozone standards to 0.075 parts per million (ppm). The governor recommended to the EPA in March 2009 that Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties be designated as a nonattainment area for the 2008 eight-hour ozone standard. In September 2009, the EPA announced that it intended to reconsider the 2008 ozone standard. On January 19, 2010, the EPA proposed revisions in the *Federal Register* (75 FR 2938) to strengthen the primary eight-hour ozone standard in the range of 0.060 to 0.070 ppm. On September 2, 2011, the President announced a request that the EPA withdraw the proposed, reconsidered ozone standard.

In a September 2011 memo, the EPA announced that it would proceed with initial area designations under the 2008 (0.075 ppm) eight-hour ozone standard, starting with the recommendations states made in 2009 and updating those recommendations with the most current, certified air quality data (2008 through 2010).

The EPA published final designations and classifications for the 2008 eight-hour ozone standard in the May 21, 2012, *Federal Register* (77 FR 30088). Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties were designated nonattainment and classified marginal. This rule also establishes December 31 of each relevant calendar year as the attainment date for each classification. According to the May 21, 2012, *Federal Register* (77 FR 30160), the EPA will revoke the 1997 eight-hour ozone NAAQS for purposes of transportation conformity, effective July 20, 2013. The HGB area is required to attain the 2008 eight-hour ozone standard by December 31, 2015.

1.2.2.1 May 23, 2007 (No change from 2010 HGB AD SIP Revision)

1.2.2.2 March 10, 2010 (No change from 2011 HGB RACT Update SIP Revision)

1.2.2.3 December 7, 2011 (Added)

On December 7, 2011, the commission adopted the 2011 HGB RACT Update SIP Revision. The Reasonably Available Control Technology (RACT) analysis only provides an update to the HGB volatile organic compounds (VOC) RACT demonstration, because this SIP revision focuses specifically on the seven Control Technique Guidelines (CTG) documents issued by the EPA from 2006 through 2008 that were not addressed in the 2010 HGB AD SIP Revision.

The 2011 HGB RACT Update SIP Revision incorporates concurrent CTG-related rulemaking that revises 30 Texas Administrative Code Chapter 115, Subchapter E to implement RACT for flexible package printing; industrial cleaning solvents; large appliance coatings; metal furniture coatings; paper, film, and foil coatings; miscellaneous industrial adhesives; and miscellaneous metal and plastic parts coatings CTG emission source categories in the HGB area.

1.2.3 Existing Ozone Control Strategies (No change from 2010 HGB AD SIP Revision)

1.2.4 Current SIP Revision (Updated)

The 2010 HGB AD SIP Revision and the *Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 RFP SIP Revision) contain on-road mobile emissions inventories, nitrogen oxides (NO_X) motor vehicle emissions budgets (MVEB), and VOC MVEBs developed using a version of the EPA's mobile source emissions estimation model. The MVEBs included in both SIP revisions were developed using the EPA's MOBILE (MOBILE6.2) emissions estimation model, which was used to develop on-road mobile source emissions inventories used in the SIPs and to establish MVEBs for local metropolitan planning organizations (MPO) in nonattainment areas to use in transportation conformity analyses. The EPA found the MOBILE6.2-based MVEBs in the 2010 HGB AD and RFP SIP Revisions adequate for use in transportation conformity effective February 9, 2011, as published in the *Federal Register* on January 25, 2011 (76 FR 4342).

On March 2, 2010, the EPA officially released a new model, the Motor Vehicle Emission Simulator (MOVES) model, to replace the MOBILE model for SIP applications. Beginning March 2, 2013, transportation conformity must be conducted using the MOVES model. To demonstrate transportation conformity, a nonattainment area must show that its metropolitan transportation plans, transportation improvement programs, and projects funded by the Federal Highway Administration or the Federal Transit Administration conform to the MVEBs established in the SIP. Conformity must be demonstrated before area transportation plans can be approved or funded by the United States Department of Transportation or the MPO. Updating MVEBs using MOVES-based on-road mobile emissions inventories requires a SIP revision. This proposed SIP revision would facilitate future MOVES-based transportation conformity determinations by providing MVEBs based on the latest version of the MOVES model, MOVES2010a.

This proposed SIP revision would update the 2010 HGB AD SIP Revision and the 2010 RFP SIP Revision to replace the on-road mobile source emissions inventories for NO_X and VOC based on the EPA's MOBILE6.2 model with those based on the EPA's MOVES2010a model. The MVEBs would be updated using the MOVES2010a-based emissions inventories. In addition, this SIP revision would also include a technical analysis to support the modification of the HGB MVEBs.

The technical analysis update included in this SIP revision shows that the effects of replacing MOBILE6.2 with MOVES2010a are significant; however, the projected 2018 design value (DV) is within the EPA's recommended threshold for corroborative weight of evidence, i.e., ≤ 87 parts per billion (ppb), to be used in an attainment demonstration. Chapter 3: *Photochemical Modeling* includes an episodic model performance assessment showing that the additional NO_X emissions associated with using MOVES increased ozone concentrations in many instances. In a number of cases, however, this caused the daily peak ozone concentrations to decrease, particularly in areas where fresh NO_X from motor vehicles is prevalent.

This proposed SIP revision would incorporate the strategy outlined in an October 13, 2011, letter to the EPA and satisfy the EPA's MOVES implementation policy guidance[2] concerning updating MVEBs in attainment demonstrations. Growth and control strategy assumptions continue to be valid for the point, area, and non-road mobile source categories in the 2010 HGB AD and RFP SIP Revisions. Minor updates have occurred to these source categories since the 2010 HGB AD and RFP SIP Revisions; however, these updates would not change the overall conclusion of those SIP revisions. Therefore, updates to the point, area, and non-road mobile source categories using the MOVES model are not included in this SIP revision. Updates to these source categories will be addressed as part of the emissions inventory submittal to the EPA for the 2008 eight-hour ozone standard.

In the 2010 HGB AD SIP Revision, the commission included a commitment to provide a mid-course review (MCR) by December 2013, to coincide with a SIP revision submittal date for the EPA's proposed 2010 eight-hour ozone standard. The EPA changed course in reconsidering the 2008 eight-hour ozone standard and the proposed 2010 eight-hour ozone standard was not finalized. Instead, the EPA promulgated designations for the 2008 eight-hour ozone standard effective July 20, 2012. The HGB area was designated nonattainment with a marginal classification. Further, the 1997 eight-hour ozone standard will be revoked effective July 20, 2013. Given these changes to the circumstances surrounding submittal of an MCR, the Texas Commission on Environmental Quality (TCEQ) has focused its review on specific elements that bear the most relevance for supporting the previously submitted attainment demonstration regarding the 1997 eight-hour ozone standard. This SIP revision meets the primary obligations of the MCR commitment.

This SIP revision includes updates to the on-road mobile source emissions inventories for NO_X and VOC using the EPA's MOVES 2010a model. Minor updates to the point, area, and non-road source categories would not change the overall conclusion of the 2010 HGB AD SIP Revision. Emission inventory updates for all source categories will be included as part of the emissions inventory submittal for the 2008 eight-hour ozone standard, which is anticipated to be submitted to the EPA by July 20, 2014. For example, the EPA's final rule for National VOC Emission Standards for Aerosol Coatings mentioned in Chapter 4: *Control Strategies and Required Elements* of the 2010 HGB AD SIP Revision will be updated as part of the emissions inventory submittal for the 2008 eight-hour ozone standard.

This SIP revision also includes:

- updates to the statistical, graphical, and sensitivity analyses of the photochemical modeling, supporting the adequacy of the model's performance evaluation;
- updates to the attainment year (2018 target) ozone projections, including the unmonitored area analysis;
- updates to the matrix modeling, which assesses the change in ozone to the change in VOC and NO_X emissions;
- updates to the source apportionment analyses (Ozone Source Apportionment Technology and Anthropogenic Precursor Culpability Assessment), which identifies the contribution of

[2] EPA, 2009. "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes." Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-B-09-046, December 2009.

various emission source categories in various source regions to the 2018 projected ozone concentration; and
- reviews and assessments of the quantitative corroborative analyses used as weight of evidence, in particular, the trends in ozone and precursor emissions.

In addition, the TCEQ has provided an updated analysis regarding the contingency requirement to demonstrate that the 2019 contingency reductions exceed the 3% contingency reduction requirement; therefore, the attainment demonstration contingency requirement for the 1997 eight-hour ozone standard is fulfilled for the HGB area. Additional control measures are not needed to fulfill the 3% contingency requirement of the 2010 HGB AD SIP Revision; however, control measures were reviewed and updated as part of the qualitative corroborative analysis used as weight of evidence in this SIP revision.

The TCEQ has also provided an update on state and federal control measures, including the following measures:

- control of VOC emissions from storage tanks;
- new international marine diesel engine and marine fuel standards for oceangoing vessels and emissions control areas;
- standard of performance for stationary compression ignition internal combustion engines; and
- the Mass Emissions Cap and Trade Program.

The TCEQ's ongoing assessment of new technologies and innovative ideas in this SIP revision includes information regarding the completion of the 2010 Flare Study and subsequent public and industry outreach. Updated information on technologies for detecting VOC such as optical gas imaging technology and open path sensing technology are also included as part of this SIP revision. A recent United States (U.S.) Ninth Circuit Court of Appeals decision [Association of Irritated Residents, et. al. v. United States Environmental Protection Agency, 2012 WL 251912 (C.A.9)] addressed the requirements for transportation control measures (TCM) in SIPs for severe nonattainment areas. In light of the recent U.S. Ninth Circuit Court of Appeals decision, the EPA has determined that additional analysis is needed to demonstrate that the vehicle miles traveled (VMT) increase does not trigger additional TCMs for the HGB area. On August 30, 2012, the EPA released guidance on how to address this requirement and sent the TCEQ a revised model (MOVES2010bROP) to conduct the necessary analysis. The TCEQ did not receive the guidance and model in time to incorporate the demonstration into this proposed SIP revision; however, the TCEQ is now evaluating the guidance and model, and the commission will consider providing the analysis at adoption of this revision in order to submit to the EPA for consideration.

1.3 HEALTH EFFECTS (NO CHANGE FROM 2010 HGB AD SIP REVISION)

1.4 STAKEHOLDER PARTICIPATION AND PUBLIC HEARINGS (UPDATED)

1.4.1 Stakeholder Participation (Updated)

There have been no stakeholder meetings because there are no new rules proposed with this SIP revision.

1.4.2 Public Hearings and Comment Information (Updated)

The commission will offer a public hearing in Houston on November 19, 2012, at 2:00 p.m. The public hearing will be held in Conference Room B on the second floor of the Houston-Galveston Area Council at 3555 Timmons Lane, Houston, Texas 77027.

The public comment period will open on October 19, 2012, and will close on November 26, 2012. Notice of public hearing for this SIP revision will be published in the *Texas Register*, the *Austin American Statesman*, and the *Houston Chronicle*. Written comments will be accepted via mail, fax, or through the eComments system. All comments should reference the "HGB MVEB Update SIP Revision" and Project Number 2012-002-SIP-NR. Comments may be submitted to Lola Brown, MC 206, State Implementation Plan Team, Office of Air, Texas Commission on Environmental Quality, P.O. Box 13087, Austin, Texas 78711-3087 or faxed to (512) 239-6188. If you choose to submit electronic comments, they must be submitted through the eComments (http://www5.tceq.state.tx.us/rules/ecomments) system. File size restrictions may apply to comments being submitted via the eComments system. Comments must be received by November 26, 2012.

1.5 SOCIAL AND ECONOMIC CONSIDERATIONS (NO CHANGE FROM 2011 HGB RACT UPDATE SIP REVISION)

1.6 FISCAL AND MANPOWER RESOURCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

CHAPTER 2: ANTHROPOGENIC EMISSIONS INVENTORY DESCRIPTION (UPDATED)

2.1 INTRODUCTION (UPDATED)

This chapter discusses general emissions inventory development for each of the source categories. This state implementation plan (SIP) revision includes changes only to on-road mobile sources. Section 2.5: *On-Road Mobile Sources* documents the general updates to on-road mobile sources. Chapter 3: *Photochemical Modeling* details specific on-road mobile source emissions inventories and emissions inputs developed for the Houston-Galveston-Brazoria (HGB) ozone photochemical modeling. Chapter 7: *Reasonable Further Progress Motor Vehicle Emissions Budget Update* details specific on-road mobile source emissions inventories and emissions input updates developed for the *Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard*. This chapter is an update to Chapter 2: *Anthropogenic Emissions Inventory Description* of the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision).

2.1.1 EI Improvement (No change from 2010 HGB AD SIP Revision)

2.2 POINT SOURCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

2.3 AREA SOURCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

2.4 NON-ROAD MOBILE SOURCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

2.5 ON-ROAD MOBILE SOURCES (UPDATED)

On-road mobile sources consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways. Combustion-related emissions are estimated for vehicle engine exhaust, and evaporative hydrocarbon emissions are estimated for fuel tank and other evaporative leak sources on the vehicle. The information necessary to estimate on-road mobile emissions consists of emission factors for each vehicle category, the estimated level of vehicle activity, and the estimated roadway speed.

Emission factors were developed using the United States Environmental Protection Agency's (EPA) mobile emissions factor model. Until March 2010, MOBILE6 was the EPA's official on-road emissions factor model. The EPA officially released the Motor Vehicle Emission Simulator (MOVES) model on March 2, 2010, as a replacement to MOBILE6 for SIP and transportation conformity applications. A revised version of MOVES, MOVES2010a, was released by the EPA on September 23, 2011. Similar to MOBILE6, various inputs are provided to MOVES to simulate the vehicle fleet in each nonattainment area. Inputs used to develop localized emission factors include vehicle speeds, vehicle age distributions, local meteorological conditions, type of inspection and maintenance program in place, and local fuel properties. As part of the transition from MOBILE6.2 to MOVES2010a, vehicle categories have changed from MOBILE6 vehicle types to MOVES source-use types. MOBILE6 vehicle types used vehicle certification standards, weight class, and fuel type to categorize vehicles. In addition to the factors used by MOBILE6, MOVES source-use types take into account vehicle use profile to categorize vehicles. This further refinement allows, for example, a light-duty truck used for commercial purposes to have different emission rates than the same truck used as a passenger vehicle. Emission factors are developed for all MOVES source-use types and roadway types.

The level of vehicle travel activity is developed using localized travel demand models (TDM) run by the Texas Transportation Institute, the Texas Department of Transportation, or regional metropolitan planning organizations. The TDMs have been validated using a large number of ground counts from traffic counters placed in various locations throughout Texas. Estimates of vehicle miles traveled (VMT) are often calibrated to outputs from the federal Highway Performance Monitoring System, a model validated using a different set of traffic counters. The VMT is allocated to the appropriate vehicle types using region-specific VMT mixes developed using ground counts and vehicle registration data.

Roadway speeds are needed to select the appropriate MOVES emission factors. Roadway speeds are calculated by a post-processor to the TDMs. The speed models use roadway capacity information, the estimated volumes from the TDMs, and speed correlations based on volume-to-capacity ratios to estimate roadway speeds. To develop on-road mobile emissions estimates, the speed-specific MOVES emission factors are multiplied by the VMT for each roadway link in the TDMs network.

CHAPTER 3: PHOTOCHEMICAL MODELING (UPDATED)

3.1 INTRODUCTION (UPDATED)

This chapter is an update to Chapter 3: *Photochemical Modeling* of the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision). The table and figure numbers in this chapter correspond to those in Chapter 3 of the 2010 HGB AD SIP Revision, but may be formatted differently than those in Chapter 3 of the 2010 HGB AD SIP Revision. For example, the first table in this chapter is numbered Table 3-6 instead of Table 3-1 because it corresponds with Table 3-6 in Chapter 3 of the 2010 HGB AD SIP Revision.

3.2 EPISODE SELECTION (NO CHANGE FROM 2010 HGB AD SIP REVISION)

3.3 METEOROLOGICAL MODEL (NO CHANGE FROM 2010 HGB AD SIP REVISION)

3.4 MODELING EMISSIONS (UPDATED)

For the stationary emission source types, which consist of point and area sources, routine emission inventories provided the major inputs for the emissions modeling processing. Emissions from mobile and biogenic sources were derived from relevant emission models. Specifically, link-based on-road mobile source emissions were derived from a travel demand model (TDM) coupled with the United States Environmental Protection Agency's (EPA) 2010 version of the Motor Vehicle Emission Simulator (MOVES2010a), and non-road mobile source emissions were derived from the EPA's National Mobile Inventory Model, or the Texas NONROAD mobile source model. The on- and non-road emissions were processed to air quality model-ready inputs using version three of the Emissions Processing System (EPS3) (Environ, 2007). Biogenic emissions were derived from the Global Biosphere Emissions and Interactions System model, which outputs air quality model-ready emissions.

Appendix B: *Emissions Modeling for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard* of the 2010 HGB SIP Revision provides details on the development and processing of the emissions using the various EPS3 modules. The modules, listed in Table 3-6: *EPS3 Emissions Processing Modules* are used to create the chemically speciated, temporally (hourly) allocated, and spatially distributed emission files needed for the air quality model.

Table 3-6: EPS3 Emissions Processing Modules

EPS3 Module	Description
PREAM	Prepare area and non-link-based mobile sources emissions for further processing
LBASE	Spatially allocate link-based mobile source emissions among grid cells
PREPNT	Group point source emissions into elevated and low-level for further processing
CNTLEM	Apply controls to model strategies, apply adjustments, etc.
TMPRL	Apply temporal profiles to hourly allocate emissions
CHMSPL	Chemically speciate emissions into nitric oxide (NO), nitrogen dioxide (NO_2), and various CB05-VOC species
GRDEM	Spatially distribute emissions by grid cell using source category surrogates
MRGUAM	Merge and adjust multiple gridded files for model-ready input
PIGEMS	Assigns PiGs and merges elevated point source files

Notes: CB05 = the 2005 version of the Carbon Bond chemical mechanism
PiG = Plume-in-Grid

Model-ready emissions were developed for the episode days listed in Table 3-7: *2005 and 2006 Episode Days for Emissions Modeling*.

Table 3-7: 2005 and 2006 Episode Days for Emissions Modeling

Episode Code	Episode Designation	Episode Days
Bc05ep0	May/June 2005	May 19 through June 3, 2005
Bc05ep1	June 2005	June 17 through 30, 2005
Bc05ep2	July/August 2005	July 26 through August 8, 2005
Bc06ep0	June 2006	May 31 through June 15, 2006
Bc06aqs1	August/September 2006	August 13 through September 15, 2006
Bc06aqs2	September/October 2006	September 16 through October 11, 2006

The following sections give a brief description of the development of each type of emissions.

3.4.1 Biogenic Emissions (No change from 2010 HGB AD SIP Revision)

3.4.2 Base Cases (Updated)

3.4.2.1 Point Sources (No change from 2010 HGB AD SIP Revision)

3.4.2.2 On-Road Mobile Sources (Updated)

On-road mobile source modeling emissions were developed using the EPA MOVES2010a model. MOVES2010b is the currently available version of the model but was not released until April 2012, which is well after on-road inventory development work had to commence for this SIP revision. For the eight-county Houston-Galveston-Brazoria (HGB) area, hourly MOVES2010a emission factors were combined with vehicle miles traveled (VMT) estimates for each roadway segment from the TDM managed by the Houston-Galveston Area Council (H-GAC). For non-HGB areas within the modeling domain, MOVES2010a emission factors were combined with VMT estimates from the Highway Performance Monitoring System (HPMS) managed by the Texas Department of Transportation (TxDOT). For non-Texas areas within the modeling domain, MOVES2010a was run in default mode for each non-Texas county. The output from these emission modeling applications was processed through EPS3 to generate the speciated and gridded on-road emission inputs for photochemical modeling applications.

HGB Area

For the eight-county HGB area, link-based on-road emissions were developed by the Texas Transportation Institute (TTI) using 2006 TDM output and the EPA MOVES2010a on-road mobile source emissions factor model to generate average summer and school season on-road emission estimates for the four day types of weekday (Monday through Thursday average), Friday, Saturday, and Sunday. The summer season on-road emission estimates were used for the Bc06ep0 episode that occurred during June 2006, and the school season on-road emission estimates were used for the Bc06aqs1 and Bc06aqs2 episodes that occurred from mid-August through early October 2006.

Non-HGB Portions of Texas

A similar link-based on-road emissions inventory was developed for the Dallas-Fort Worth (DFW) metropolitan area using TDM output from the North Central Texas Council of Governments. For the Texas counties outside of the HGB and DFW areas, on-road emissions were developed by TTI using 2006 HPMS data and MOVES2010a emission factors. Summer season estimates were prepared for the weekday, Friday, Saturday, and Sunday day types.

Outside Texas

For the non-Texas, United States (U.S.) portions of the modeling domain, the Texas Commission on Environmental Quality (TCEQ) ran MOVES2010a in default mode to generate 2006 July weekday mobile source emissions by county. Pollutant-specific ratios by hour were applied to these July weekday figures to yield emission estimates for Friday, Saturday, and Sunday day types. These ratios for non-Texas inventories were obtained from the 2006 Texas on-road emission estimates developed specifically for each day type.

Table 3-9: *Summary of the Development of On-Road Mobile Sources Emissions* provides features of the on-road mobile inventory approach for different regions of the modeling domain.

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

On-Road Inventory Parameter	HGB and DFW	Non-HGB and Non-DFW Texas	Non-Texas U.S. States and Counties
VMT Source and Resolution	TDM Roadway Links	HPMS Data Sets 19 Roadway Types	MOVES2010a Database 12 Roadway Types
Season/Month Modeled	School and Summer	Summer Only	July Only
Day Types	Weekday, Friday, Saturday and Sunday	Weekday, Friday, Saturday and Sunday	Weekday, Friday, Saturday and Sunday
Roadway Speed Distribution	Varies by Hour and Link	Varies by Hour and Roadway Type	MOVES2010aDefault
MOVES Source Use Types	All Thirteen	All Thirteen	All Thirteen
MOVES Fuel Types	Gasoline and Diesel	Gasoline and Diesel	Gasoline and Diesel
Extended Idling Emissions Allocation	Truck Stops	Interstates and Other Highway Types	Interstates and Other Highway Types

Note: VMT= Vehicle Miles Traveled

Table 3-10: *2006 Base Case Episode On-Road Modeling Emissions for HGB* summarizes the on-road mobile source emissions for the 2006 base case episodes for the eight-county HGB area in tons per day (tpd). Unlike previous on-road emission models, MOVES2010a estimates nitric oxide (NO) and nitrogen dioxide (NO_2) separately. Nitrogen oxides (NO_X) are the combination of NO and NO_2, but all three are reported below along with volatile organic compounds (VOC) and carbon monoxide (CO).

Table 3-10: 2006 Base Case Episode On-Road Modeling Emissions for HGB

Season and Day Type	NO (tpd)	NO_2 (tpd)	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	248.97	21.02	270.00	104.74	1,024.03
Summer Friday	263.65	22.51	286.16	109.26	1,096.07
Summer Saturday	188.11	16.44	204.55	88.28	857.40
Summer Sunday	154.03	13.40	167.43	81.24	748.53
School Weekday	255.88	21.67	277.55	106.50	1,049.60
School Friday	272.38	23.33	295.71	111.58	1,129.50
School Saturday	197.00	16.97	213.97	96.45	932.44
School Sunday	155.01	13.51	168.52	81.55	753.79

3.4.2.3 Non- and Off-Road Mobile Sources (No change from 2010 HGB AD SIP Revision)

3.4.2.4 Area Sources (No change from 2010 HGB AD SIP Revision)

3.4.2.5 Base Case Summary (Updated)

Table 3-12a: *2005 Base Case Episode Anthropogenic Modeling Emissions for HGB* and Table 3-12b: *2006 Base Case Episode Anthropogenic Modeling Emissions for HGB* summarize the typical weekday emissions in the eight-county HGB area by source type for each base case episode.

Table 3-12a: 2005 Base Case Episode Anthropogenic Modeling Emissions for HGB

Source Type	Bc05ep 0 NO_X (tpd)	Bc05ep 0 VOC[5] (tpd)	Bc05ep 0 CO (tpd)	Bc05ep 1 NO_X (tpd)	Bc05ep 1 VOC[5] (tpd)	Bc05ep 1 CO (tpd)	Bc05ep 2 NO_X (tpd)	Bc05ep 2 VOC[5] (tpd)	Bc05ep2 CO (tpd)
Point[1]	191.45	307.86	128.71	190.65	276.48	144.44	203.70	299.12	236.45
On-Road[2,6]	233.35	110.29	1307.35	221.67	104.27	1244.37	221.67	104.27	1244.37
Non-Road[3]	84.97	81.01	805.50	84.97	81.01	805.50	84.97	81.01	805.50
Off-Road[3, 4]	74.35	5.99	53.04	74.35	5.99	53.04	74.35	5.99	53.04
Area[3]	36.18	524.35	131.71	36.18	524.35	131.71	36.18	524.35	131.71
Totals	**620.30**	**1029.50**	**2426.31**	**607.82**	**992.10**	**2379.06**	**620.87**	**1014.74**	**2471.07**

Notes: 1. Point source emissions are based on non-startup Wednesday Acid Rain Database (ARD) emissions and average non-zero tank landing emissions.
2. On-road emissions are season- (school or summer) and year-specific emissions.
3. Non-road, off-road, and area emissions are year-specific ozone season day (OSD) emissions.
4. Off-road emissions consist of airport, locomotive, and marine emissions.
5. VOC is reported as sum of CB05 species.
6. 2005 on-road emission estimates are with older MOBILE6.2 model from the 2010 HGB AD SIP Revision.

Table 3-12b: 2006 Base Case Episode Anthropogenic Modeling Emissions for HGB

Source Type	Bc06ep 0 NO_X (tpd)	Bc06ep 0 VOC[5] (tpd)	Bc06ep 0 CO (tpd)	Bc06aq s1 NO_X (tpd)	Bc06aq s1 VOC[5] (tpd)	Bc06aq s1 CO (tpd)	Bc06aq s2 NO_X (tpd)	Bc06aq s2 VOC[5] (tpd)	Bc06aq s2 CO (tpd)
Point[1]	170.82	222.33	132.64	162.49	200.46	131.26	172.59	205.11	129.71
On-Road[2,6]	270.00	104.74	1024.03	277.55	106.50	1049.60	277.55	106.50	1049.60
Non – Road[3]	78.85	75.97	772.94	78.85	75.97	772.94	78.85	75.97	772.94
Off-Road[3, 4]	73.55	6.05	53.25	73.55	6.05	53.25	73.55	6.05	53.25
Area[3]	36.35	528.99	134.59	36.35	528.99	134.59	36.35	528.99	134.59
Totals	**629.57**	**938.08**	**2117.45**	**628.79**	**917.97**	**2141.64**	**638.89**	**922.62**	**2140.09**

Notes: 1. Point source emissions are based on non-startup Wednesday ARD emissions and average non- zero tank landing emissions.
2. On-road emissions are season- (school or summer) and year-specific emissions.
3. Non-road, off-road, and area emissions are year-specific OSD emissions.
4. Off-road emissions consist of airport, locomotive, and marine emissions.
5. VOC is reported as sum of CB05 species.
6. 2006 on-road emission estimates are with newer MOVES2010a model.

3.4.3 2006 Baseline (Updated)

In general, the baseline modeling emissions are based on typical ozone season emissions, whereas the base case modeling emissions are episode day-specific. The biogenic emissions are an exception in that the same episode day-specific emissions are used in the 2006 baseline and base cases. In addition, the 2006 baseline non- and off-road and area source modeling emissions are the same as used for the 2006 base case episodes since these emission categories are based on typical ozone season emissions. No fire emissions were included in the 2006 baseline.

3.4.3.1 Point Sources (No change from 2010 HGB AD SIP Revision)

3.4.3.2 On-Road Mobile Sources (Updated)

The 2006 baseline on-road mobile source emissions are the same as used for the June 2006 (Bc06ep0) base case episode. These are the summer season modeling emissions for each of the four day types of weekday, Friday, Saturday, and Sunday.

3.4.4 2018 Future Base and Control Strategy (Updated)

The biogenic emissions used for the 2018 future base and control strategy modeling are the same episode day-specific emissions used in the base cases. In addition, similar to the 2006 baseline, no fire emissions were included in the 2018 future base and control strategy modeling. Appendix B of the 2010 HGB AD SIP Revision provides extensive details of the 2018 modeling emissions development.

3.4.4.1 Point Sources (No change from 2010 HGB AD SIP Revision)

3.4.4.2 On-Road Mobile Sources (Updated)

2018 future case on-road emission estimates were developed in the same manner as the 2006 base case data sets described above in Section 3.4.2.2: *On-Road Mobile Sources*. For the HGB area, 2018 TDM output from H-GAC was combined with MOVES2010a emission rates to obtain link-based inventories for four day types during the school and summer season. For non-HGB areas within the modeling domain, MOVES2010a emission factors were combined with 2018 VMT estimates projected from historical HPMS data collected by the TxDOT. For non-Texas areas within the modeling domain, MOVES2010a July 2018 weekday scenarios were run in default mode for each non-Texas U.S. county. The output from these emission modeling applications were processed through EPS3 to generate the 2018 on-road speciated and gridded emission inputs for photochemical modeling applications.

New Table 3-A: *2018 Future Case Episode On-Road Modeling Emissions for HGB* summarizes the on-road mobile source emissions for the 2018 future case projection for the eight-county HGB area.

New Table 3-A: 2018 Future Case Episode On-Road Modeling Emissions for HGB

Season and Day Type	NO (tpd)	NO_2 (tpd)	NO_X (tpd)	VOC (tpd)	CO (tpd)
Summer Weekday	87.01	16.33	103.34	50.13	656.24
Summer Friday	91.60	17.17	108.77	51.65	698.62
Summer Saturday	66.33	11.93	78.25	43.10	540.96
Summer Sunday	55.48	9.65	65.13	40.63	474.88
School Weekday	88.34	16.62	104.96	50.51	665.79
School Friday	94.15	17.72	111.87	52.38	716.92
School Saturday	67.15	12.10	79.25	43.33	548.17
School Sunday	55.59	9.68	65.27	40.69	476.57

Using the summer weekday as an example, the eight-county HGB on-road NO_X emissions are reduced by roughly 62% from the 2006 baseline (270.00 tpd) to the 2018 future case (103.34 tpd). The summer weekday VOC emissions are reduced by roughly 52% from the 2006 baseline

(104.74 tpd) to the 2018 future case (50.13 tpd). During these twelve years, summer weekday VMT is expected to grow by 26% from 143,408,584 miles per day in 2006 to 180,955,402 miles per day in 2018, which is an average annualized growth rate of almost 2%. The calculated emission reductions during a period of VMT growth are primarily attributable to more stringent engine emission standards and fleet turnover. On-road emission estimates for both 2006 and 2018 include the benefits of an inspection and maintenance program, reformulated gasoline, Texas Low Emission Diesel, and the ongoing fleet turnover impacts from more stringent emission standards. Post-processing adjustments were not applied to either the 2006 or 2018 on-road inventories for transportation control measures or voluntary mobile emission reduction program measures. For more information on the development and EPS3 processing of these on-road emission inventories, refer to Appendix A: *Evaluation of On-Road Mobile Source Emissions Developed with the MOVES2010a Model Replacing Emissions Developed with the MOBILE6.2 Model for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard, Adopted March 10, 2010* of this SIP revision.

3.4.4.3 Non- and Off-Road Mobile Sources (No change from 2010 HGB AD SIP Revision)

3.4.4.4 Area Sources (No change from 2010 HGB AD SIP Revision)

3.4.5 2006 and 2018 Modeling Emissions Summary for HGB (Updated)

Table 3-13: *Summary of 2006 Baseline and 2018 Baseline Anthropogenic Modeling Emissions for HGB* summarizes typical weekday anthropogenic emissions in the eight-county HGB area by source type for the 2006 and 2018 future base modeling emissions.

Table 3-13: Summary of 2006 Baseline and 2018 Baseline Anthropogenic Modeling Emissions for HGB

Source Type	2006 Baseline NO_X (tpd)	2006 Baseline VOC (tpd)	2006 Baseline CO (tpd)	2018 Baseline NO_X (tpd)	2018 Baseline VOC (tpd)	2018 Baseline CO (tpd)
Point	172.86	241.00	132.25	154.36	292.05	222.06
On-Road	270.00	104.74	1024.03	103.35	50.13	656.24
Non-Road	79.33	61.41	572.37	33.62	30.18	427.56
Off-Road	73.26	5.75	52.30	85.66	6.68	44.71
Area	36.35	528.99	134.59	42.04	650.09	158.99
Totals	**631.80**	**941.89**	**1915.54**	**419.03**	**1029.13**	**1509.56**

Figure 3-10: *2006 Baseline and 2018 Future Case Anthropogenic NO_X and VOC Modeling Emissions for HGB* graphically compares the anthropogenic NO_X and VOC modeling emissions for the eight-county HGB area.

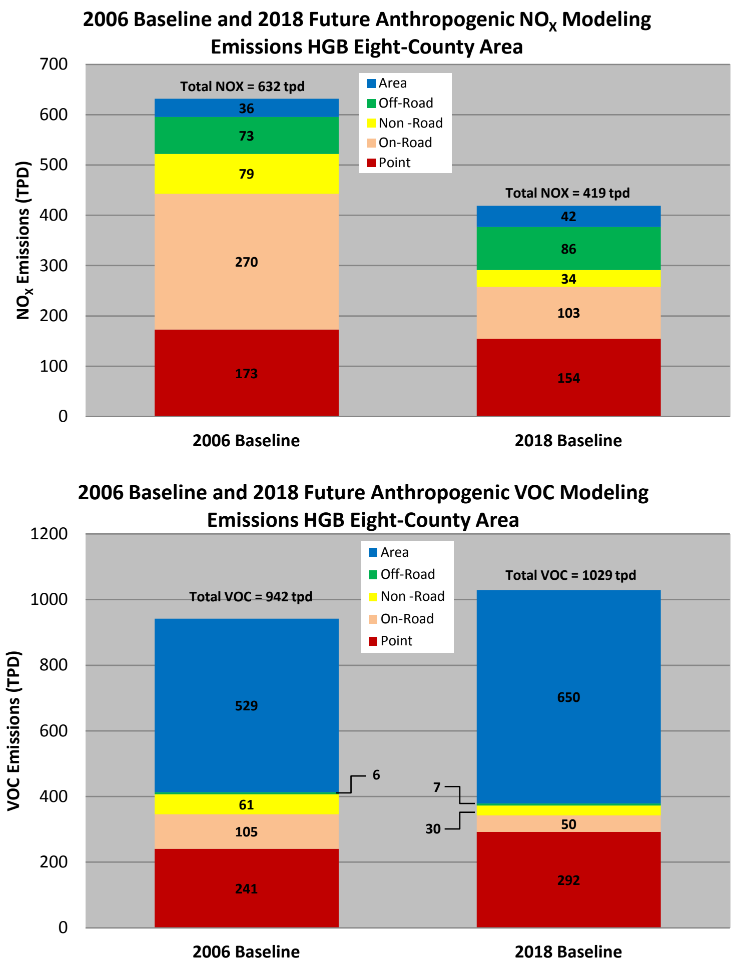


Figure 3-10: 2006 Baseline and 2018 Future Case Anthropogenic NO_X and VOC Modeling Emissions for HGB

Appendix A of this SIP revision includes a comparison between the previous on-road emissions developed with the MOBILE6.2 emissions factor model (2010 HGB AD SIP Revision) and these revised on-road emissions developed with the MOVES2010a emissions factor model.

3.5 PHOTOCHEMICAL MODELING (UPDATED)

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

- The model must have a reasonably current, peer-reviewed, scientific formulation.
- The model must be available at no or low cost to stakeholders.
- The model must be consistent with air quality models being used for other Texas air quality planning areas.

The only model to meet all three of these criteria is the Comprehensive Air Model with Extension (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, which helps avoid the artificial diffusion that occurs when point source emissions are introduced into a grid volume. The CAMx model software (http://www.camx.com) and the CAMx user's guide are publicly available. In addition, the TCEQ has many years of experience with CAMx. CAMx was used for the modeling conducted in the DFW nonattainment area, as well as for modeling being conducted in other areas of Texas [e.g., San Antonio, Beaumont-Port Arthur (BPA)].

CAMx Version 4.53 was used for this modeling study. Some of the features in this version include the ability to process in parallel on multiple processors and the following probing tools for sensitivity analysis:

- Process Analysis, which provides in depth details of ozone formation showing the various physical and chemical processes that determine the modeled ozone concentrations at specified locations and times;
- Ozone Source Apportionment Technology (OSAT), which estimates the contribution of emissions from multiple geographic areas and source categories (including biogenic emissions) to ozone formation; and
- Anthropogenic Precursor Culpability Assessment (APCA), which reallocates ozone apportioned to non-controllable biogenic emissions to the controllable portion of precursors that participated in ozone formation.

3.5.1 Modeling Domains and Horizontal Grid Cell Size (No change from 2010 HGB AD SIP Revision)

3.5.2 Vertical Layer Structure (No change from 2010 HGB AD SIP Revision)

3.5.3 Model Configuration (No change from 2010 HGB AD SIP Revision)

3.5.4 Model Performance Evaluation (Updated)

The CAMx model configuration was applied to the 2005 and 2006 base cases using episode-specific meteorological parameters and emissions. The CAMx modeling results were compared to the measured ozone and ozone precursor concentrations, which resulted in a number of modeling iterations involving improvements to the meteorological and emissions modeling and subsequent CAMx modeling. A detailed performance evaluation for each of the 2005 and 2006 base case modeling episodes is included in Appendix C: *Photochemical Modeling for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard* of the 2010 HGB AD SIP Revision. In addition, all performance evaluation products are available on the TCEQ's HGB Eight-Hour Ozone SIP Modeling Web page (http://www.tceq.state.tx.us/implementation/air/airmod/data/ hgb8h2/hgb8h2.html).

3.5.4.1 Performance Evaluations Overview (No change from 2010 HGB AD SIP Revision)

3.5.4.2 Operational Evaluations (Updated)

Statistical measures including the Unpaired Peak Accuracy (UPA), the Mean Normalized Bias (MNB), and the Mean Normalized Gross Error (MNGE) were calculated by comparing monitored (measured) and 4-cell bi-linearly interpolated modeled ozone concentrations for all episode days and monitors. Graphical measures, including time series and scatter plots of hourly measured and bi-linearly interpolated modeled ozone and, where applicable, some ozone precursors (e.g., NO_X, ethylene (ETH), and olefins (OLE) concentrations), were developed for each regulatory monitor. In addition, tile plots of modeled daily maximum eight-hour ozone concentrations were developed and overlaid with the measured daily maximum eight-hour ozone concentrations. Detailed operational evaluations for each of the 2005 and 2006 base case modeling episodes are included in Appendix C of the 2010 HGB AD SIP Revision.

Statistical Evaluations

The statistical evaluations presented focus on the comparison of the measured and modeled eight-hour ozone concentrations. Figure 3-12a: *Peak Eight-Hour Ozone Concentration, Measured versus Modeled for the 2005 Episode Days* and Figure 3-12b: *Peak Eight-Hour Ozone Concentration, Measured versus Modeled for the 2006 Episode Days* compare the measured and modeled daily maximum eight-hour ozone concentrations for each episode day of the 2005 and 2006 base cases, respectively. Figure 3-13a: *Mean Normalized Gross Error (MNGE) and Bias (MNB) for 2005 Episode Days* and Figure 3-13b: *Mean Normalized Gross Error (MNGE) and Bias (MNB) for 2006 Episode Days* show the MNGE and MNB for monitored eight-hour ozone concentrations greater than 40 parts per billion (ppb) for each episode day of the 2005 and 2006 base cases, respectively. Although there are no recommended criteria for the eight-hour UPA, MNGE, and MNB, the one-hour levels recommended by the EPA (i.e., ± 20%, 30%, and ±15%, respectively) were used for statistical evaluations.

The UPA statistic compares the percent difference between the daily maximum modeled (scenario Reg10 for 2005 episodes and scenario Reg11_MVS for the 2006 episodes) and monitored eight-hour ozone concentrations to ±20%. The error bars on the daily maximum measured eight-hour ozone concentrations in Figure 3-12a and Figure 3-12b represent the ± 20% UPA range for comparison with the daily maximum modeled eight-hour ozone concentrations. For the 37 episode days in the 2005 base cases, only seven days have daily maximum modeled eight-hour ozone concentrations outside the +20% of the daily maximum measured eight-hour ozone concentrations. For the 50 episode days in the 2006 base cases, only eight days have daily maximum modeled eight-hour ozone concentrations outside the ± 20% UPA range.

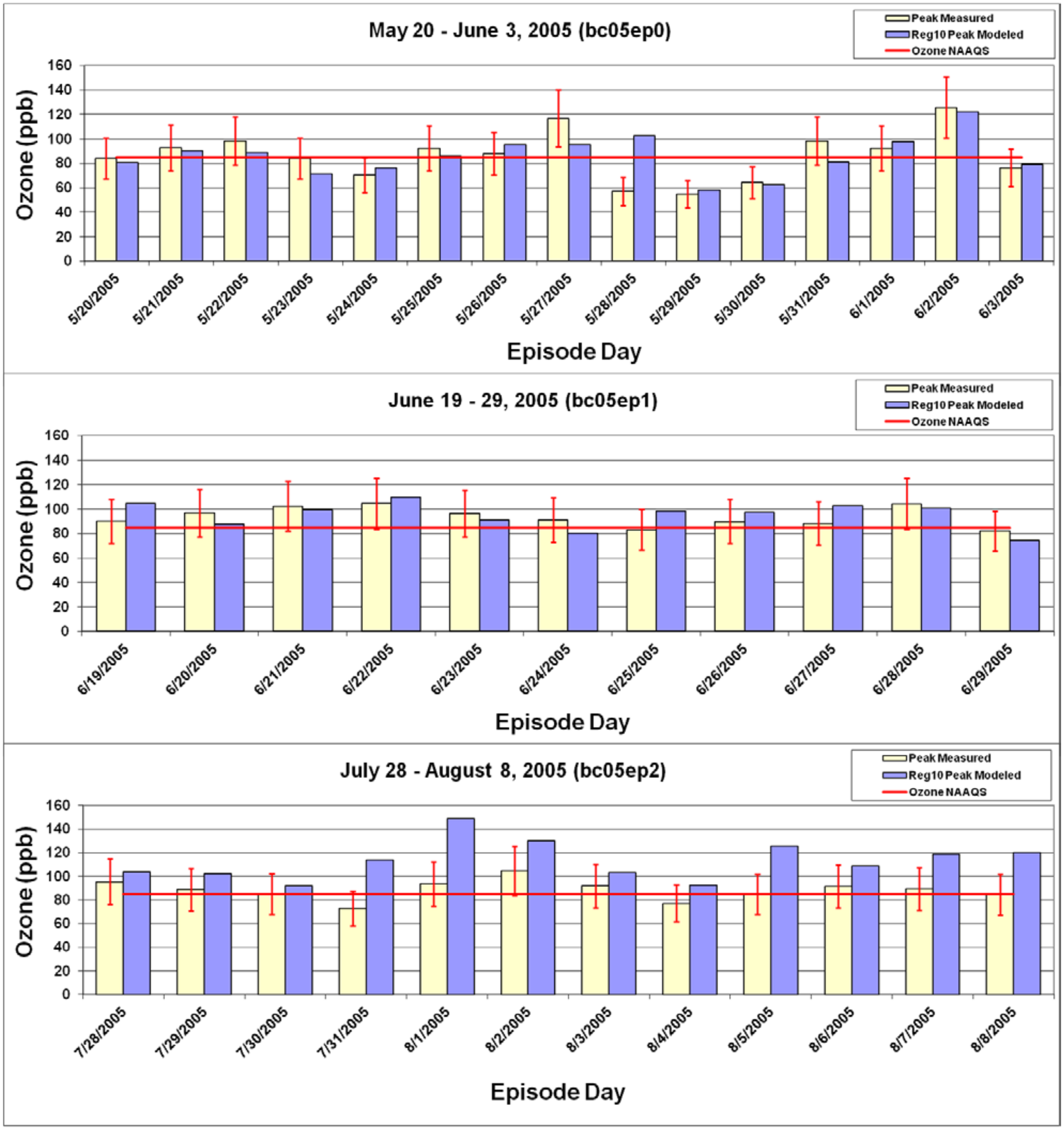


Figure 3-12a: Peak Eight-Hour Ozone Concentration, Measured versus Modeled for the 2005 Episode Days

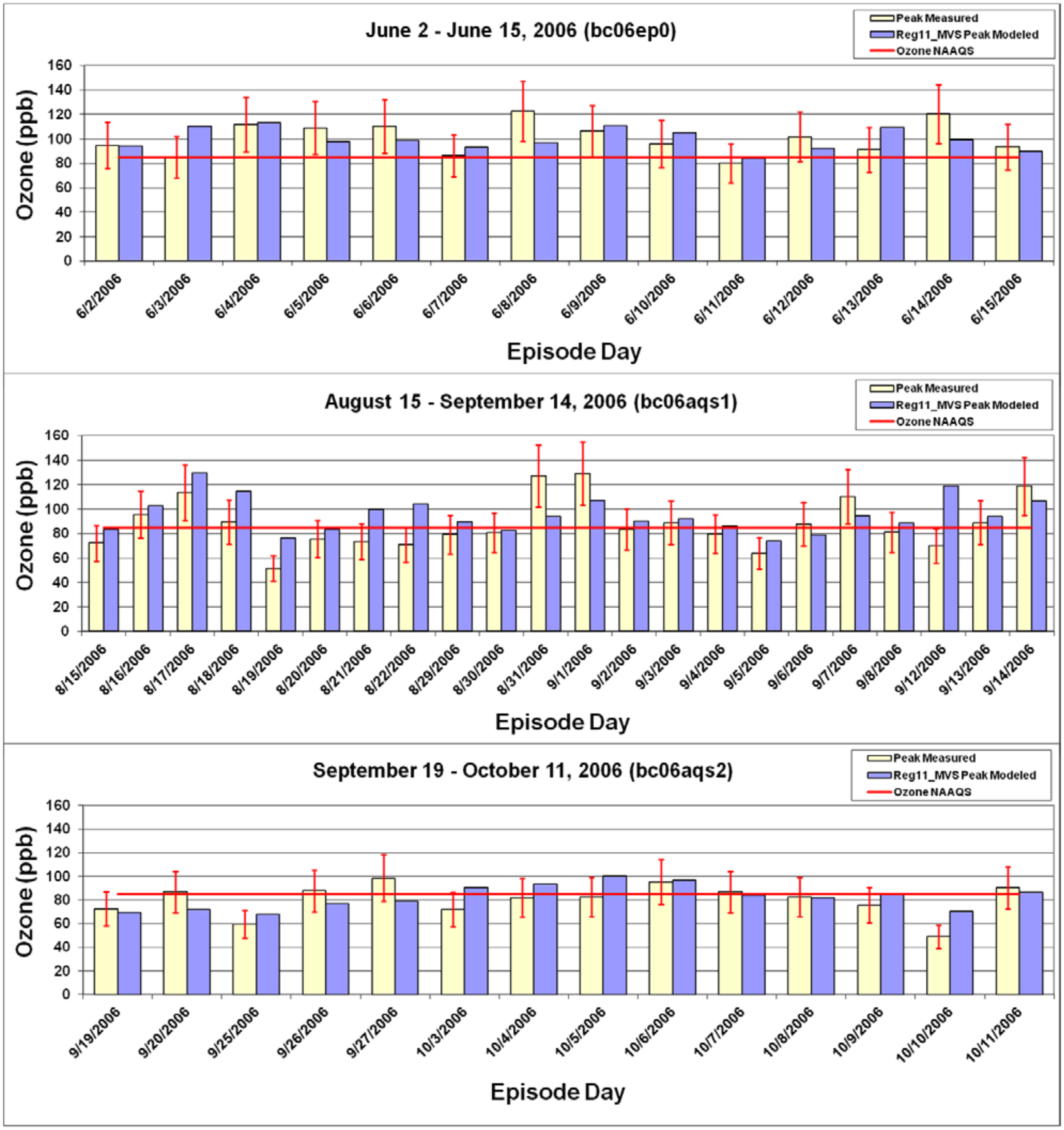


Figure 3-12b: Peak Eight-Hour Ozone Concentration, Measured versus Modeled for the 2006 Episode Days

Taking into consideration that only 15 days out of the 87 days modeled in the 2005 and 2006 base case episodes have daily maximum modeled eight-hour ozone concentrations outside the ±20% UPA range, the model suitably predicts the daily maximum eight-hour ozone concentrations. The area depicted in Figure 3-13a and Figure 3-13b, with MNGE ≤ 30% and -15% ≤MNB ≤ +15%, represents the joint condition for which both the MNGE and MNB are within acceptable ranges. The episode days labeled in red indicate those days for which daily peak measured eight-hour ozone concentrations were greater than or equal to 85 ppb.

For the 25 days of the 2005 base case episodes with daily maximum measured eight-hour ozone concentrations greater than or equal to 85 ppb, 16 days meet the joint condition of having both the MNGE ≤ 30% and -15% ≤ MNB ≤ +15%. The average daily maximum monitored ozone for those 25 days was 96.3 ppb, and the corresponding average daily maximum modeled ozone concentration was 101.1 ppb. The average mean normalized bias and mean normalized gross error were 11.4% and 19.0%, respectively.

For the 30 days of the 2006 base case episodes with daily maximum measured eight-hour ozone concentrations greater than or equal to 85 ppb, 21 days meet the joint condition of having both the MNGE ≤ 30% and -15% ≤ MNB ≤ +15%. The average daily maximum monitored ozone for those 30 days was 99.9 ppb, and the corresponding average daily maximum modeled ozone concentration was 96.4 ppb. The average mean normalized bias and normalized gross error were 10.2% and 17.5%, respectively, for the same 36 days.

Taking into consideration that 37 days out of the 55 episode days in the 2005 and 2006 base cases with daily maximum measured eight-hour ozone concentration greater than or equal to 85 ppb meet the joint condition of having both the MNGE ≤ 30% and -15% ≤ MNB ≤ +15%, the model suitably simulates the frequency and magnitude of daily maximum eight-hour ozone concentrations at the various monitors.

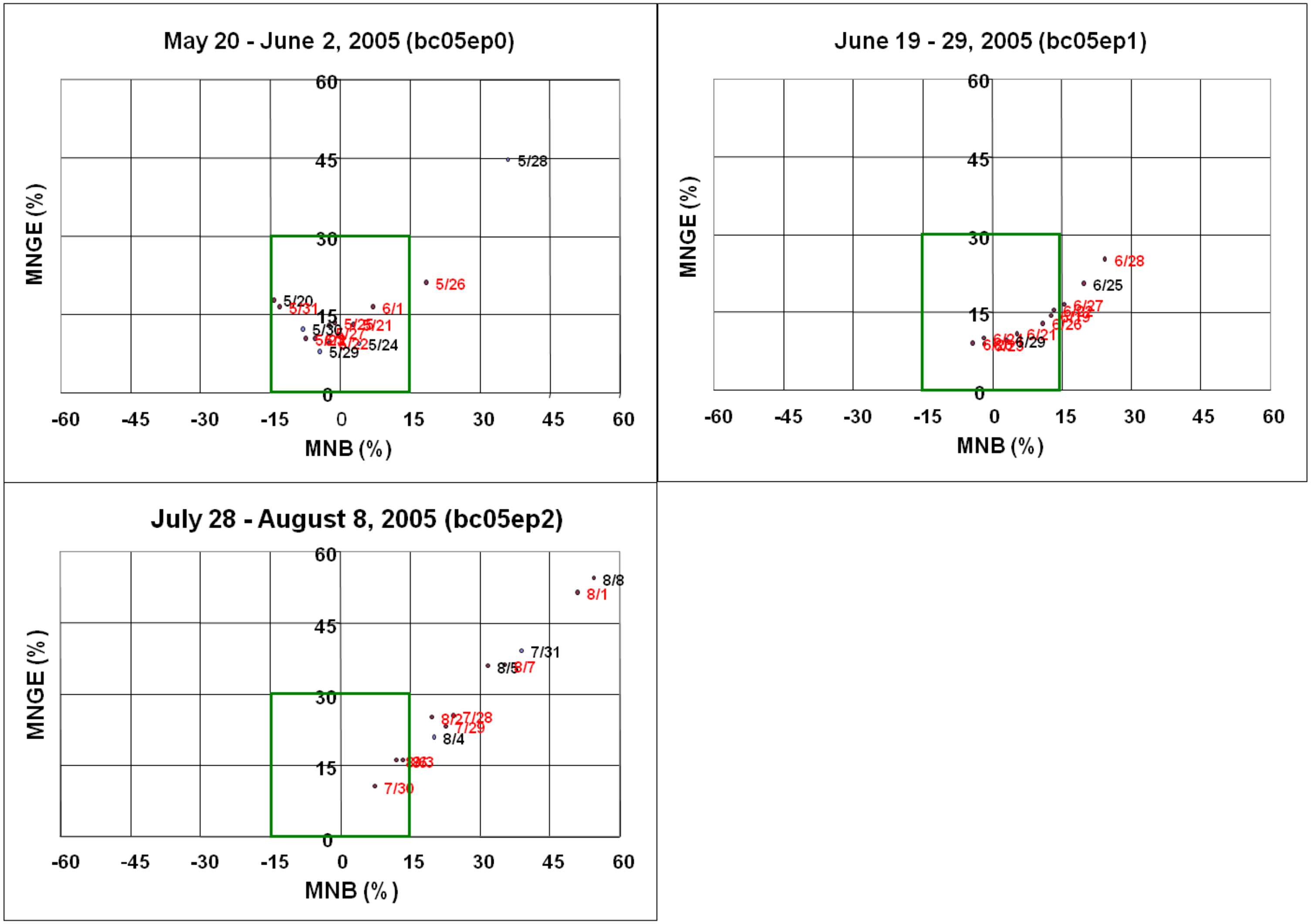


Figure 3-13a: Mean Normalized Gross Error (MNGE) and Bias (MNB) for 2005 Episode Days

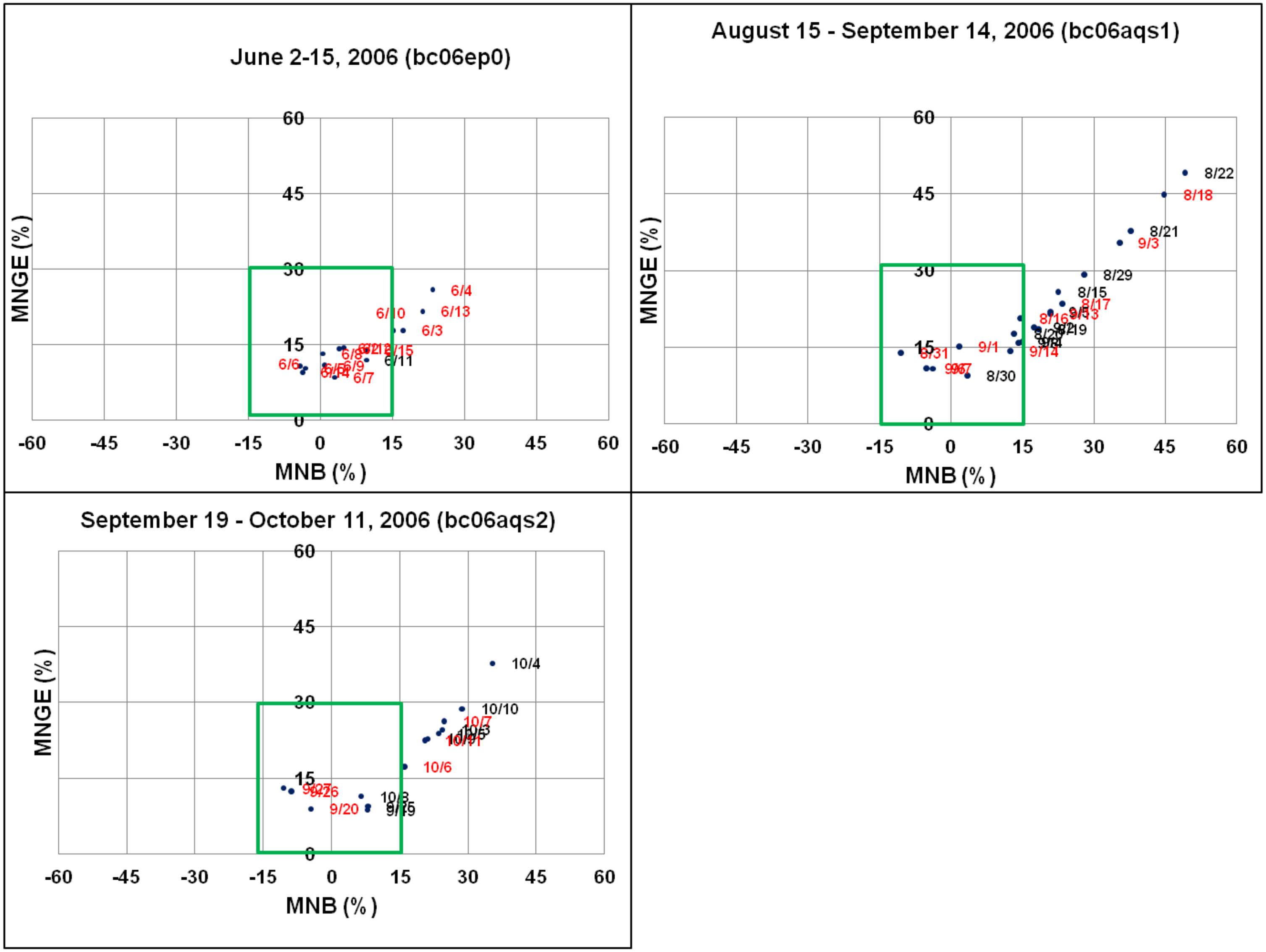


Figure 3-13b: Mean Normalized Gross Error (MNGE) and Bias (MNB) for 2006 Episode Days

Graphical Evaluations

A detailed graphical evaluation of modeling results is presented in Appendix C of the 2010 HGB AD SIP Revision. A selection of graphical evaluations, organized by episode modeled, is presented in this section.

For each of the 2005 and 2006 base case episodes, time series comparing hourly measured (red dots) and modeled (blue line) ozone concentrations are shown for three monitors in the eight-county HGB area in Figure 3-27: *Time Series of Hourly Ozone Concentrations for Episode Bc06ep0 at the HROC, SHWH, and WALV Monitors* and Figure 3-28: *Time Series of Hourly Ozone Concentrations for Episode Bc06ep0 at the GRVL, LACT, and SAGA Rural Monitors*. The monitors presented vary by episode and were selected on the basis of ozone measured. Included on the time-series graphic is the modeled maximum and minimum hourly ozone concentration within the 7 x 7 grid cell array around the monitor (green shading). Additionally, time series comparing hourly measured and modeled ozone concentrations are shown for two or three rural monitors (Greenville (GRVL; CAMS 1006) and Livingston (LACT, CAMS 1027) and San Augustine (SAGA; CAMS 0646), which was not in operation during Bc05ep0 and Bc05ep1). Figure 3-14: *TexAQS II Monitoring Sites Outside HGB/BPA* is a map of rural monitors with a list detailing the selected monitors.

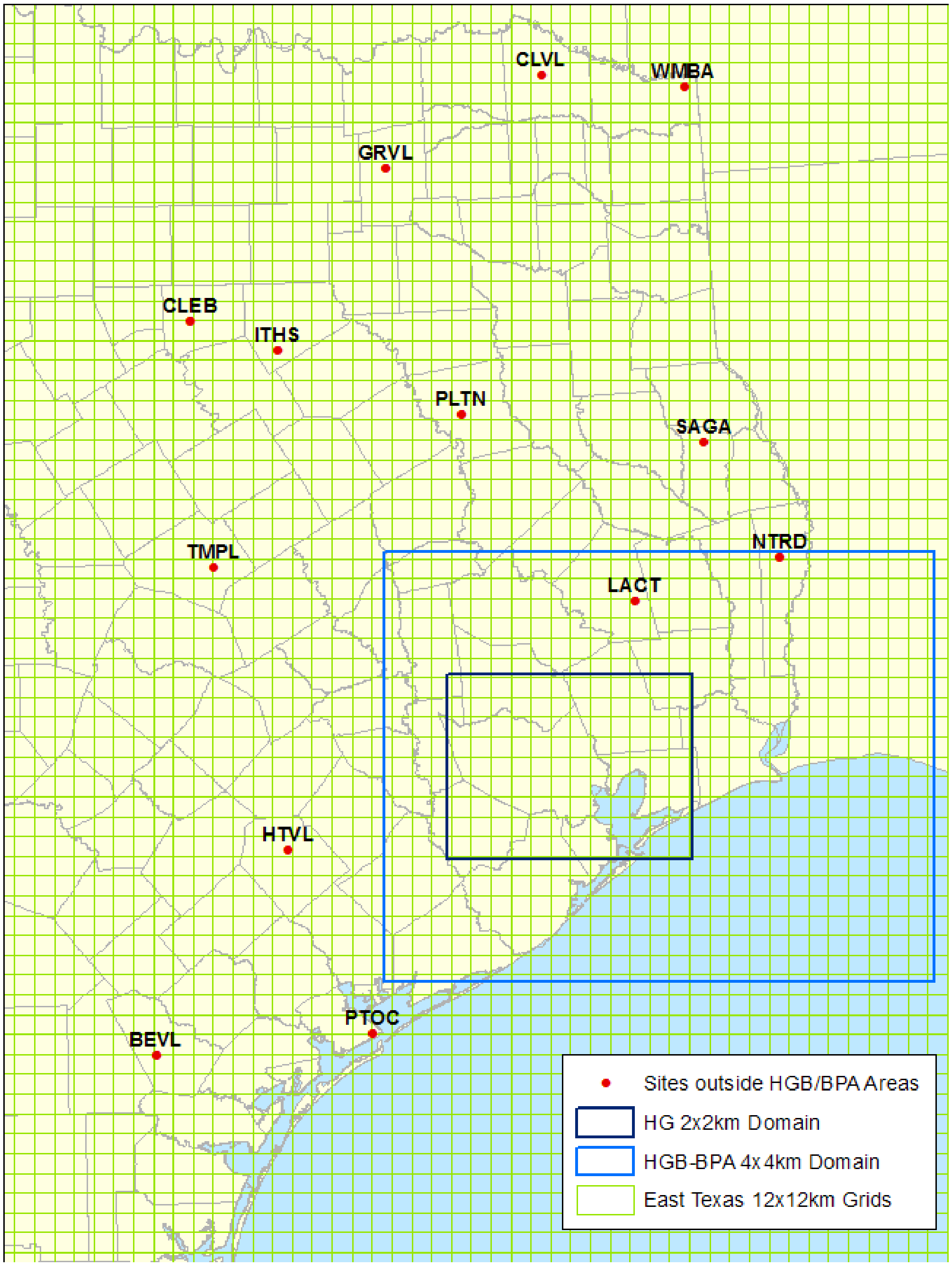


Figure 3-14: TexAQS II Monitoring Sites Outside HGB/BPA

Monitor Site Codes:

- GRVL: Greenville, northwest of Dallas
- CLEB: Cleburne, southwest of Fort Worth
- LACT: Livingston, northeast of Houston
- BEVL: Beeville, northwest of Corpus Christi
- CLVL: Clarksville, eastern TX-OK border
- NTRD: Newton, south-central TX-LA border
- PLTN: Palestine, central east Texas
- SAGA: San Augustine, central TX-LA border
- WMBA: Wamba, near Texarkana
- HTVL: Hallettsville, north of Victoria
- ITHS: Italy, south of Dallas
- PTOC: Port O'Conner, middle TX coast
- TMPL: near Temple

Also included for each of the episodes are linearly-scaled scatter plots comparing the hourly measured and modeled concentrations of ozone (O_3) and NO_X, and logarithmically-scaled scatter plots comparing the hourly measured and modeled concentrations of ETH and OLE in Figure 3-29: *Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the WALV Monitor for the Bc06ep0 Episode* and Figure 3-33: *Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the DRPK Monitor for the Bc06aqs1 Episode*. Monitor sites included in the graphical representation were the three monitors with the highest daily maximum monitored eight-hour ozone concentrations. If one of the top three sites did not also have an automated gas chromatograph (auto-GC), the third highest ozone monitoring site was replaced by the auto-GC site measuring the highest ozone. OLE is a CAMx chemical surrogate representing olefinic VOC, such as propylene, but excluding ethylene and certain compounds known as internal olefins such as butenes (internal olefins (IOLE) are represented in CB05 by the surrogate species IOLE). Both ethylene and propylene are highly reactive volatile organic compounds (HRVOC), and their emissions were adjusted in the base case modeling by the emissions reconciliation (see Appendix B of the HGB AD SIP Revision. Included on the scatter plots is the measured versus modeled Quantile-Quantile (QQ) plot, which first sorts independently both the measured and modeled concentrations, then plots the sorted values together. QQ plot data, shown as red dots, provide a measure of how close the modeled and measured distributions of values are to each other. If the red dots lie close to the diagonal one-to-one line, the model generates the correct proportions of low, medium, and high concentration values.

Tile plots of the daily maximum modeled eight-hour ozone concentrations are shown for selected episode days on which several monitors measured daily maximum eight-hour ozone concentrations greater than 84 ppb. Included on the tile plots are the monitor locations, represented by small circles and color coded for the measured daily maximum eight-hour ozone concentration. The same color coding is used for the measured and modeled maximum daily eight-hour ozone concentrations.

Bc05ep0: May 19 through June 3, 2005 (No change from 2010 HGB AD SIP Revision)

Bc05ep1: June 17 through 30, 2005 (No change from 2010 HGB AD SIP Revision)

Bc05ep2: July 26 through August 8, 2005 (No change from 2010 HGB AD SIP Revision)

Bc06ep0: May 31 through June 15, 2006

For the Bc06ep0 episode, represented in Figure 3-27, hourly time series are presented for the TCEQ Houston Regional Office (HROC; CAMS 81), Shell Westhollow (SHWH; CAMS 410), and the non-regulatory, industry-sponsored Wallisville (WALV; CAMS 617) monitors. Relatively high ozone concentrations were measured at these monitors on several days during this episode. In general, the modeled ozone concentrations, including the 7 x 7 cell maximum-minimum range, replicate the diurnal pattern of the observations, with the exception of the lower ozone concentrations measured during the early morning hours, especially at the SHWH (CAMS 410) monitor. The unfavorable comparison between the measured and modeled hourly ozone concentrations during the early morning hours at the SHWH (CAMS410) monitor is likely due to local factors, such as nearby NO_X emissions and low wind speed meteorological conditions, which reduces the areal representation of the monitor to much less than the 2 km grid cell size on which the modeled concentration is simulated. Thus, at the SHWH (CAMS 410) monitor during the early morning hours, the comparison of modeled and measured ozone concentrations may be inappropriate. A disparity is not necessarily an indication of poor model performance.

Figure 3-28 provides a comparison of measured and modeled hourly ozone concentrations at rural monitors. Modeled concentrations generally replicate the diurnal pattern of the observations, with generally favorable comparisons during the daytime. The model does not replicate the lower ozone concentrations measured on some days during the early morning hours, most likely due to localized emissions and meteorology limiting the representativeness of the monitors. Overall, modeled and measured rural concentrations compare favorably enough during periods of elevated ozone that modeled rural concentrations are unlikely to cause any substantial predictive bias within the HGB area during this episode.

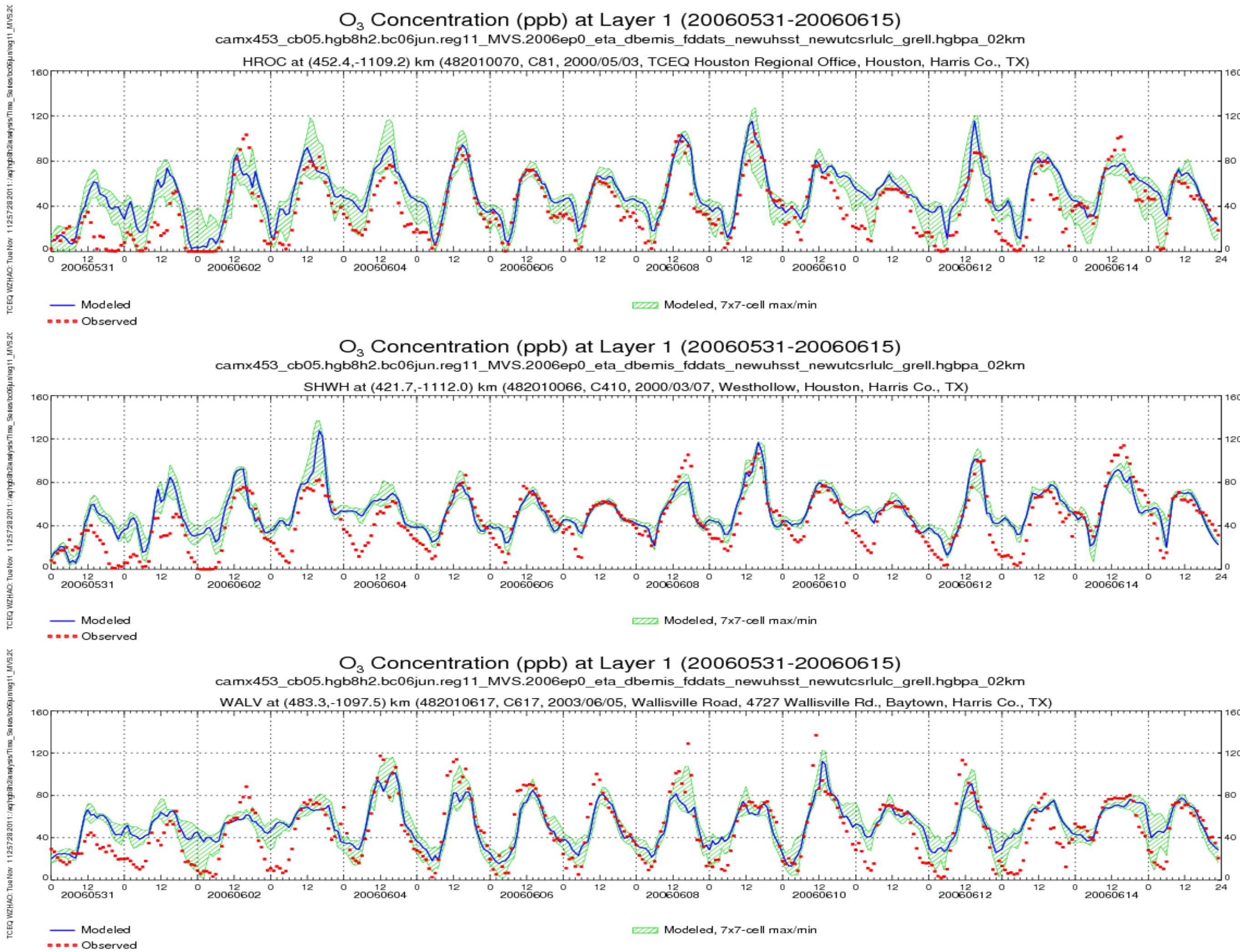


Figure 3-27: Time Series of Hourly Ozone Concentrations for Episode Bc06ep0 at the HROC, SHWH, and WALV Monitors

Note: WALV (CAMS 617) is a non-regulatory monitor.

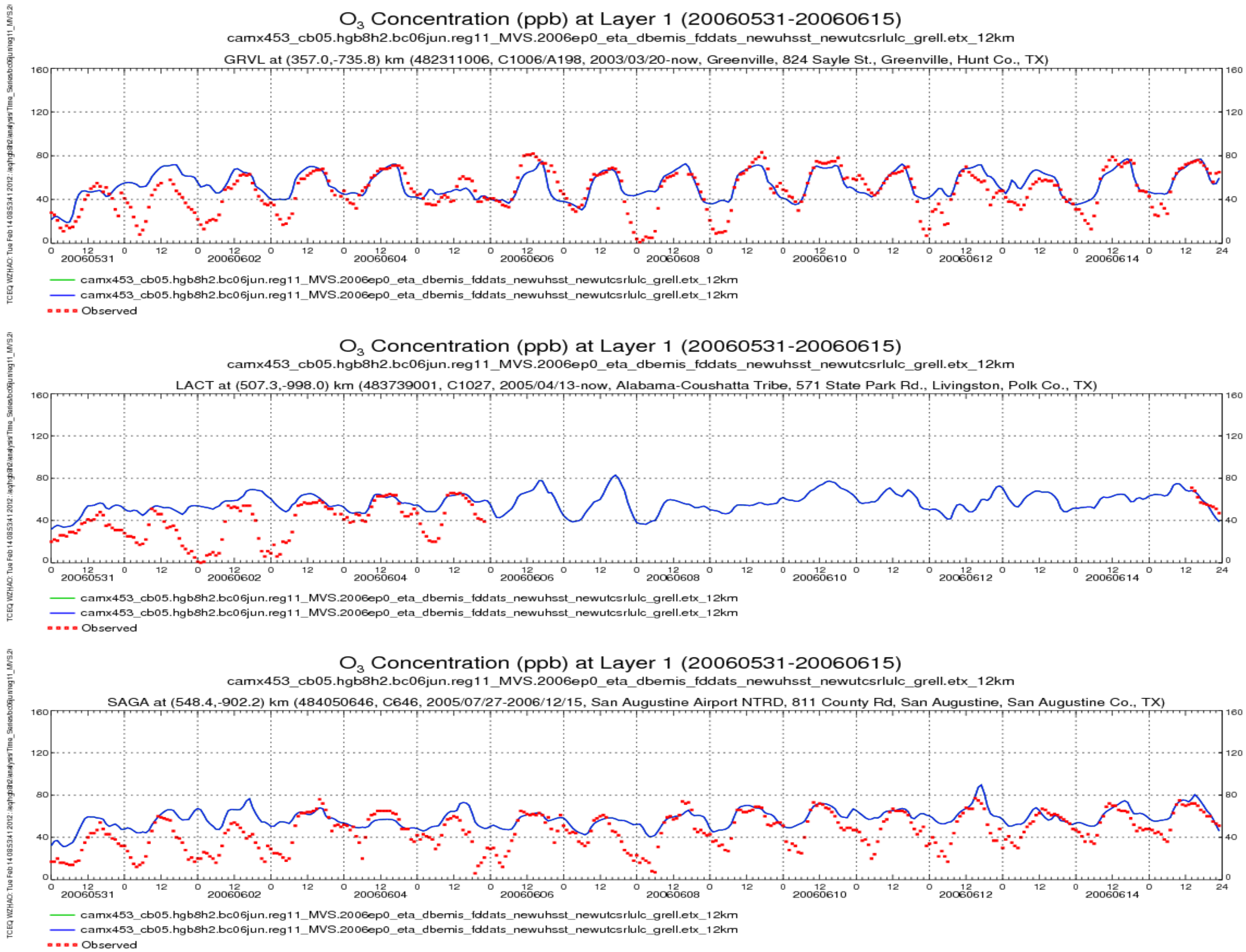


Figure 3-28: Time Series of Hourly Ozone Concentrations for Episode Bc06ep0 at the GRVL, LACT, and SAGA Rural Monitors

Scatter plots for the Bc06ep0 episode comparing the hourly measured and modeled concentrations at the non-regulatory, industry-sponsored WALV (CAMS 617) monitor are shown in Figure 3-29. The model tends to over-predict ozone at the lower measured concentrations, but compares more favorably at the higher concentrations. Conversely, the model tends to slightly over-predict at the higher NO_X concentrations. The QQ plot for ETH indicates a somewhat favorable comparison between the measured and modeled distributions, although the model generally tends to under-predict the ETH concentrations. The model also tends to under-predict the OLE concentrations.

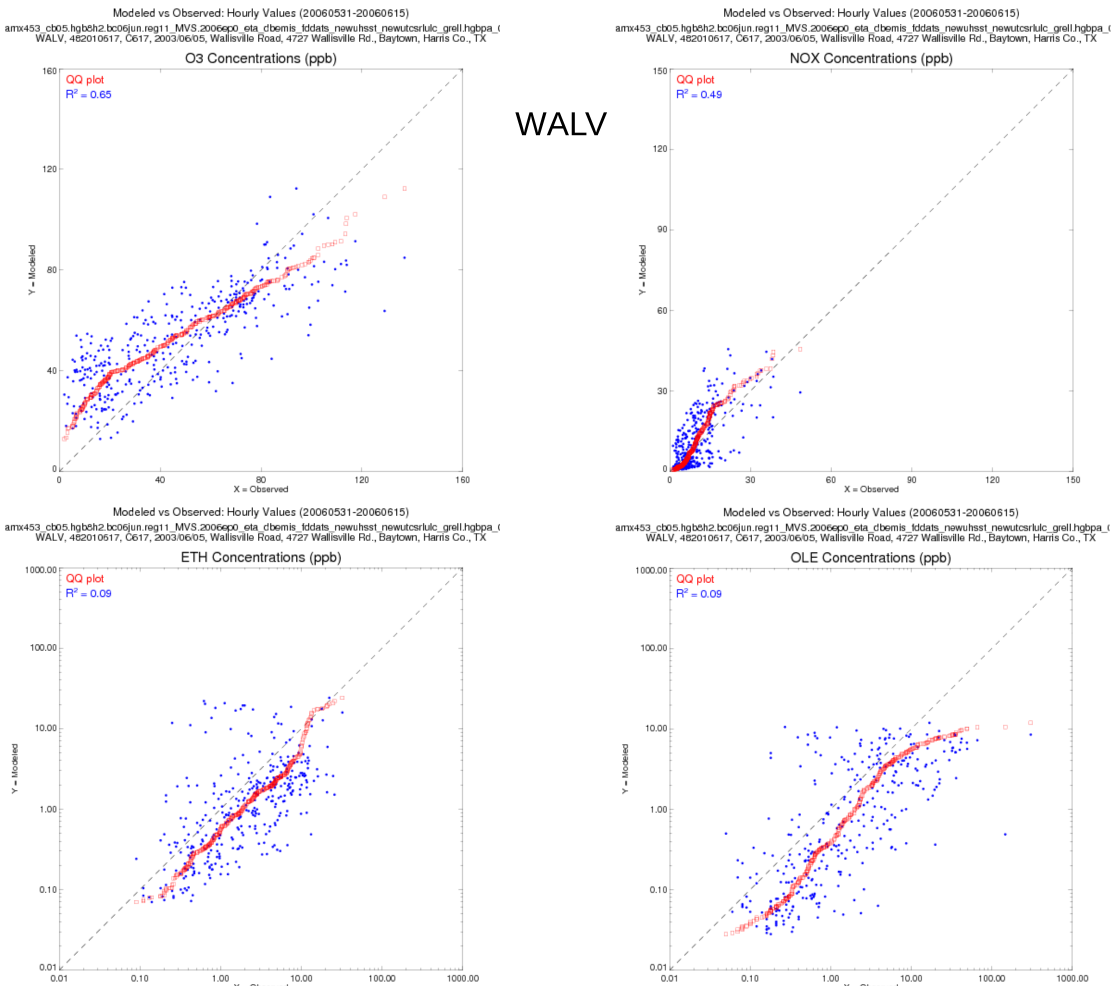


Figure 3-29: Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the WALV Monitor for the Bc06ep0 Episode

Note: WALV (CAMS617) is a non-regulatory monitor.

Tile plots of daily maximum eight-hour ozone concentrations for June 5, June 8 through 9, and June 14, 2006, are shown in Figure 3-30: *Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for June 5, 8 through 9, and 14, 2006*. The model replicates the areas of highest eight-hour ozone for the selected days, although, with the exception of June 9, it somewhat under-predicts the daily maximum eight-hour ozone concentrations.

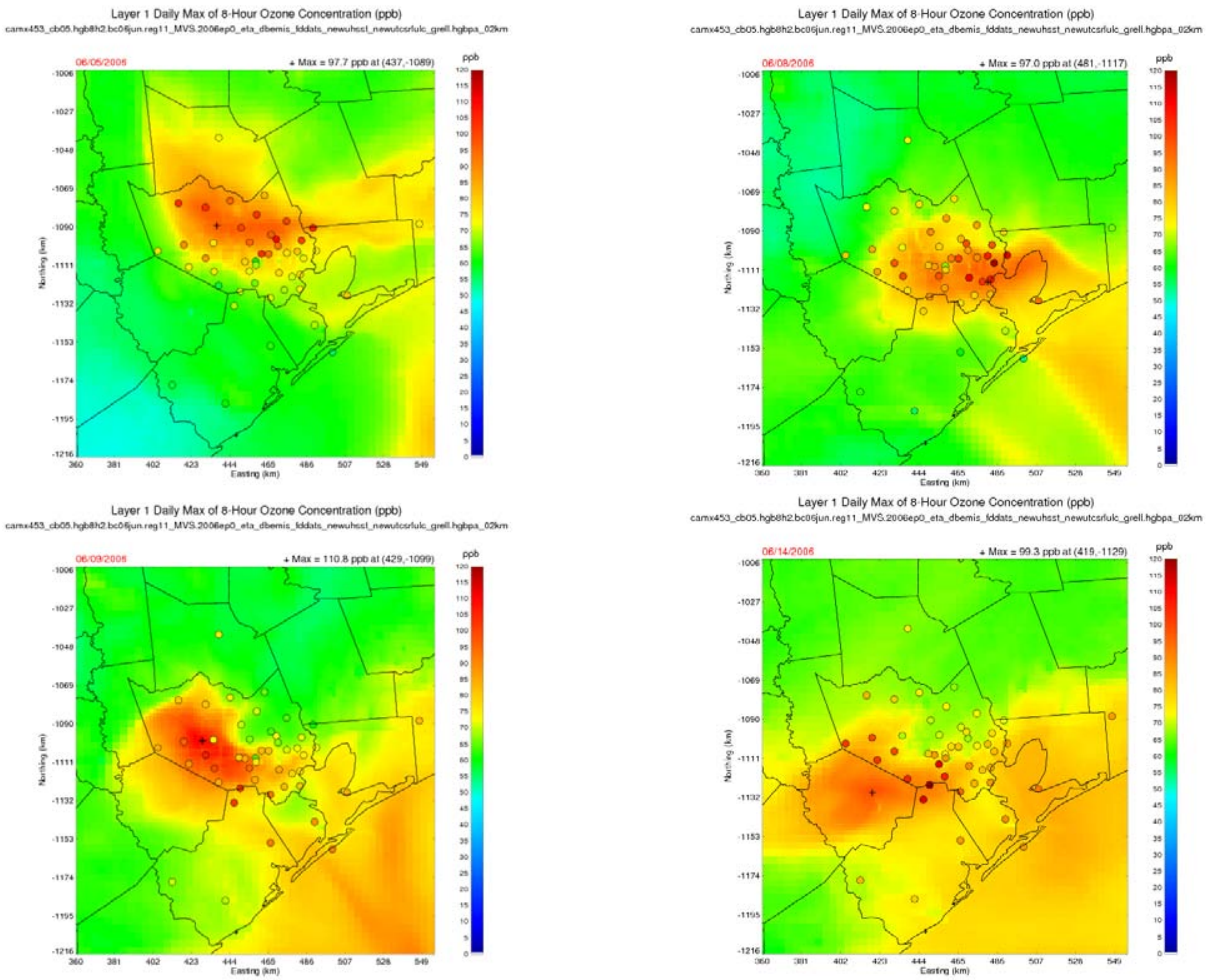


Figure 3-30: Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for June 5, 8 through 9, and 14, 2006

Overall, the graphical evaluation of model performance at key monitors on key episode days indicates the modeling adequately replicates the features that produced high ozone during this episode.

Bc06aqs1: August 13 through September 15, 2006

For the Bc06aqs1 episode, hourly time series are presented for the Houston Bayland Park (BAYP; CAMS 53), Swiss and Monroe (HSMA; CAMS 406), and Deer Park (DRPK; CAMS 35) monitors in Figure 3-31: *Time Series of Hourly Ozone Concentrations for Episode Bc06aqs1 at the BAYP, DRPK, and HSMA Monitors*. Relatively high ozone concentrations were measured at these monitors on several days during this episode. In general, the modeled ozone concentrations, including the 7 x 7 cell maximum-minimum range, replicate the diurnal pattern of the observations, with the exception of the very highest measured hourly ozone concentrations.

Figure 3-32: *Time Series of Hourly Ozone Concentrations for Episode Bc06aqs1 at the GRVL, LACT, and SAGA Rural Monitors* provides a comparison of measured and modeled hourly ozone concentrations at rural monitors. Modeled concentrations generally replicate the diurnal pattern of the observations with generally favorable comparisons during the daytime, with the exception of the region represented by the GRVL (CAMS 1006) monitor on August 31 and September 1, 2006, when the higher measured ozone concentrations are notably under-predicted. In addition, the model tends to over-predict ozone concentrations during the first segment of this episode, August 15 through 22, 2006, in the regions represented by LACT (CAMS 1027) and SAGA (CAMS 0646) monitors. Again, the model does not replicate the lower ozone concentrations measured on some days during the early morning hours, which is most likely due to localized emissions and meteorology limiting the areal representativeness of the monitors. Overall, modeled and measured rural concentrations compare favorably enough during periods of elevated ozone that the modeled rural concentrations are unlikely to cause any substantial predictive bias within the HGB area during this episode.

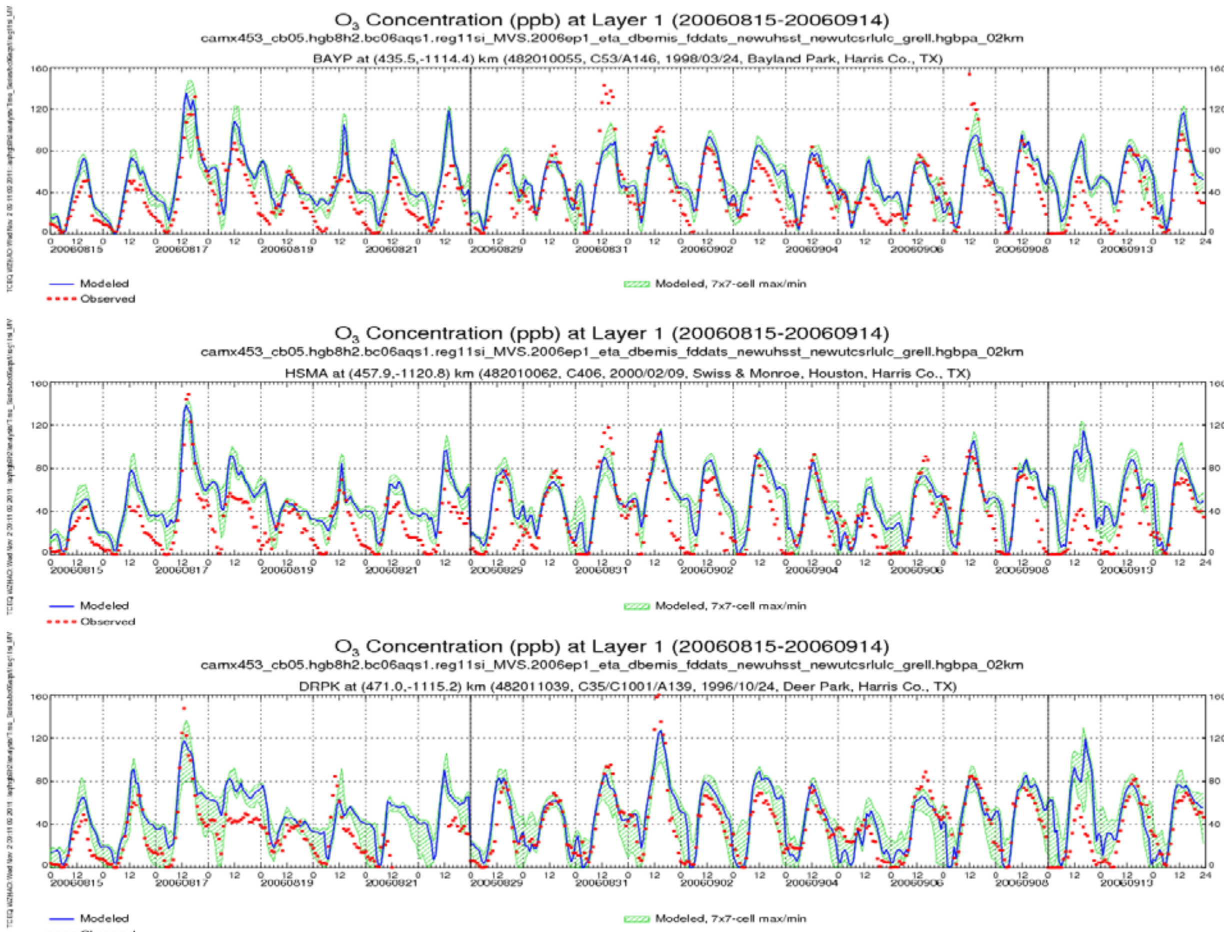


Figure 3-31: Time Series of Hourly Ozone Concentrations for Episode Bc06aqs1 at the BAYP, DRPK, and HSMA Monitors

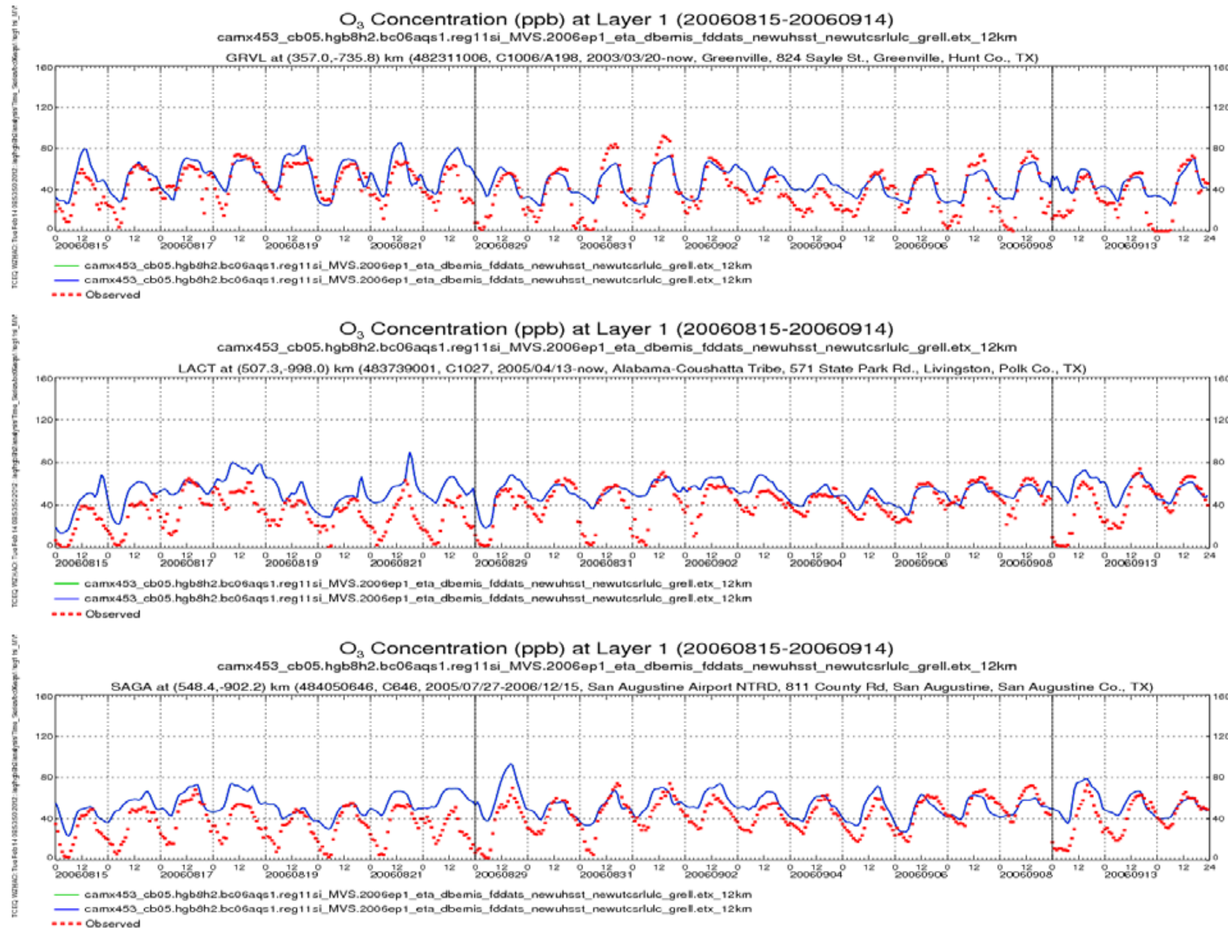


Figure 3-32: Time Series of Hourly Ozone Concentrations for Episode Bc06aqs1 at the GRVL, LACT, and SAGA Rural Monitors

Scatter plots for the Bc06aqs1 episode comparing the hourly measured and modeled concentrations at the DRPK (CAMS 35) monitor are shown in Figure 3-33. The model tends to over-predict ozone at the lower measured concentrations but compares more favorably at the higher concentrations. The model tends to generally over-predict NO_X concentrations. The QQ plot for ETH indicates a favorable comparison between the measured and modeled distributions, although the model tends to slightly under-predict the higher ETH concentrations. The model tends to under-predict the lower range of OLE concentrations and also under-predicts the very highest.

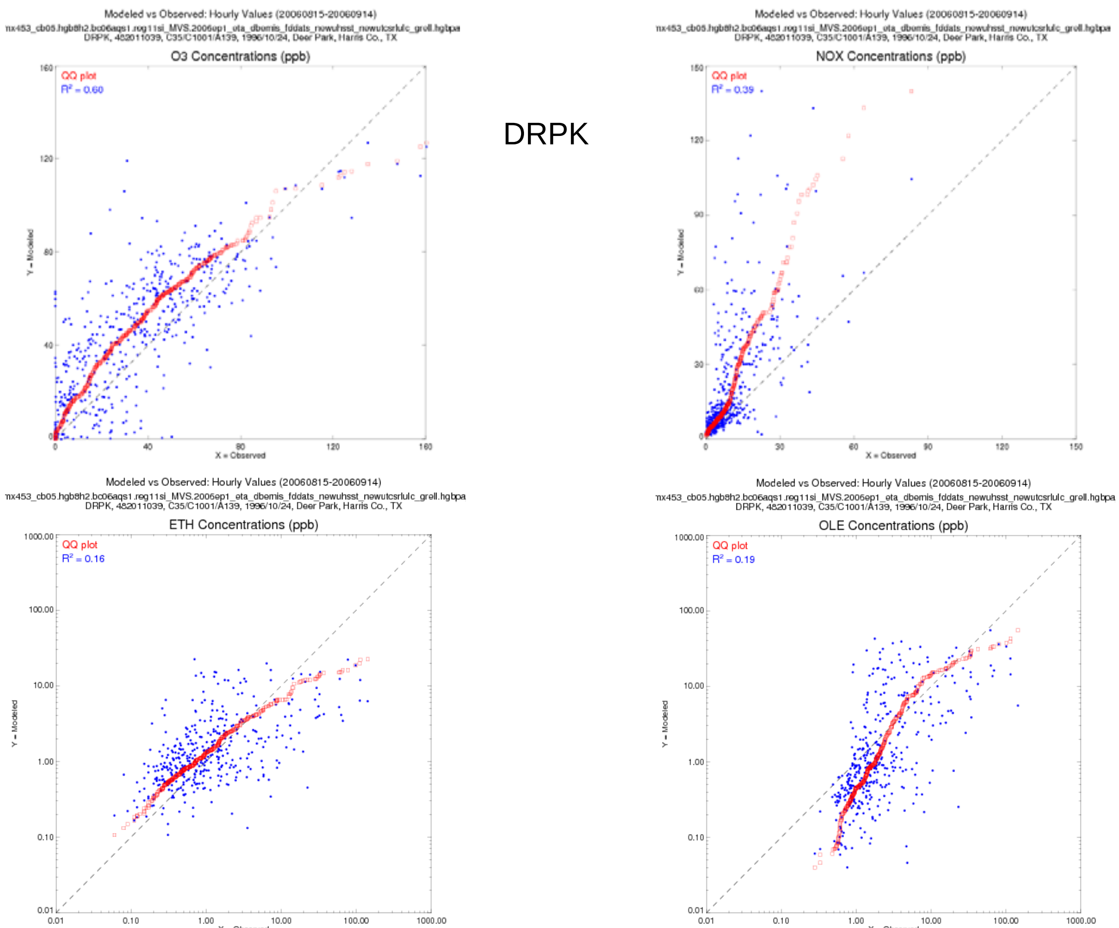


Figure 3-33: Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the DRPK Monitor for the Bc06aqs1 Episode

Tile plots of daily maximum eight-hour ozone concentrations for August 17, August 31, September 1, and September 7, 2006, are shown in Figure 3-34: *Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for August 17 and 31, and September 1 and 7, 2006*. The model replicates the areas of highest eight-hour ozone for the selected days, although it somewhat under-predicts the daily maximum eight-hour ozone concentrations. An exception occurs for August 17, 2006, when the model over-predicts the daily maximum eight-hour ozone concentrations.

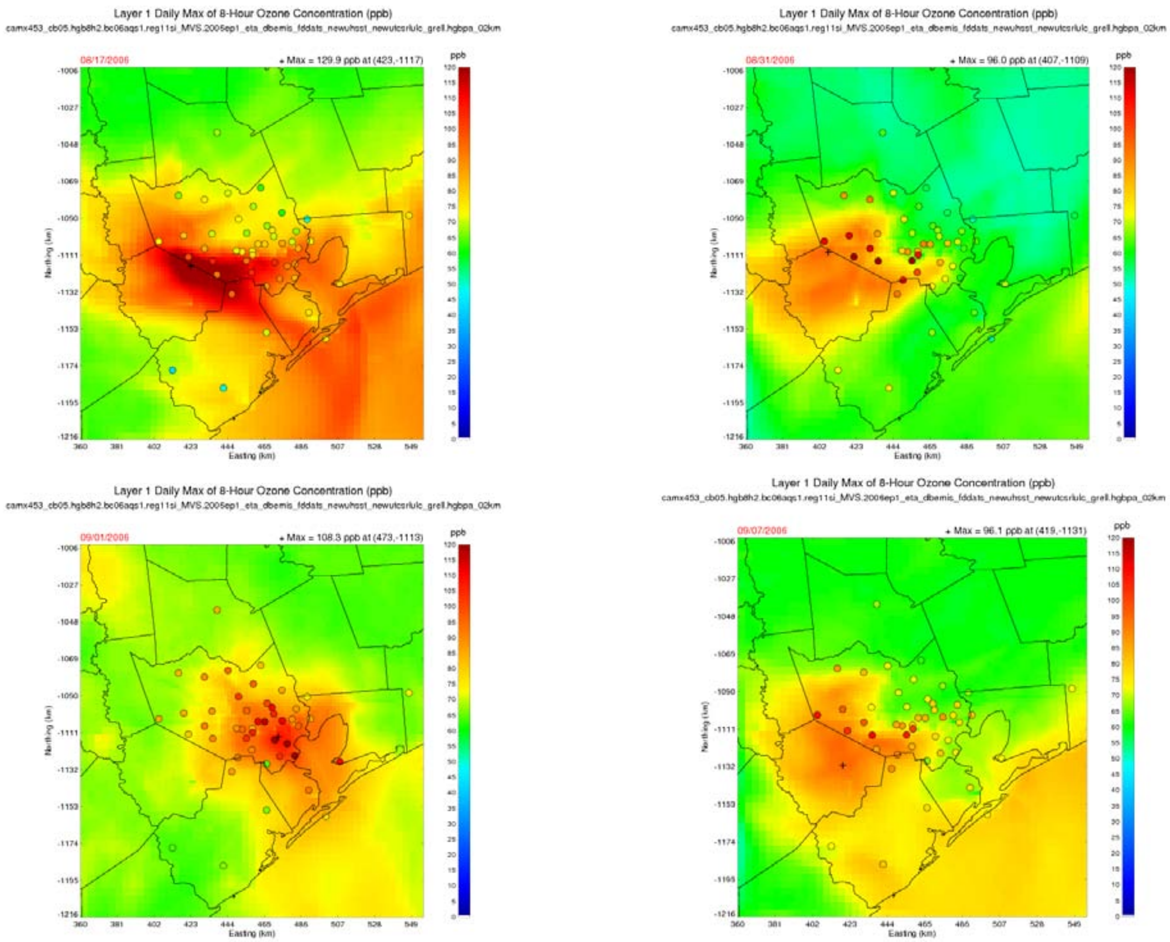


Figure 3-34: Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for August 17 and 31, and September 1 and 7, 2006

Overall, the graphical evaluation of model performance at key monitors on key episode days indicates the modeling adequately replicates the features that produced high ozone during this episode.

Bc06aqs2: September 16 through October 11, 2006

Hourly time series for the Bc06aqs2 episode are presented for the Conroe Relocated (CNR2; CAMS 78), Galveston (GALC; CAMS 34), and DRPK (CAMS 35) monitors in Figure 3-35: *Time Series of Hourly Ozone Concentrations for Episode Bc06aqs2 at the CNR2, DRPK, and GALC Monitors*. Relatively high ozone concentrations were measured at these monitors on several days during this episode. In general, the modeled ozone concentrations, including the 7 x 7 cell maximum-minimum range, replicate the diurnal pattern of the observations. However, an exception is the lower ozone concentrations measured during the early morning hours, especially at the CNR2 (CAMS 78) monitor. These lower measures are most likely due to localized emissions and meteorology limiting the areal representativeness of the monitor.

Figure 3-36: *Time Series of Hourly Ozone Concentrations for Episode Bc06aqs2 at the GRVL, LACT, and SAGA Rural Monitors* provides a comparison of measured and modeled hourly ozone concentrations at rural monitors. Modeled concentrations generally replicate the diurnal pattern of the observations. However, the model performance in the rural areas represented by these monitors varies for the different segments of the episode. For example, during the first segment, the model notably under-predicts the peak daytime ozone concentrations at all three monitors but compares more favorably with the peak daytime ozone concentrations measured during the middle portion of the third segment. Again, the model does not replicate the lower ozone concentrations measured on some days during the early morning hours, most likely due to localized emissions and meteorology limiting the representativeness of the monitors. Overall, modeled and measured rural concentrations compare favorably enough during periods of elevated ozone that the modeled rural concentrations are unlikely to cause any substantial predictive bias within the HGB area during this episode.

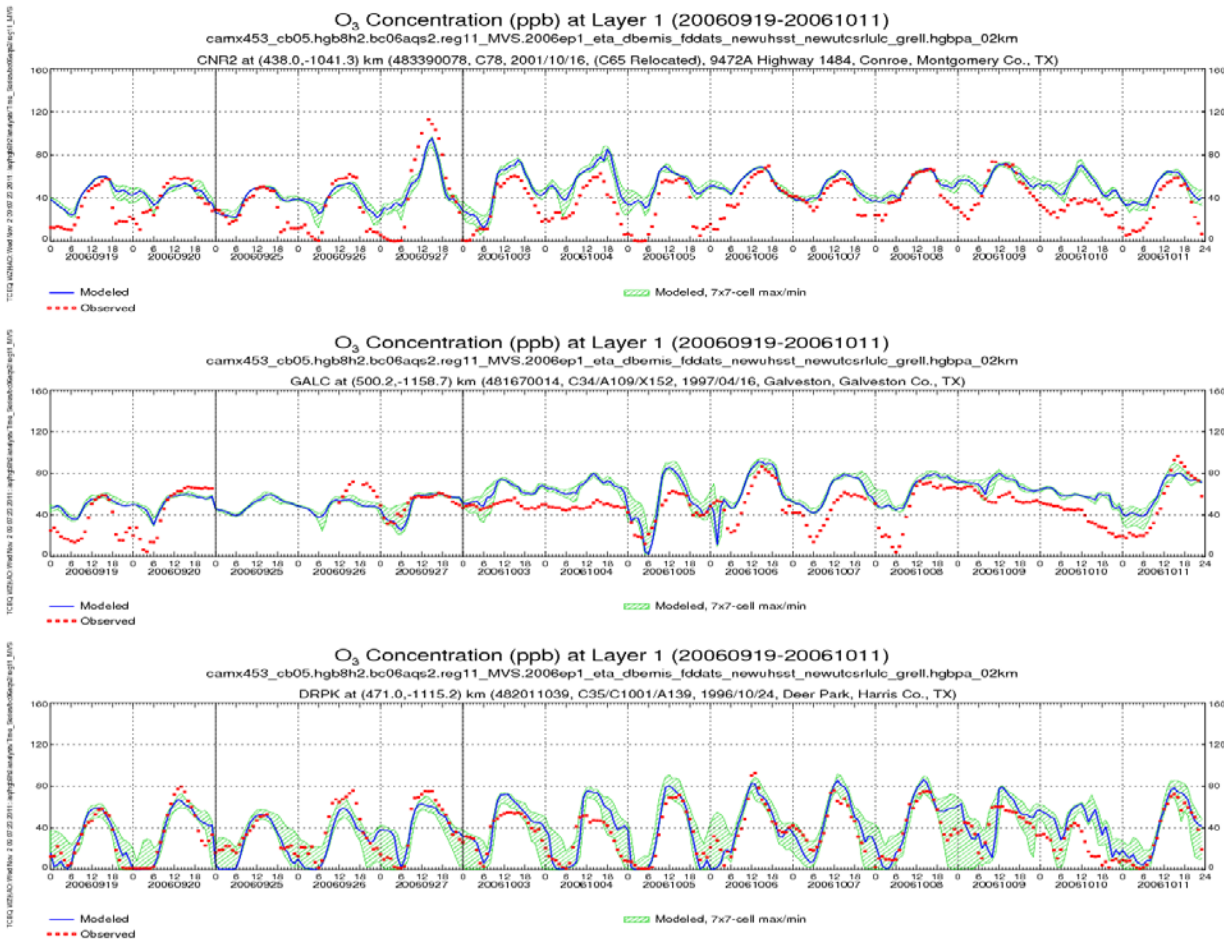


Figure 3-35: Time Series of Hourly Ozone Concentrations for Episode Bc06aqs2 at the CNR2, DRPK, and GALC Monitors

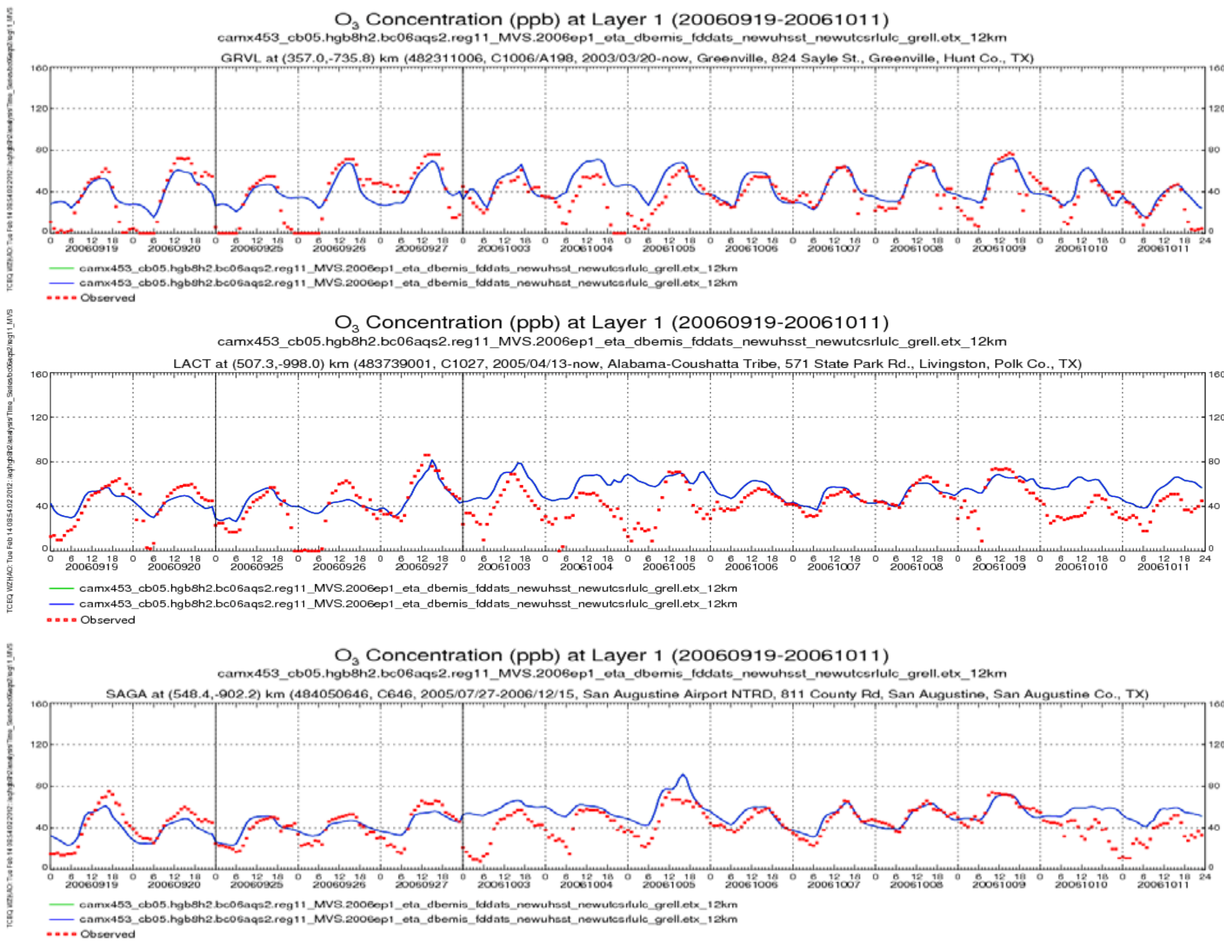


Figure 3-36: Time Series of Hourly Ozone Concentrations for Episode Bc06aqs2 at the GRVL, LACT, and SAGA Rural Monitors

Scatter plots for the Bc06aqs2 episode comparing the hourly measured and modeled concentrations at the Deer Park (CAMS 35) monitor are shown in Figure 3-37: *Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the DRPK Monitor for the Bc06aqs2 Episode.* As shown, there is a favorable comparison for the full range of ozone concentrations, with a slight tendency for the model to over-predict the measured concentrations. The model tends to generally over-predict the NO_X concentrations. The QQ plot for ETH indicates a favorable comparison between the measured and modeled distributions, although the model shows a slight tendency to over-predict the lower concentrations and under-predict the higher ETH concentrations. The model tends to under-predict the lower range of OLE concentrations with considerable scatter at the higher concentrations.

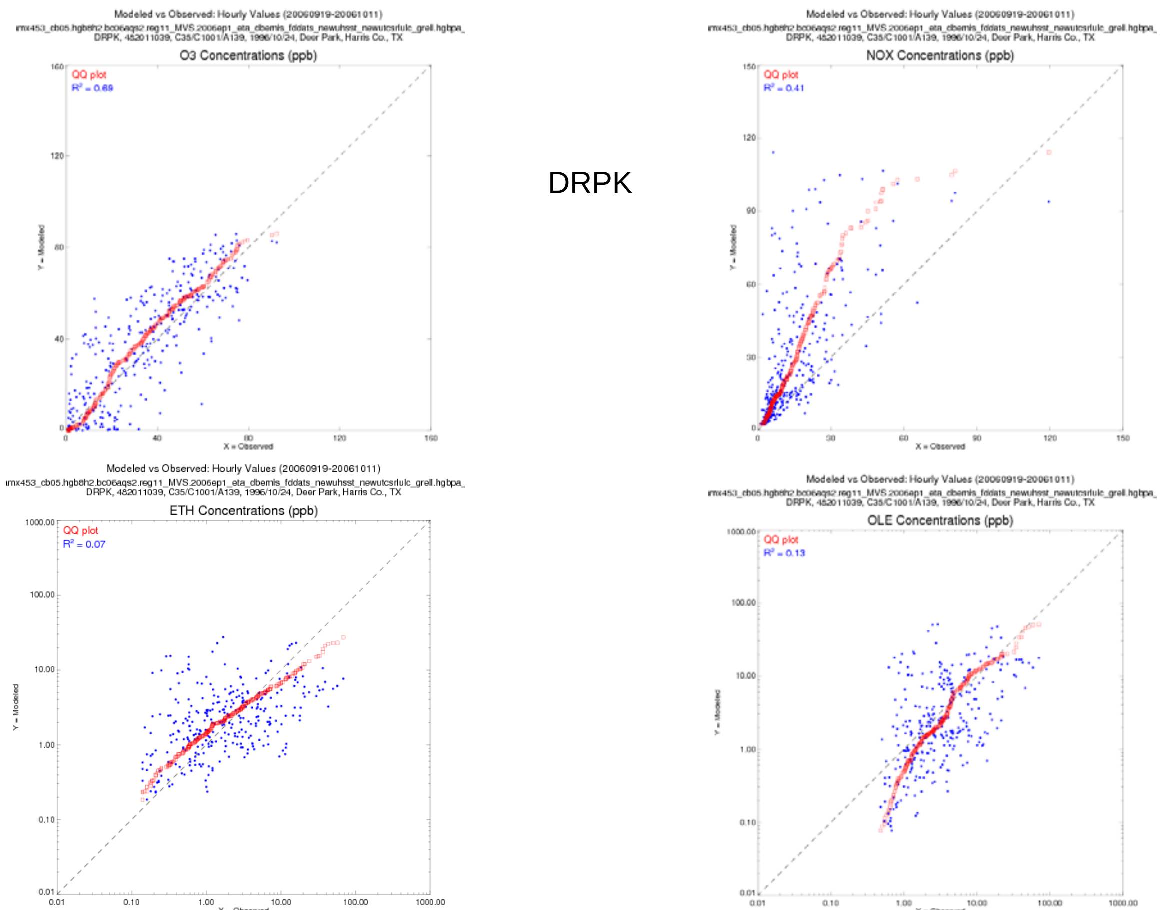


Figure 3-37: Scatter Plots of Hourly Ozone, NO_X, ETH, and OLE at the DRPK Monitor for the Bc06aqs2 Episode

Tile plots of daily maximum eight-hour ozone concentrations for September 20, September 27, October 6, and October 11, 2006, are shown in Figure 3-38: *Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for September 20 and 27, and October 6 and 11, 2006*. The model replicates the areas of highest eight-hour ozone for the selected days, with the exception of September 20, 2006, when the model under-predicts higher levels of daily maximum eight-hour ozone concentrations.

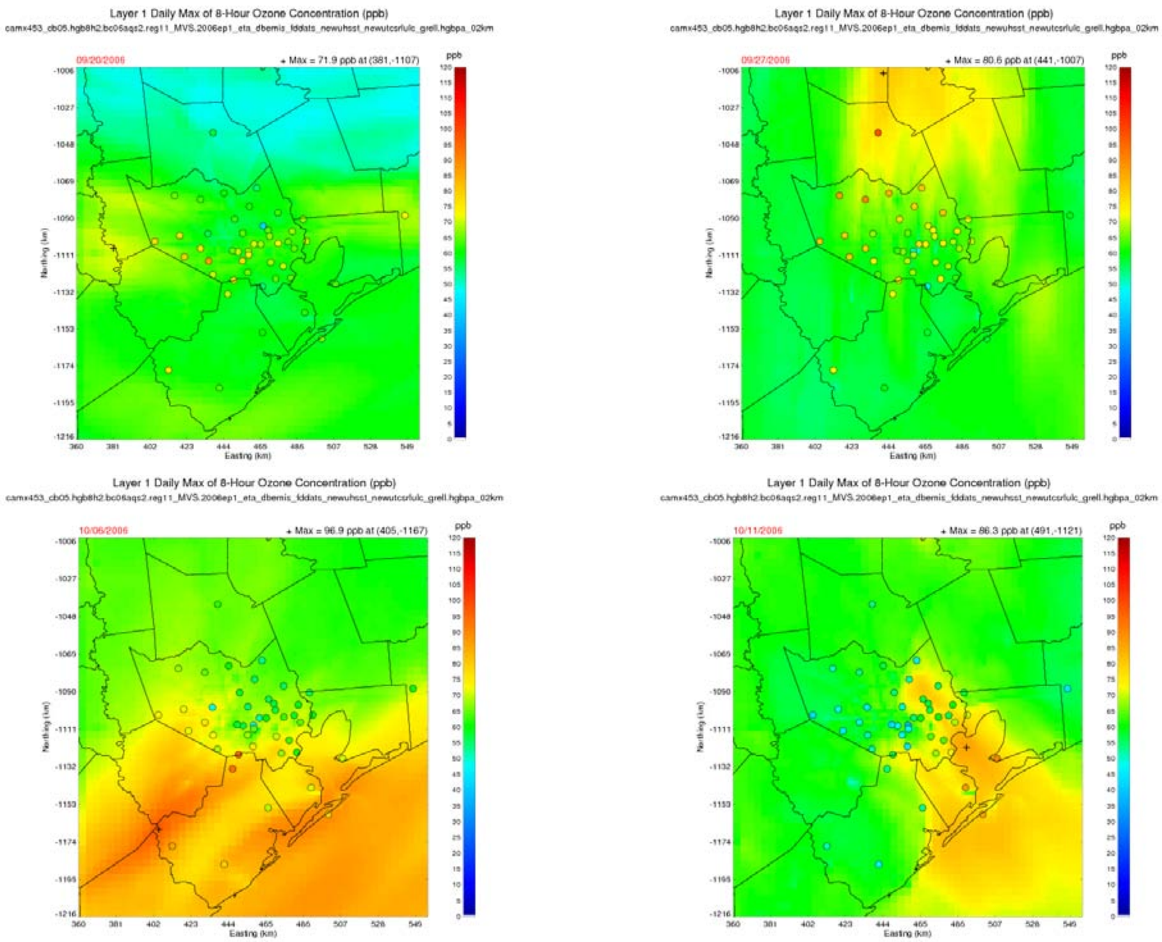


Figure 3-38: Tile Plot of Daily Maximum Eight-Hour Ozone Concentrations for September 20 and 27, and October 6 and 11, 2006

Overall, the graphical evaluation of model performance at key monitors on key episode days indicates the modeling adequately replicates the features that produced high ozone during this episode.

Appendix B: *Comparison of Modeling Using MOVES2010a with Modeling Using MOBILE6.2 for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard, Adopted March 10, 2010* of this SIP revision provides a comparison between the operational evaluations for the previous photochemical modeling, for which the on-road mobile emissions input was developed with the MOBILE6.2 emissions factor model, and the revised photochemical modeling, for which the on-road mobile emissions input was developed with the MOVES2010a emissions factor model.

Evaluations Based on TexAQS II Data (No change from 2010 HGB AD SIP Revision)

3.5.4.3 Diagnostic Evaluations (Updated)

Flare Sensitivity Modeling (No change from 2010 HGB AD SIP Revision)

Retrospective Modeling – 2000 Backcast

The purpose of this diagnostic analysis is to test the model in a forecast (in this case, backcast) mode in which the answer is known in advance. Retrospective modeling is usually difficult to implement in practice because of the need to create an emissions inventory; however, for this analysis a 2000 emissions inventory was already available. In this test, most of the 2006 baseline inventory was replaced with a baseline inventory previously developed for the 2000 ozone episode used in prior eight-hour SIP revisions. The episode day-specific biogenic emissions for the 2005 and 2006 episodes were used, as is the practice when modeling a future projected year. The 2005 and 2006 meteorology was also used with the 2000 baseline emissions, as is the procedure when modeling a future projected year.

The 2000 on-road emission estimates available were developed with the older MOBILE6.2 model for the HGB attainment demonstration that was adopted in December 2004. For the purposes of this retrospective modeling, the significant time and effort needed to develop 2000 link-based on-road emission estimates with MOVES2010a would be unwarranted. Instead, adjustment factors were applied by county, pollutant, and vehicle type to the 2006 link-based on-road emission estimates referenced above in Section 3.4.2.2. The source of these adjustment factors is a 1999 to 2030 on-road trends study (ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Trends/mvs/) performed with MOVES2010a for every Texas county by TTI. A similar adjustment factor approach based on this trends study was taken with the HPMS-based on-road emission inventories for the non-HGB Texas counties within the modeling domain. For the non-Texas U.S. portions of the modeling domain, the MOVES2010a model was run in default mode for a 2000 July weekday scenario. New Table 3-B: *Preparation of 2000 Summer Weekday On-Road Emission Estimates for the Eight-County HGB Area* summarizes the results of this approach for the greater HGB area.

New Table 3-B: Preparation of 2000 Summer Weekday On-Road Emission Estimates for the HGB Area

On-Road Model and Calendar Year	NO_X (tpd)	VOC (tpd)	CO (tpd)
2006 with MOVES2010a	270.00	104.74	1,024.03
2006-to-2000 Adjusted MOVES2010a	382.23	134.27	1,651.25
2000 with MOBILE6.2 from 2004 HGB SIP	341.75	150.52	2,108.32

Since the model predictions of a typical future design value are based on a baseline year ozone design value (DV_B), which is the average of three regulatory design values (EPA, 2007), the quantity forecast in this test is not a specific future year's design value but rather the average of three years' design values. Thus, the regulatory design values for 2000, 2001, and 2002 were averaged in the same manner the 2006 DV_B was calculated, as the average of the 2006, 2007, and 2008 regulatory design values. Table 3-16: *2000 Baseline Design Values Calculation for Retrospective Analysis* shows the 2000, 2001, and 2002 annual design values and the calculated 2000 baseline design value. Only regulatory monitors that had at least one design value in both the 2000 through 2002 and the 2006 through 2008 periods were used.

Table 3-16: 2000 Baseline Design Values Calculation for Retrospective Analysis

Modeling Site Code	CAMS Number	2000 Design Value (ppb)	2001 Design Value (ppb)	2002 Design Value (ppb)	2000 Baseline Design Value (ppb)
BAYP	53	111	110	100	107.0
C35C	403	101	97	93	97.0
DRPK	35	112	108	103	107.7
GALC	34	108	98	89	98.3
HALC	8	111	108	107	108.7
HCQA	409	110	104	102	105.3
HLAA	408	96	91	83	90.0
HNWA	26	108	105	101	104.7
HOEA	1	102	103	101	102.0
HROC	95	-	-	95	95.0
HSMA	406	106	93	90	96.3
HWAA	405	105	98	89	97.3
SHWH	410	102	104	95	100.3

Once the model was run with the 2000 baseline emissions, relative response factors (RRFs) were calculated. In a retrospective analysis, the RRFs are expected to be greater than 1.0 because ozone has decreased since the retrospective year. Table 3-17: *2000 Projected DVs Compared with Calculated DVs* shows the modeled RRFs and the corresponding projected 2000 design values compared with calculated design values, as listed in Table 3-16.

Table 3-17: 2000 Projected DVs Compared with Calculated DVs

Modeling Site Code	CAMS Number	2006 Baseline Design Value (ppb)	2000/2006 Relative Response Factor	2000 Projected Design Value (ppb)	2000 Baseline Design Value (ppb)
BAYP	53	96.7	1.11	107.0	107.0
C35C	403	79.0	1.18	93.5	97.0
DRPK	35	92.0	1.18	108.1	107.7
GALC	34	81.7	1.11	90.7	98.3
HALC	8	85.0	1.15	97.9	108.7
HCQA	409	87.0	1.13	98.6	105.3
HLAA	408	77.7	1.11	86.4	90.0
HNWA	26	89.0	1.13	100.4	104.7
HOEA	1	80.3	1.17	94.0	102.0
HROC	95	79.7	1.15	91.6	95.0
HSMA	406	90.3	1.16	104.8	96.3
HWAA	405	76.3	1.14	86.9	97.3
SHWH	410	92.3	1.11	102.9	100.3

For nine of the 13 sites, the model-projected 2000 DVs were lower than the calculated values, indicating that the model did not respond as well to emission changes as the actual airshed. For two sites, BAYP (CAMS 53) and DRPK (CAMS 35), the projections were nearly identical to the calculated baseline values. For other sites, HSMA (CAMS 406) and SHWH (CAMS 410), the model-projected 2000 DVs were higher than the calculated values.

In general, this retrospective modeling indicates that the modeled response was lower than the actual airshed's response to the 2000 through 2006 emission reductions. This result provides evidence that the model's predictions are conservative and that future monitored ozone concentrations will likely be lower than those predicted by the model.

Observational Modeling – Weekday/Weekend

Weekend emissions of NO_X in urban areas tend to be lower than weekday emissions because of fewer miles driven. The effect is most pronounced on weekend mornings, especially Sundays, since commuting is much lower than on weekdays. These emissions changes usually have a measureable effect on observed ozone concentrations, and one test of a model's responsiveness is to see how well it can reproduce these observed changes. To assess the model's responsiveness to weekday-weekend emission changes, the TCEQ conducted three separate runs wherein each episode day's modeled emissions were replaced with first Wednesday, then Saturday, and finally Sunday emissions. These runs provided a total of 88 "Wednesdays," 88 "Saturdays," and 88 "Sundays."

For comparison, 6:00 a.m. NO_X concentrations were averaged for every Wednesday, Saturday, and Sunday from May 15 through October 15 in the years 2005 through 2008, which gives over 100 instances of each day minus any monitor downtime. Figure 3-46: *Mean Observed NO_X Concentrations at HGB Monitors as a Percentage of Wednesday Mean Values, May 15 through October 15, 2005 through 2008* shows observed and modeled 6:00 a.m. NO_X concentrations at 15 sites in the HGB area. Except for anomalous behavior at GALC (CAMS 34), all monitors show observed and modeled NO_X concentrations that decline from Wednesday through Saturday to Sunday. The observed concentrations (excluding GALC (CAMS 34)) show similar percentage declines, but the modeled values have much greater variability, with sites in eastern Harris County, near the Ship Channel, [e.g. HCHV (CAMS 15), LYNF (CAMS 1015), and DRPK (CAMS 35)] showing the smallest declines. This effect could be due to the model mixing down industrial NO_X emissions too vigorously.

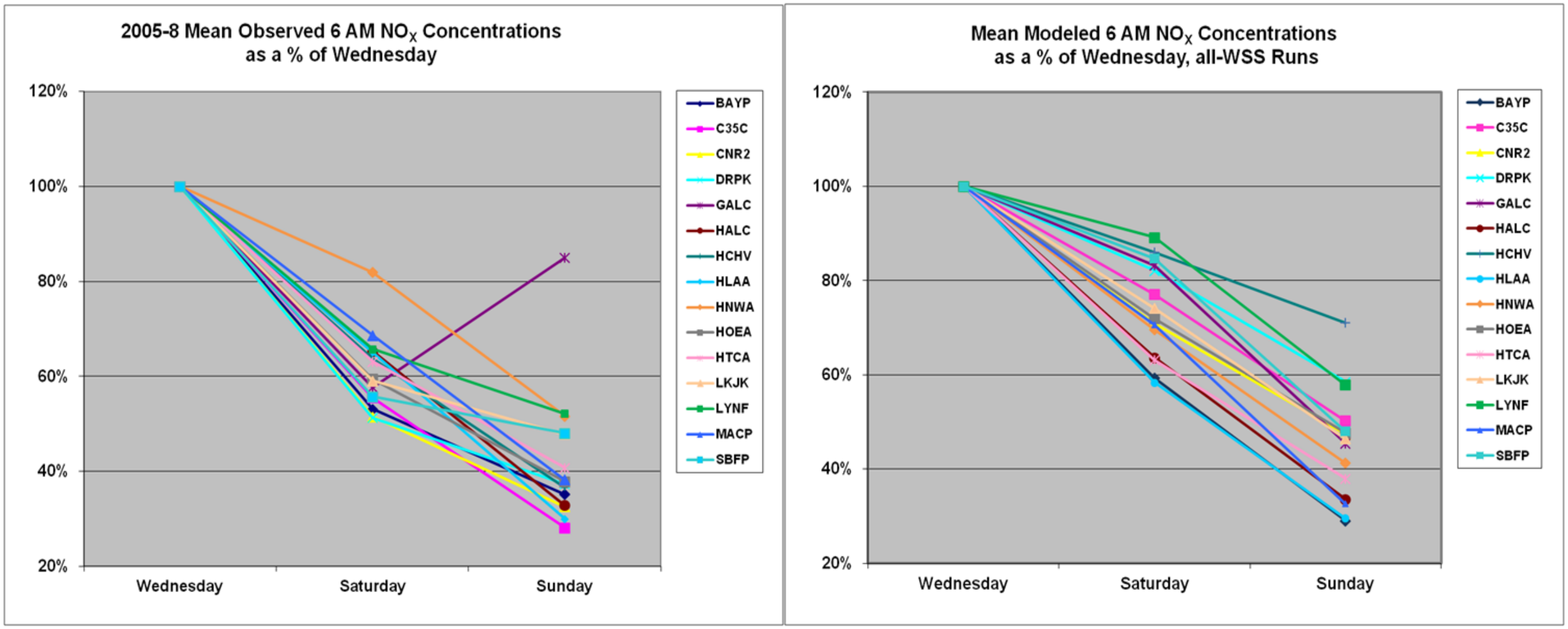
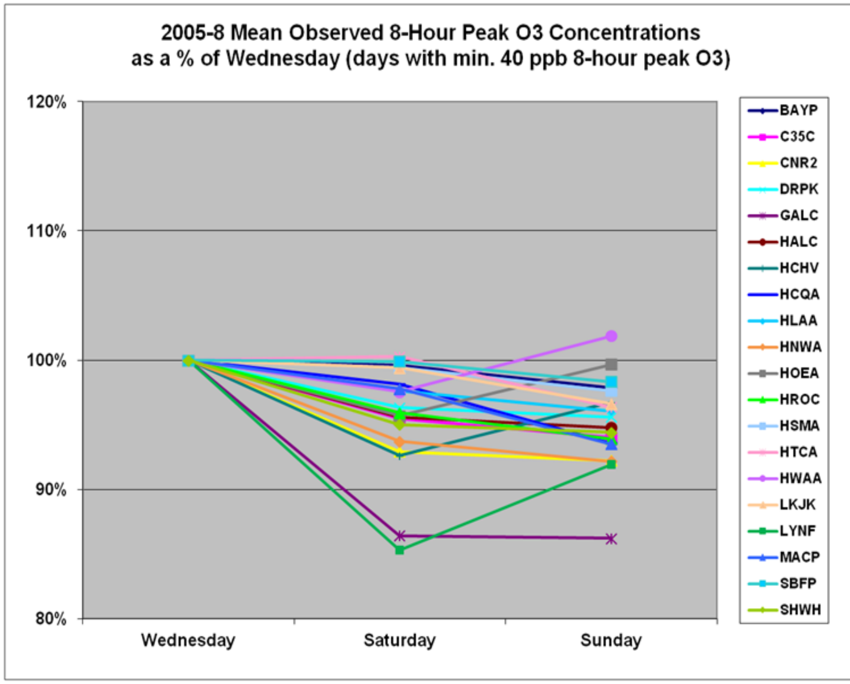


Figure 3-46: Mean Observed NO_X Concentrations at HGB Monitors as a Percentage of Wednesday Mean Values, May 15 through October 15, 2005 through 2008

Figure 3-47: *Observed and Modeled Daily Peak Eight-Hour Ozone Concentrations as a Percentage of Wednesdays* shows observed and modeled daily peak eight-hour ozone concentrations as a percentage of Wednesdays for the same sites. Because the modeled episodes represent periods of higher-than-average ozone concentrations, the observed concentrations were filtered to remove values less than 40 ppb. The panel on the left of the figure shows observed concentrations decreasing for nearly all sites, but some seem to rebound on Sunday and exceed the respective Saturday concentrations. This effect is probably due to filtering concentrations below 40 ppb, which removes very low concentrations from the average.



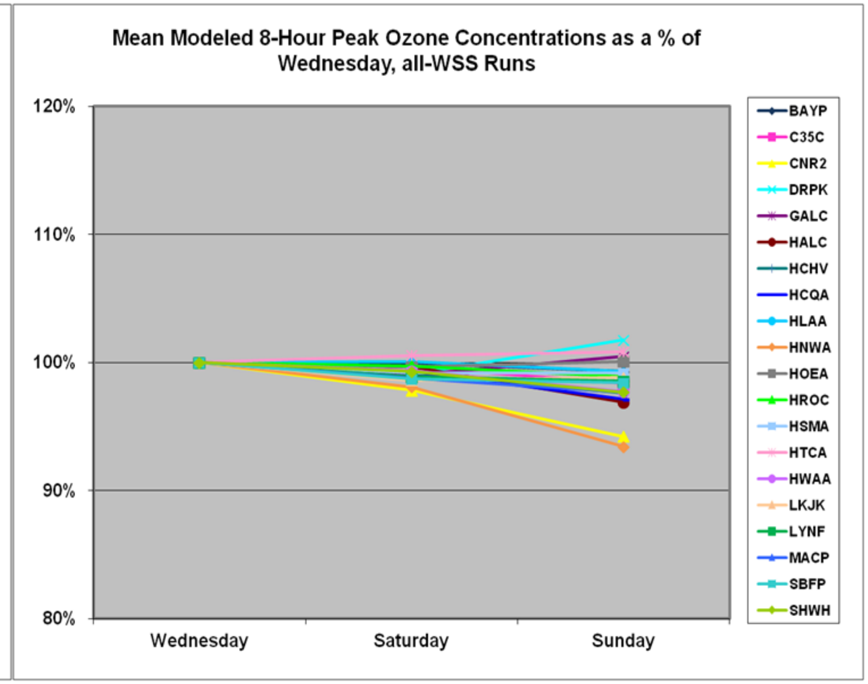


Figure 3-47: Observed and Modeled Daily Peak Eight-Hour Ozone Concentrations as a Percentage of Wednesdays

While the modeled concentrations are very tightly clustered in the figure, these concentrations generally decline from Wednesday through Saturday to Sunday, with all but a few sites showing behavior similar to the pattern shown by the observations (ignoring the anomalous rebound effect). The airshed and model both show sensitivity to NO_X reductions, at least for days with some ozone-forming potential. In fact, the airshed seems to show greater sensitivity to NO_X than the model, which suggests that anticipated reductions to motor vehicle emissions over the next several years may be more effective than suggested by the model.

Appendix B of this SIP revision provides a comparison between the diagnostic evaluations for the previous photochemical modeling, for which the on-road mobile emissions input was developed with the MOBILE6.2 emissions factor model, and the revised photochemical modeling, for which the on-road mobile emissions input was developed with the MOVES2010a emissions factor model.

3.6 BASELINE (2006) AND FUTURE CASE (2018) MODELING (UPDATED)

3.6.1 2006 Baseline Modeling (No change from 2010 HGB AD SIP Revision)

3.6.2 Future Baseline Modeling (Updated)

Similar to the 2006 baseline modeling, the 2018 modeling was conducted for each of the episode days using the projected 2018 ozone season day emissions, as previously summarized in Table 3-13. Using the same days as used in the 2006 baseline modeling to calculate the RRF denominator (RRF_D), an RRF numerator (RRF_N) was calculated as the average of the of the 2018 modeled daily maximum eight-hour ozone concentrations within the 7 x 7 grid cell array about each monitor. The RRF at each monitor was calculated as the ratio RRF_N / RRF_D, and the 2018 future design value (DV_F) at each monitor was estimated, per EPA's modeling guidance, by multiplying the 2006 DV_B by the RRF. Table 3-19: *Summary of 2006 Baseline Modeling, RRF, and Future Design Values* summarizes the 2006 DV_B, RRF and 2018 DV_F at each of the regulatory and industry-sponsored monitors.

Table 3-19: Summary of 2006 Baseline Modeling, RRF, and Future Design Values

Monitor Designation	Site Code	2006 DV_B (ppb)**	RRF	2018 DV_F (ppb)**
Houston East (CAMS 1)	HOEA	80.3	0.943	75.8
Aldine (CAMS 8)	HALC	85.0	0.918	78.0
Channelview (CAMS 15)	HCHV	82.7	0.940	77.7
Northwest Harris County (CAMS 26)	HNWA	89.0	0.878	78.1
Galveston Airport (CAMS 34)	GALC	81.7	0.928	75.8
Deer Park (CAMS 35)	DRPK	92.0	0.937	86.2
Seabrook Friendship Park (CAMS 45)	SBFP	85.3	0.925	78.9
Bayland Park (CAMS 53)	BAYP	96.7	0.900	87.0
Conroe Relocated (CAMS 78)	CNR2	83.0	0.878	72.9
Houston Regional Office (CAMS 81)	HROC	79.7	0.951	75.8
Manvel Croix Park (CAMS 84)	MACP	90.7	0.891	80.8
Clinton (CAMS 403)	C35C	79.0	0.949	75.0
North Wayside (CAMS 405)	HWAA	76.3	0.934	71.3
Swiss and Monroe (CAMS 406)	HSMA	90.3	0.919	83.0
Lang (CAMS 408)	HLAA	77.7	0.898	69.7
Croquet (CAMS 409)	HCQA	87.0	0.898	78.2
Shell Westhollow (CAMS 410)	SHWH	92.3	0.869	80.2
Houston Texas Avenue (CAMS 411)	HTCA	79.3	0.939	74.5
Haden Road (CAMS 603)*	H03H	84.0	0.945	79.4
Wallisville Road (CAMS 617)*	WALV	92.0	0.936	86.2
Danciger (CAMS 618)*	DNCG	80.3	0.882	70.8
Mustang Bayou (CAMS 619)*	MSTG	84.7	0.901	76.3
Texas City (CAMS 620)*	TXCT	84.3	0.922	77.7
Lynchburg Ferry (CAMS 1015)	LYNF	81.7	0.944	77.1
Lake Jackson (CAMS 1016)	LKJK	77.0	0.892	68.6

* Non-regulatory, industry-sponsored monitor
** Values 85 ppb or greater are shown in red.

The 2018 baseline attainment modeling projects two regulatory monitors [BAYP (CAMS 53) and DRPK (CAMS 35)] and one non-regulatory, industry-sponsored monitor [WALV (CAMS 617)] to have DV_Fs greater than 84 ppb.

3.6.2.1 Matrix Modeling (Updated)

A series of modeling sensitivities using across-the-board percentage reductions to the 2018 baseline modeling emissions from sources in the eight-county HGB area was conducted. The results of the modeling were used to assess the responsiveness of the model to reductions of VOC and NO_X emissions and to combined VOC and NO_X reductions. In these runs, anthropogenic VOC, NO_X, and VOC+NO_X were reduced across-the-board by 25% and 50%, and the results are presented in Figure 3-49: *DV_F versus NO_X and/or VOC Emissions Reduction Response Curves for the BAYP, DRPK, and WALV Monitors*. Figure 3-49 shows that for the all three monitors, the model is more responsive to NO_X reductions than to VOC reductions alone, but that combined VOC+NO_X reductions provide the greatest response. In Appendix B, the model response using MOVES-based mobile source emissions is compared to the model response using MOBILE6-based mobile source emissions, which are very similar.

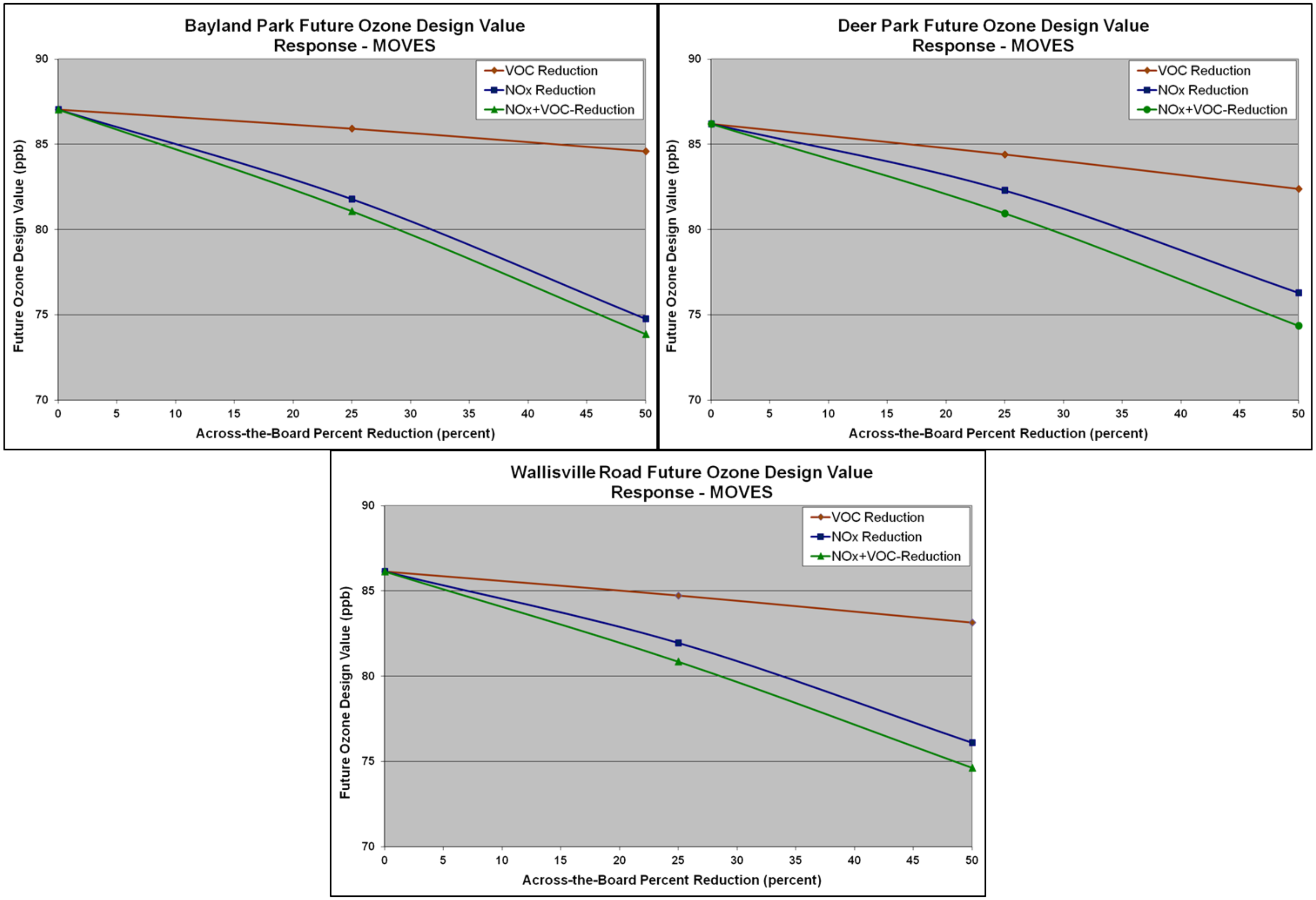


Figure 3-49: DV_F versus NO_X and/or VOC Emissions Reduction Response Curves for the BAYP, DRPK, and WALV Monitors

3.6.2.2 Modeling Sensitivities: Emissions Reductions within 100 and 200 km of HGB (No change from 2010 HGB AD SIP Revision)

3.6.2.3 Ozone Source Apportionment Tool and Anthropogenic Precursor Culpability Analysis (Updated)

The TCEQ applied the OSAT and APCA CAMx tools to the 2018 baseline modeling. For both types of analyses, emission source groups (e.g., on-road mobile, non- and off-road mobile, and biogenics) and source regions (i.e., HGB and non-HGB) are defined. OSAT keeps track of the origin of the NO_X and VOC precursors creating the ozone, and ozone can then be apportioned to specific sources groups and regions. APCA is similar to OSAT, but it recognizes that certain sources groups, such as biogenics, are not controllable. Where OSAT would apportion ozone production to biogenic emissions, APCA reallocates that ozone production to the controllable or anthropogenic emissions that combined with the biogenic emissions to create ozone.

Table 3-23: *OSAT/APCA Source Groups and Regions Defined* lists all of the source groups and regions tracked in the OSAT and APCA analyses.

Table 3-23: OSAT/APCA Source Groups and Regions Defined

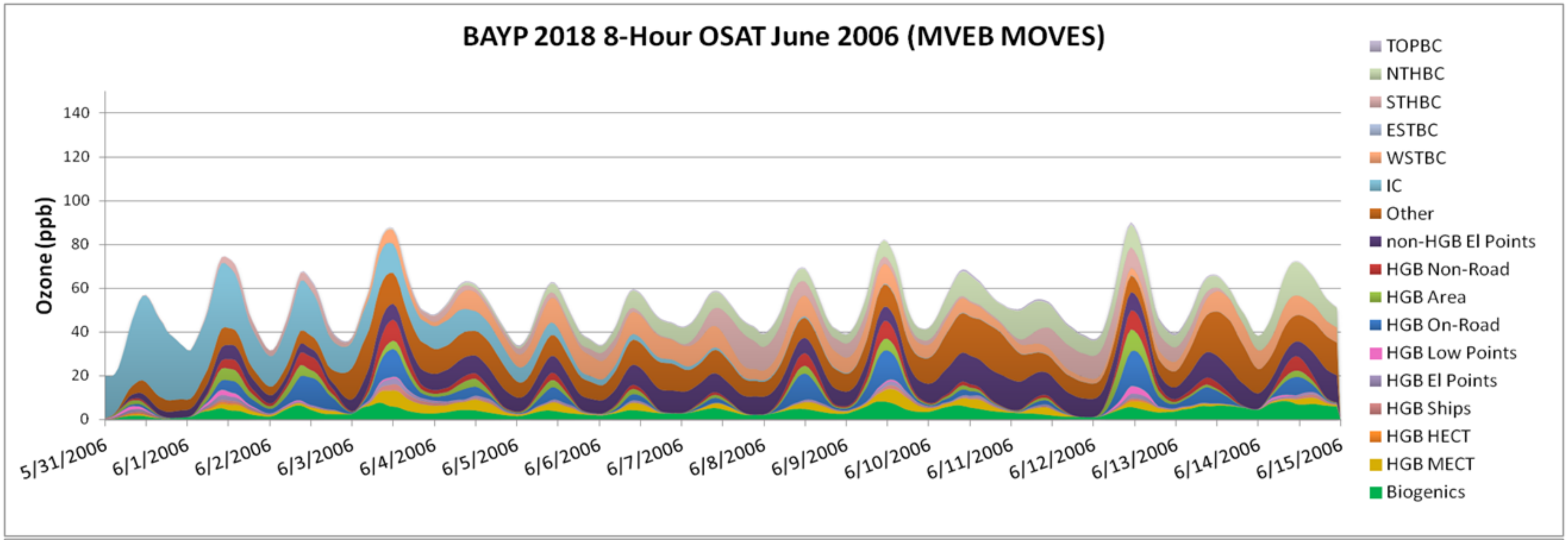
Figure Legend Abbreviation	Description of Source Group and Region
TOPBC	Top Boundary Condition
NTHBC	North Boundary Condition
STHBC	South Boundary Condition
ESTBC	East Boundary Condition
WSTBC	West Boundary Condition
IC	Initial Condition
Other	All emission source types outside HGB, with the exception of elevated point sources
Non-HGB El Points	Elevated point sources outside HGB
HGB Non-Road	Non-road sources in HGB
HGB Area	Area sources in HGB
HGB On-Road	On-road sources in HGB
HGB Low Points	Low-level point sources in HGB
HGB El Points	Elevated point sources in HGB
HGB Ships	Ship emissions in HGB
HGB HECT	Highly-Reactive Volatile Organic Compound Emissions Cap and Trade Program sources in HGB
HGB MECT	Mass Emissions Cap and Trade sources in HGB
Biogenics	Biogenic emissions from the entire modeling domain

Figure 3-51: *OSAT and APCA Results for BAYP*, Figure 3-52: *OSAT and APCA Results for DRPK*, and Figure 3-53: *OSAT and APCA Results for WALV* show the results of these analyses for the June 2006 episode for BAYP (CAMS 53), DRPK (CAMS 35), and the non-regulatory, industry-sponsored WALV (CAMS 617) monitor, respectively. The layer corresponding to the

initial model conditions disappears after the first few days of the episode are modeled, as expected. Layers corresponding to boundary conditions give an indication of wind direction on individual episode days and concentrations of ozone attributable to that boundary.

Layers that correspond to HGB emission sources indicate the HGB contribution to the total modeled ozone concentration. The other layers, Biogenics, Other, Initial and Boundary Conditions, and Non-HGB Elevated Points, indicate non-HGB contributions to ozone concentration. Differences between the depth of the biogenic layers between the OSAT and APCA plots indicate how ozone of biogenic origin is reallocated to anthropogenic sources in APCA.

Lower-level local emission sources, including non-road mobile, area, on-road mobile, and low-level points, make a greater contribution to ozone at BAYP (CAMS 53) than DRPK (CAMS 35), although Ship Channel sources make a noticeable contribution at BAYP (CAMS 53). Conversely, local elevated sources, including HGB elevated points, ships, the Highly-Reactive Volatile Organic Compound Emissions Cap and Trade (HECT) Program, and the Mass Emissions Cap and Trade (MECT) Program, make a greater contribution at DRPK (CAMS 35) than BAYP (CAMS 53). Ozone origins at the non-regulatory, industry-sponsored WALV (CAMS 617) monitor are more like DRPK (CAMS 35) than BAYP (CAMS 53).



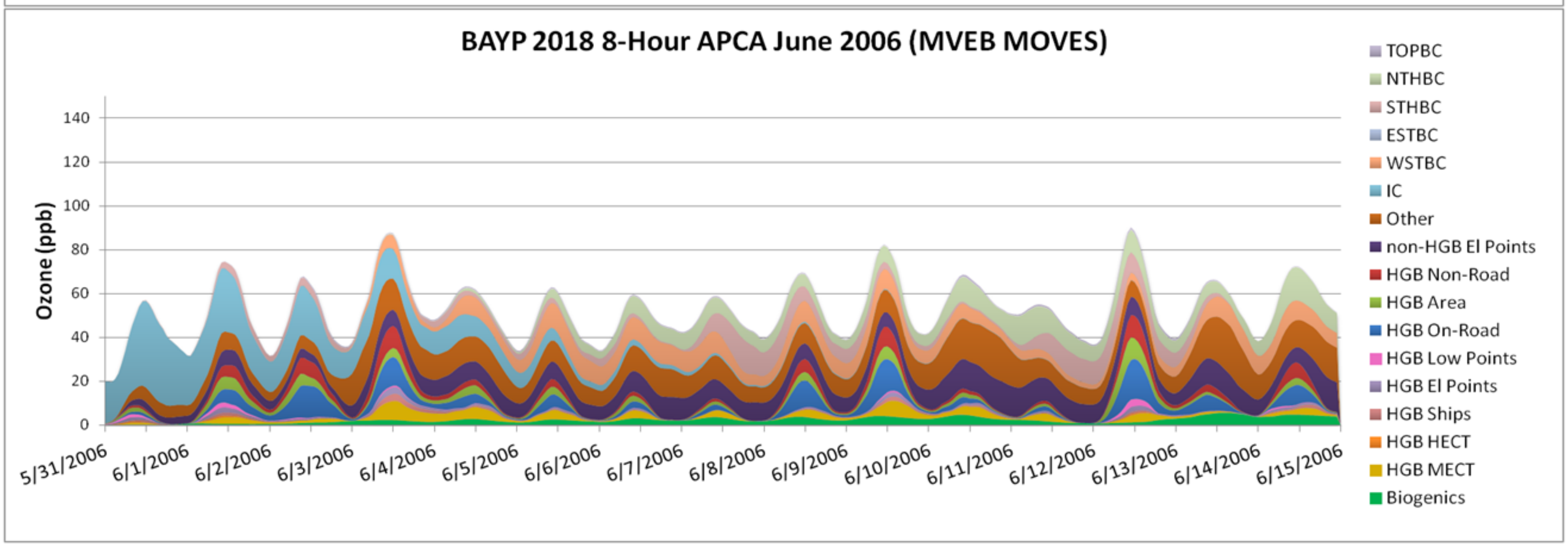
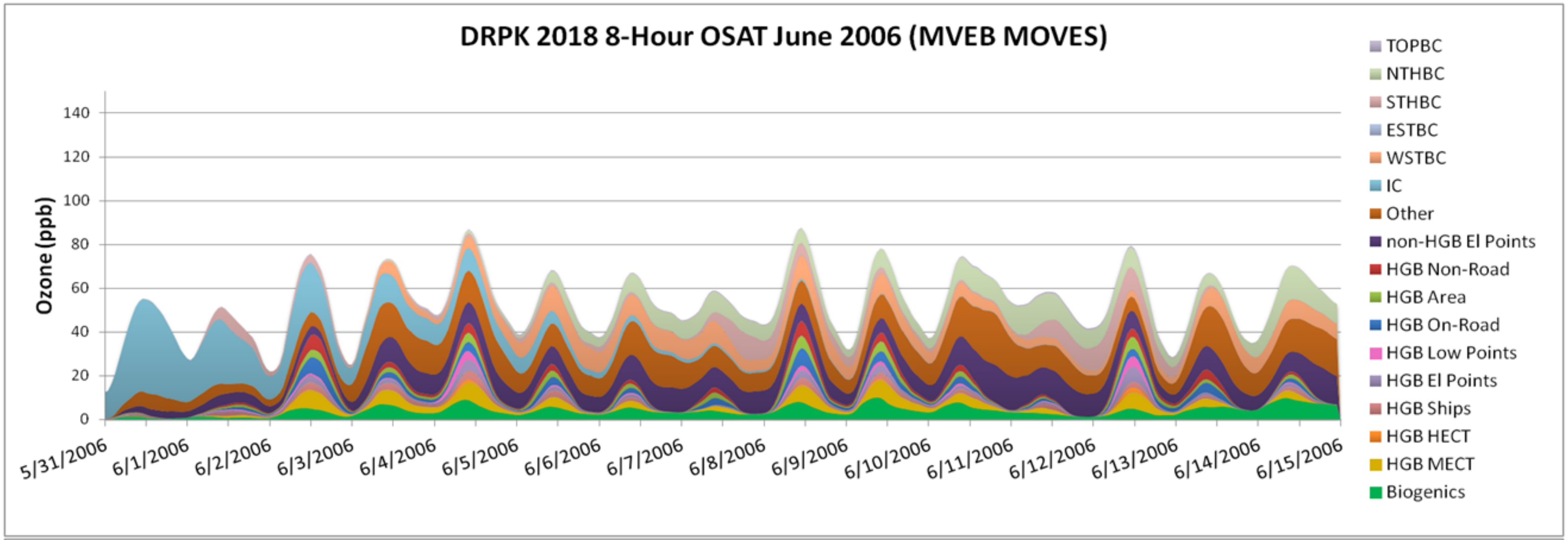


Figure 3-51: OSAT and APCA Results for BAYP



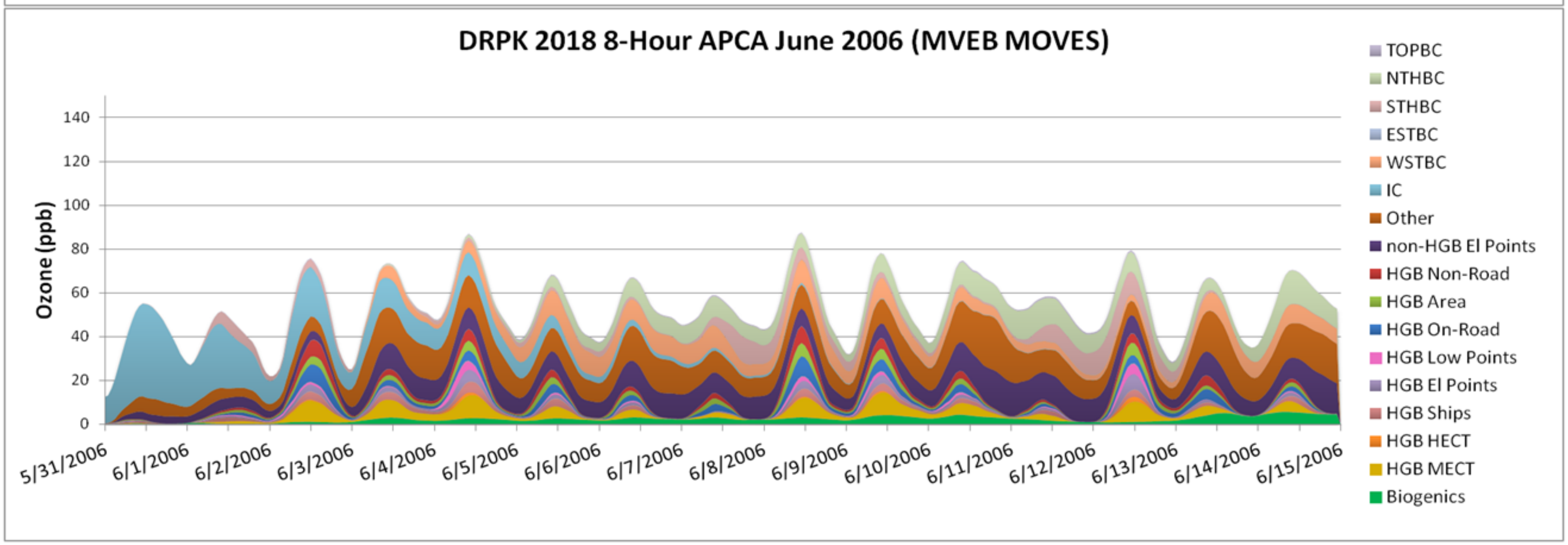
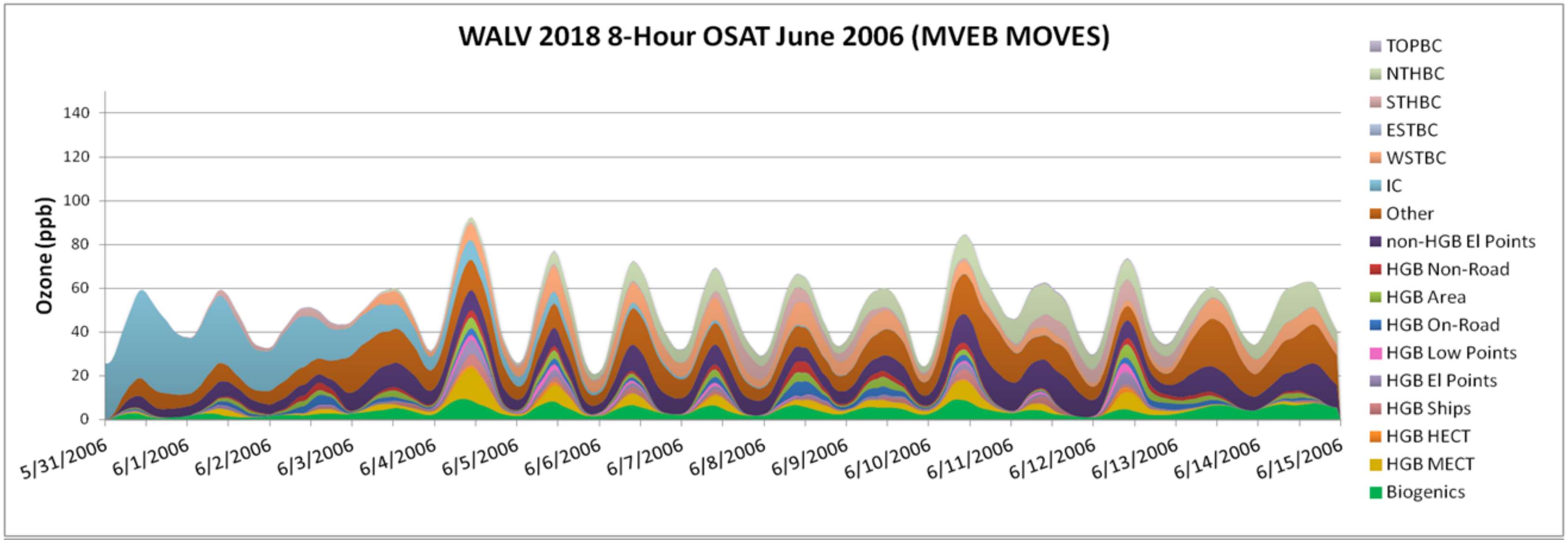


Figure 3-52: OSAT and APCA Results for DRPK



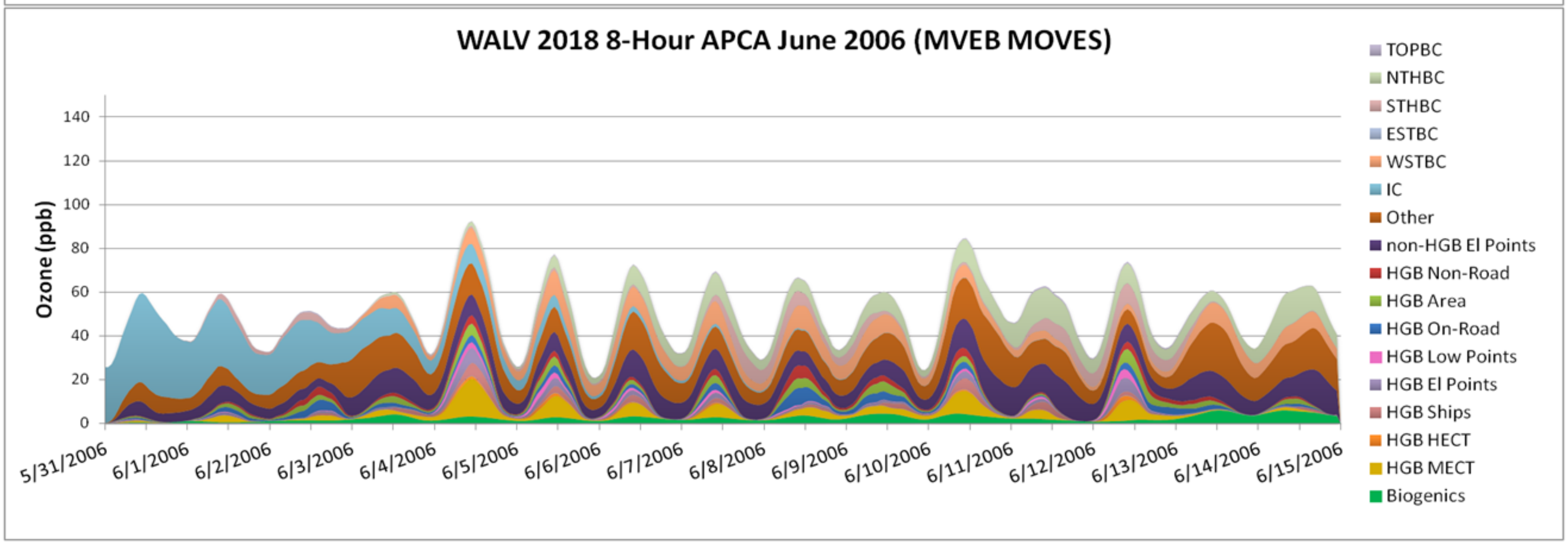


Figure 3-53: OSAT and APCA Results for WALV

3.6.3 Future Case Modeling with Controls (Updated)

Controls adopted concurrently with the 2010 HGB AD SIP Revision include reallocating and lowering the total point source HRVOC emissions allocated by the HECT rule in Harris County.

3.6.3.1 HECT Reallocation and 25 Percent Cap Reduction (Updated)

The modeling sensitivity for the HECT rule revision redistributes and reduces current total allocated point source HRVOC emissions by 25%, 2.69 tpd from HECT applicable sources in Harris County. Table 3-24: *HECT Modeling Sensitivity Results* shows the DV_Fs at the DRPK (CAMS 35) and BAYP (CAMS 53) regulatory monitors and the non-regulatory, industry-sponsored WALV (CAMS 617) monitor for the 2018 baseline as well as those resulting from the reallocation and 25% reduction in the HRVOC from HECT applicable sources in Harris County.

Table 3-24: HECT Modeling Sensitivity Results

Monitor Site Code	Baseline DV_F (ppb)	HECT DV_F (ppb)
DRPK	86.20	86.08
BAYP	87.04	86.95
WALV	86.15	85.98

Note: WALV (CAMS 617) is a non-regulatory, industry-sponsored monitor.

Applying the rounding and truncating convention for calculating DV_Fs, as per the EPA's modeling guidance, each of these monitors is projected to have a DV_F less than or equal to 87 ppb, the recommended limit for weight-of-evidence considerations.

3.6.4 Unmonitored Area Analysis (Updated)

EPA guidance (EPA, 2007) recommends that areas not near monitoring locations (unmonitored areas) be subjected to an "unmonitored area (UMA) analysis" to demonstrate that these areas are expected to reach attainment by the area's attainment year, in this case 2018. The standard attainment test is applied only at monitor locations, and the UMA analysis is intended to identify any areas not near a monitoring location that are at risk of not meeting the attainment date. Recently, the EPA provided software that can be used to conduct UMA analyses, but has not specifically recommended using its software [called the Modeled Attainment Test Software (MATS)] in EPA guidance, instead stating that "[s]tates will be able to use the EPA-provided software or are free to develop alternative techniques that may be appropriate for their areas or situations."

The TCEQ chose to use its own procedure to conduct the UMA analysis instead of MATS for several reasons. While both procedures incorporate modeled predictions into a spatial interpolation procedure, the TCEQ Attainment Test for Unmonitored Areas (TATU) is already integrated into the TCEQ's model post-processing stream, while MATS requires that modeled concentrations be exported to a Windows platform. Additionally, MATS requires input in latitude/longitude, while TATU works directly off the Lambert Conformal Projection data used in TCEQ modeling applications. MATS cannot easily handle multi-year baseline data, which are used in the HGB attainment modeling, unlike TATU. Finally, MATS uses the Voronoi Neighbor Averaging technique for spatial interpolation while TATU relies on the more familiar kriging geospatial interpolation technique. More information about TATU is provided in Appendix C of the 2010 HGB AD SIP Revision.

Figure 3-54: *Spatially Interpolated 2006 Baseline (left) and 2018 Future Case (right) Design Values for the HGB Area* shows two color contour maps of ozone concentrations produced by

TATU, one for the 2006 baseline (left) and one for the 2018 future case, including proposed controls (right). The figure shows the extent and magnitude of the expected improvements in ozone design values resulting from controls modeled in this attainment demonstration, with only a few grid cells at or above 84 ppb in the future case plot. No areas outside Harris County show nonattainment in 2018.

Figure 3-55: *HGB Grid Cells Within 7 x 7 Arrays of Monitoring Sites Used in Attainment Analysis (Green) and Grid Cells With Predicted 2018 Future Design Values > 85 ppb (Pink)* highlights the grid cells with 2018 projected $DV_F \geq 85$ ppb (shown in pink), and the 7 x 7 grid cell arrays around each of the regulatory and industry-sponsored monitors (shown in green). This plot verifies that all the grid cells with $DV_F \geq 85$ ppb lie within the 7 x 7 array around a monitor used in the attainment test, with the exception of four cells in eastern Harris County. Since these four cells are not considered to be near any monitor used in the attainment test, additional consideration of these cells is warranted.

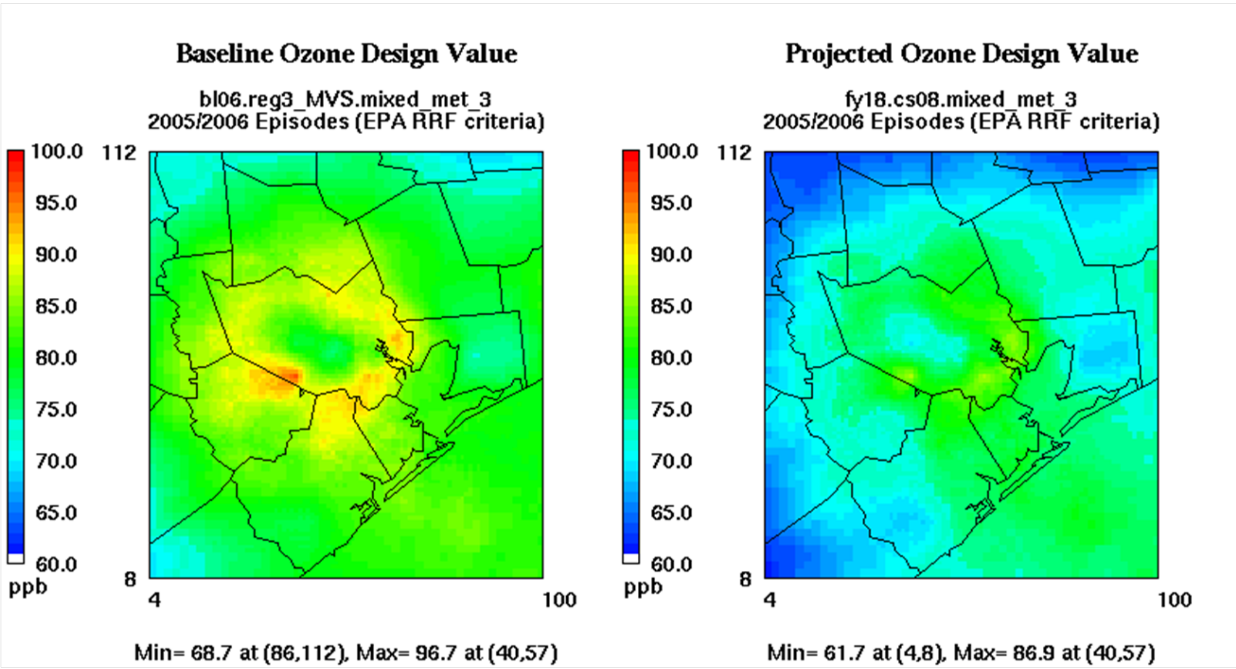


Figure 3-54: Spatially Interpolated 2006 Baseline (left) and 2018 Future Case (right) Design Values for the HGB Area

The maximum 2018 projected DV_F for the four grid cells is 85.7 ppb. This value is less than the 2018 projected DV_Fs ≥ 85 ppb at the BAYP (CAMS 53), DRPK (CAMS 35), and WALV (CAMS 617) monitored sites. In addition, as shown in Figure 3-55, the location of the four un-monitored area grid cells is close to the 7 x 7 grid cell arrays for the DRPK (CAMS 35) and the WALV (CAMS 617) monitors. Since these two monitors, in close proximity to the un-monitored area, as well as the BAYP (CAMS 53) monitor with the highest 2018 projected DV_F (87.0 ppb) are expected to reach attainment based on the weight of evidence from corroborative analyses, this un-monitored area should likewise reach attainment.

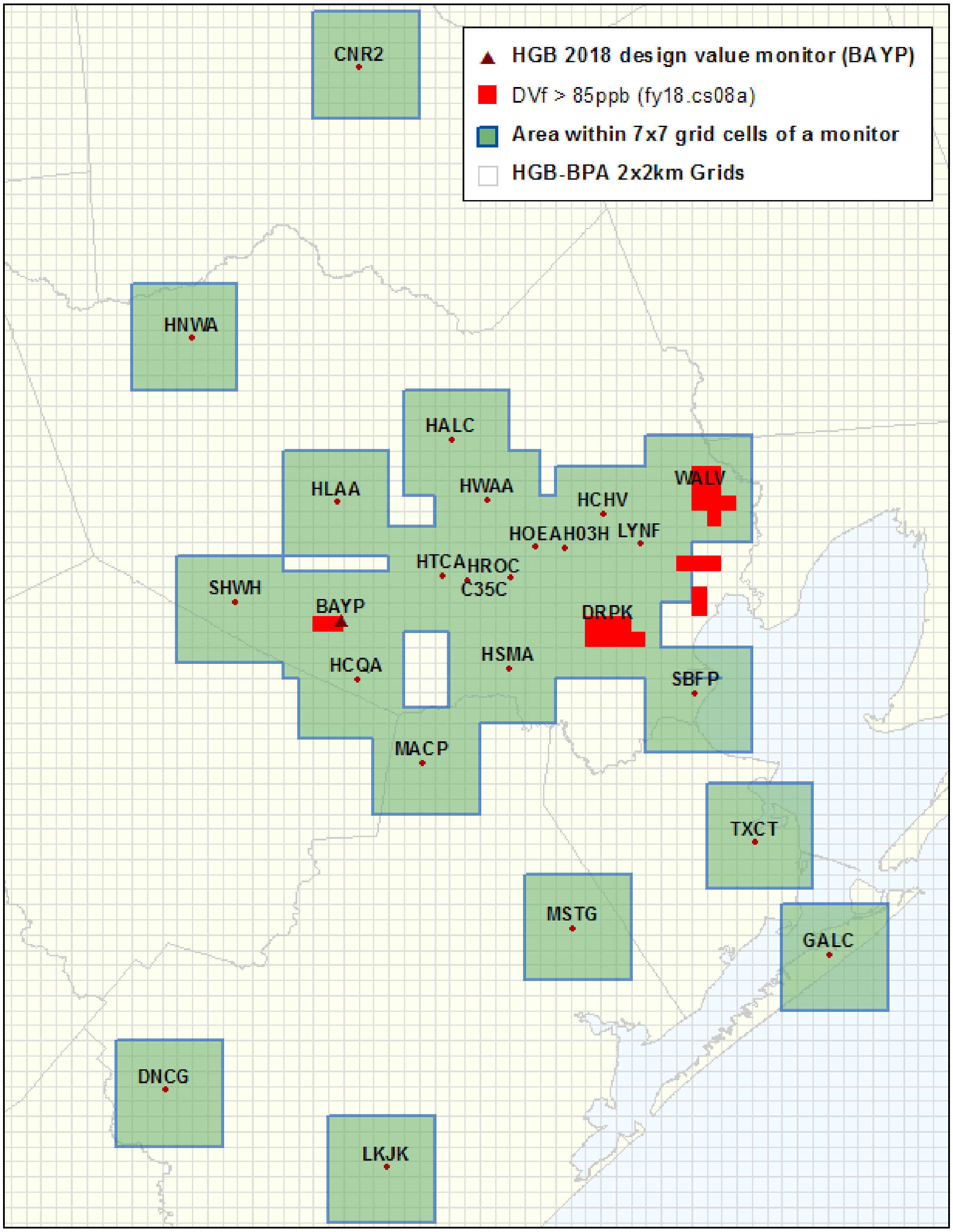


Figure 3-55: HGB Grid Cells Within 7 x 7 Arrays of Monitoring Sites Used in Attainment Analysis (Green) and Grid Cells With Predicted 2018 Future Design Values > 85 ppb (Pink)

3.7 MODELING ARCHIVE AND REFERENCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

CHAPTER 4: CONTROL STRATEGIES AND REQUIRED ELEMENTS (UPDATED)

4.1 INTRODUCTION (UPDATED)

This chapter is an update to Chapter 4: *Control Strategies and Required Elements* of the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision). The table and figure numbers in this chapter correspond to those in Chapter 4 of the 2010 HGB AD SIP Revision, but may be formatted differently than those in Chapter 4 of the 2010 HGB AD SIP Revision. For example, the first table in this chapter is numbered Table 4-2 instead of Table 4-1 because it corresponds with Table 4-2 in Chapter 4 of the 2010 HGB AD SIP Revision.

4.2 EXISTING CONTROL MEASURES (NO CHANGE FROM 2011 HGB RACT UPDATE SIP REVISION)

4.3 UPDATES TO EXISTING CONTROL MEASURES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

4.4 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT) ANALYSIS

4.4.1 General Discussion (No change from 2011 HGB RACT Update SIP Revision)

4.4.2 NO_X RACT Determination (No change from 2010 HGB AD SIP Revision)

4.4.3 VOC RACT Determination (No change from 2011 HGB RACT Update SIP Revision)

4.5 REASONABLY AVAILABLE CONTROL MEASURES (RACM) ANALYSIS (NO CHANGE FROM 2010 HGB AD SIP REVISION)

4.6 NEW CONTROL MEASURES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

4.7 MOTOR VEHICLE EMISSIONS BUDGET (MVEB) (UPDATED)

The MVEB refers to the maximum allowable emissions from on-road mobile sources for each applicable criteria pollutant or precursor as defined in the SIP. The budget must be used in transportation conformity analyses. Areas must demonstrate that the estimated emissions from transportation plans, programs, and projects do not exceed the MVEB. The attainment budget represents the on-road mobile source emissions that have been modeled for the attainment demonstration. The budget reflects all of the on-road control measures reflected in that demonstration and is based on the 2010a version of the Motor Vehicle Emission Simulator (MOVES2010a) model. The MVEB is shown in Table 4-2: *2018 Attainment Demonstration MVEB for the Eight-County HGB Area*. For additional detail, see Appendix A*: Evaluation of On-Road Mobile Source Emissions Developed with the MOVES2010a Model Replacing Emissions Developed with the MOBILE6.2 Model for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard*.

Table 4-2: 2018 Attainment Demonstration MVEB for the Eight-County HGB Area

2018 MVEB	Summer Weekday Emissions
Nitrogen Oxides (NO_X)	103.34 tpd
Volatile Organic Compounds (VOC)	50.13 tpd

4.8 MONITORING NETWORK (NO CHANGE FROM 2010 HGB AD SIP REVISION)

4.9 CONTINGENCY PLAN (UPDATED)

SIP revisions for nonattainment areas are required by §172(c)(9) of the Federal Clean Air Act (FCAA) to provide for specific contingency measures to be implemented should a nonattainment area fail to meet reasonable further progress (RFP) requirements or fail to attain the applicable National Ambient Air Quality Standard by the attainment date set by the United States Environmental Protection Agency (EPA). These contingency measures are to be implemented without further action by the state or the EPA. In the General Preamble for implementation of the FCAA Amendments of 1990 published in the April 16, 1992, issue of the *Federal Register* (57 FR 13498), the EPA interprets the contingency requirement to mean additional emissions reductions that are sufficient to equal 3% of the emissions in the adjusted base year (ABY) inventory. These emissions reductions should be realized in the year following the year in which the failure is identified (i.e., an RFP milestone year or attainment year).

The ABY emissions inventory is used in the RFP planning process to calculate required emissions reduction targets and excludes certain on-road mobile source emissions reductions from controls that were promulgated prior to the 1990 FCAA Amendments. This SIP revision also uses the ABY inventory as the inventory from which to calculate the required 3% reduction for contingency. For this SIP revision, the ABY inventory has been updated to include on-road mobile source inventories developed using the EPA's tool for developing on-road emission rates, the Motor Vehicle Emission Simulator (MOVES2010a). For further information regarding the ABY inventory for the Houston-Galveston-Brazoria (HGB) area and how the area meets RFP requirements, see Chapter 7: *Reasonable Further Progress (RFP) Motor Vehicle Emissions Budget (MVEB) Update.*

A summary of the 2019 contingency analysis is provided in Table 4-3: *2019 Contingency Demonstration for the HGB Area*. Consistent with the EPA's "NO_X Substitution Guidance," the 3% attainment demonstration contingency analysis for 2019 is based on a 2% reduction in NO_X emissions [33.20 tons per day (tpd)] and a 1% reduction in volatile organic compounds (VOC) emissions (10.83 tpd) to be achieved between 2018 and 2019 (EPA, 1993). Inventory analyses were performed on the fleet turnover effects for the federal emission certification programs for on-road and non-road vehicles. The emission reductions from 2018 to 2019 were estimated for these programs. For this SIP revision, the on-road emissions reductions estimates were updated using MOVES2010a. The emissions inventory and resulting fleet turn-over emissions reductions for 2018 and 2019 are higher with MOVES2010a than MOBILE6. The higher emission reduction estimates are incorporated into the updated contingency demonstration in Table 4-3. For a detailed description of the contingency reductions, see Appendix C: *Revisions to Appendix 1, HGB Reasonable Further Progress Demonstration Calculations Spreadsheet*.

Table 4-3: 2019 Contingency Demonstration for the HGB Area

Description	NO_X	VOC
Adjusted 2018 Base Year Emissions Inventory	1003.92	935.59
Percent for Contingency Calculation (total of 3%)	2.00	1.00
2018 to 2019 Required Contingency Reductions	20.08	9.36
Federal On-Road Reformulated Gasoline (RFG)	6.80	-0.25
Federal On-Road Mobile New Vehicle Certification Standards	22.28	9.50
State Inspection and Maintenance and Anti-Tampering Programs (Brazoria, Fort Bend, Galveston, Harris, and Montgomery Counties)	-0.67	-0.26
Federal Non-Road Mobile New Vehicle Certification Standards	3.56	1.78
Non-Road RFG Gasoline	0.00	0.03
Federal Tier I and II Locomotive Standards	0.68	0.01
Federal Tier 2 Marine Diesel Standard	0.55	0.02
Total Contingency Reductions	**33.20**	**10.83**
Contingency Excess (+) or Shortfall (-)	**+12.92**	**+1.47**

Note: Emissions are represented in tons per day.

The attainment demonstration contingency analysis demonstrates that the 2019 contingency reductions exceed the 3% contingency reduction requirement; therefore, the attainment demonstration contingency requirement for the 1997 eight-hour ozone standard is fulfilled for the HGB area. The 2010 HGB AD SIP Revision includes a commitment to address additional measures to meet the 3% contingency requirement in a mid-course review submittal; however, this SIP revision fulfills this commitment. The updated on-road mobile source emissions inventories and control strategy reduction estimates developed with MOVES2010a demonstrate more than the required 3% contingency reduction requirement. Therefore, an additional SIP revision to address contingency measures is not needed.

4.10 REFERENCES (UPDATED)

EPA, 1993. "NO_X Substitution Guidance." Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, December 1993 http://www.epa.gov/ttn/caaa/t1/memoranda/noxsubst.pdf.

EPA, 2005. "Clean-Fuel Vehicle Standards."United States Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory, CCD-05-12 LDV/LDT/MDPV/HDV/HDE/LD-AFC), July 2005. http://www.tceq.texas.gov/assets/public/implementation/air/sip/bpa/appendix_a.pdf.

EPA, 2007. “Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze.” Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, EPA-454/B-07-002, April 2007. http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf

EPA, 2009. “Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes.” Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-B-09-046, December 2009.

EPA and U.S. Department of Transportation, 2008. "Guidance for the Use of Latest Planning Assumptions in Transportation Conformity Determinations." Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency; Office of Natural and Human Environment, Federal Highway Administration, U.S. Department of Transportation; and Office of Planning and Environment, Federal Transit Administration, U.S. Department of Transportation, EPA420-B-08-901, December 2008.

Federal Register, Monday, June 2, 2003, Part II, Environmental Protection Agency, 40 CFR Part 51, Proposed Rule To Implement the Eight-Hour Ozone National Ambient Air Quality Standard; Proposed Rule.

Federal Register, Friday, April 30, 2004, Part II, Environmental Protection Agency, 40 CFR Parts 50, 51 and 81, [OAR 2003-0079, FRL-7651-7], RIN 2060-AJ99, Final Rule To Implement the 8-Hour Ozone National Ambient Air, Quality Standard-Phase 1.

Federal Register, Tuesday, November 29, 2005, Part II, Environmental Protection Agency, 40 CFR Parts 51, 52, and 80 Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard; Final Rule.

CHAPTER 5: WEIGHT OF EVIDENCE (UPDATED)

5.1 QUANTITATIVE CORROBORATIVE ANALYSIS (NO CHANGE FROM 2010 HGB AD SIP REVISION)

5.2 CORROBORATIVE ANALYSIS: MODELING (NO CHANGE FROM 2010 HGB AD SIP REVISION)

5.2.1 Solving Modeling Problems (No change from 2010 HGB AD SIP Revision)

5.2.2 Model Performance Evaluations: Implications of the Model Performance of the Current SIP Modeling (No change from 2010 HGB AD SIP Revision)

5.2.3 Model Response to Proposed Controls: Additional Ways to Measure Progress (Updated)

This chapter is an update to Chapter 5: *Weight of Evidence* from the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision). The table and figure numbers in this chapter correspond to those in Chapter 5 of the 2010 HGB AD SIP Revision, but may be formatted differently than those in Chapter 5 of the 2010 HGB AD SIP Revision.

Table 5-1: *Changes in the Area and Population Affected by an Eight-Hour Ozone Design Value Greater than or Equal to 85 ppb in Response to Growth and Controls* shows how the area, in square kilometers (km^2), subject to ozone levels over the 1997 eight-hour standard is expected to shrink dramatically in response to the emission changes projected to occur between 2006 and 2018. Even though peak ozone drops by only 9.4%, the area with an estimated ozone design value greater than the 85 parts per billion (ppb) shrinks by 98.4%. The population living in those areas and how the changes might reduce the number of people that may encounter ozone over the standard were considered. The estimated number of people residing in the area projected to be greater than 85 ppb decreases by 95.8%. Population data used are from the 2000 Census and have not been grown to reflect changes in population in those areas in 2006 or 2018. Also, the numbers reflect areas where people reside, i.e., their home addresses, not necessarily where they might be during the hours of highest ozone during the ozone season. However, the dramatic decrease in the area with ozone over the standard suggests that ozone decreases arising from the proposed control strategies are likely to benefit many residents of the Houston-Galveston-Brazoria (HGB) area. The modeling that includes Motor Vehicle Emissions Simulator (MOVES) emissions inventories shows greater decreases in ozone than the modeling presented in the 2010 HGB AD SIP Revision.

Table 5-1: Changes in the Area and Population Affected by an Eight-Hour Ozone Design Value Greater than or Equal to 85 ppb in Response to Growth and Controls

Run Name	Peak Ozone, ppb	Area with Design Value > 85 ppb, km^2	2000 Population in Area with Design Value > 85	Area × Concentration (km^2 × ppb)	Population × ppb
Baseline: 2006.reg3_MVS	96	10,680	3,105,127	32,084	13,634,090
Future year: 2018.cs08a	87	172	130,861	140	92,448
Percentage decrease from 2006 to 2018	9.4%	98.4%	95.8%	99.6%	99.3%

5.2.4 Conclusion (No change from 2010 HGB AD SIP Revision)

5.3 AIR QUALITY TRENDS IN THE HGB AREA (UPDATED)

This section describes analyses of air quality observational data in the HGB area. Trends in ozone and its precursors demonstrate not only the substantial progress the HGB area has made in improving air quality but also the magnitude of the future challenge in attaining the ozone National Ambient Air Quality Standard (NAAQS). Trends are also useful to show how ozone is related to its precursors. Decreases in nitrogen oxides (NO_X) and volatile organic compounds (VOC) demonstrate the effectiveness of policies to reduce emissions; however, due to its dependence on meteorological variables, ozone may not always exhibit trends identical to its precursors. Separating variations in meteorological factors from trends in ozone and its precursors can highlight whether ozone reductions are due to decreases in precursor emissions or are due to year-to-year variability in local meteorology (Sullivan, 2009; Camalier, et al., 2007).

5.3.1 Ozone Trends (Updated)

The following examination of the frequency at which the NAAQS for ozone is exceeded will use the 1997 eight-hour standard of 0.08 parts per million (ppm), or less than or equal to 84 ppb, as the subject of interest for this SIP revision. Though the one-hour standard is no longer in effect, it remains a useful benchmark for understanding ozone behavior in the HGB area and will also be presented. While the ozone NAAQS is expressed in units of ppm, this section will use the familiar convention of expressing concentrations in ppb.

The trend in design values for the HGB area is seen clearly in Figure 5-1: *Ozone Design Values for the HGB Area*. While the HGB area exceeded both the one-hour and 1997 eight-hour ozone NAAQS as of the end of 2011, the HGB area monitored attainment of the 1997 eight-hour ozone NAAQS in both 2009 and 2010, after decades of nonattainment. The one-hour ozone design value has generally decreased over the past 20 years, and the eight-hour ozone design value has generally decreased over at least the past twelve years. The eight-hour ozone design value in 2011 was 89 ppb, a 25% decrease from the 1990 design value of 119 ppb, though no longer below the 1997 eight-hour ozone NAAQS of 0.08 ppm, or less than or equal to 84 ppb. A regression analysis of design value on year estimates that the eight-hour ozone design value decreased at the rate of 1.5 ppb per year, which is statistically significant at the 1% level ($\alpha = 0.01$).

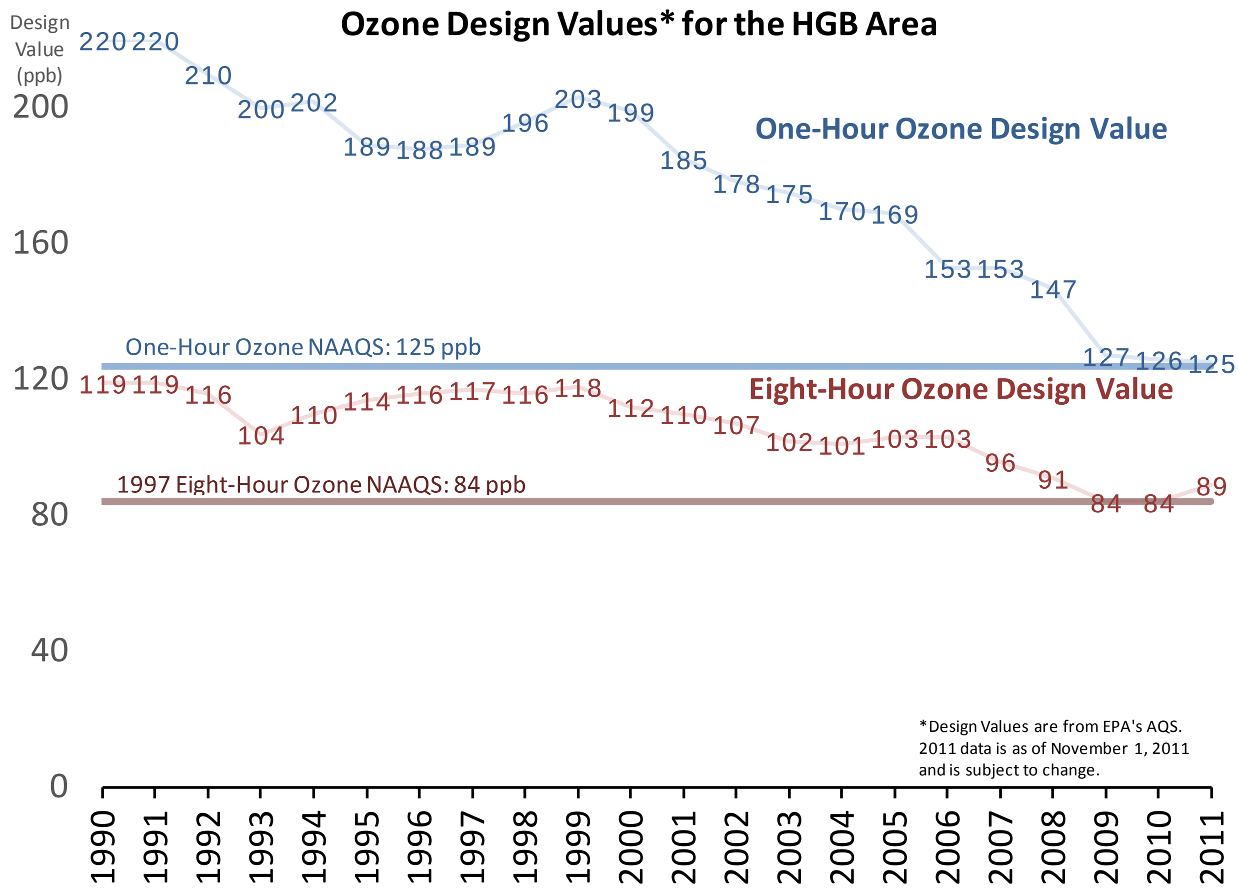


Figure 1: Ozone Design Values for the HGB Area

The one-hour ozone design value in 2011 was 125 ppb, a 43% decrease from the 1990 design value of 220 ppb. The 2011 one-hour ozone design value rests at exactly the value of the one-hour NAAQS of 0.12 ppm (or 125 ppb). A regression analysis of one-hour design value on year shows a decrease at the rate of 4.25 ppb per year; the slope is also statistically significant at the 1% level ($\alpha = 0.01$).

The design value of record in a metropolitan area is the maximum design value of all of the area's regulatory monitors' individual design values. Because ozone varies spatially, it is also prudent to investigate trends at all monitors in an area. Table 5-2: *Eight-Hour Ozone Design Values (in ppb) for Each Regulatory Monitor in the HGB Area* and Table 5-3: *One-Hour Ozone Design Values (in ppb) for Each Regulatory Monitor in the HGB Area* contain the eight-hour and one-hour ozone design values at all regulatory monitors in the HGB area from 1990 to 2011. More monitors than these operate in the HGB area, but because the data at those monitors do not meet the EPA's quality control standards, the design values at those additional monitors are not appropriate for compliance determinations and are not displayed here. These non-regulatory monitors are discussed in Section 5.2.2: *Model Performance Evaluations: Implications of the Model Performance of the Current SIP Modeling* in the 2010 HGB AD SIP Revision.

Table 5-2: Eight-Hour Ozone Design Values (in ppb) for Each Regulatory Monitor in the HGB Area

Monitor/CAMS #	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Manvel Croix Park C84														91	97	97	96	91	85	84	84	89
Northwest Harris Co. C26/A110/X154	110	98	101	100	110	113	110	106	106	109	108	105	101	100	94	93	91	91	85	84	81	84
Houston Aldine C8/AF108/X150	118	119	116	104	102	103	114	116	116	108	111	108	107	100	95	92	88	84	83	83	83	83
Houston Bayland Park C53/A146											111	110	100	102	101	103	103	96	91	84	82	83
Houston Deer Park 2 C35										108	112	108	103	102	101	100	96	93	87	81	81	83
Houston East C1/G316	110	104	103	88				86	108	106	102	103	101	100	95	87	83	78	80	76	76	81
Houston Croquet C409	117	117	112	103	96	104	104	117	115	118	110	104	102	99	99	98	94	87	80	76	77	80
Clinton C403/C304/AH113	115	115	109	100	100	106	106	107	100	103	101	97	93	96	96	95	85	79	73	74	76	79
Channelview C15/AH115														87	90	89	85	83	80	78	78	78
Park Place C416																			89	78	77	78
Lang C408	114	105	103	93	95	98	99	100	96	96	96	91	83	78	79	79	80	77	76	75	76	78
Seabrook Friendship Park C45														85	94	92	90	86	80	78	75	78
Galveston 99th Street C1034/A320																				77		78
Houston Texas Avenue C411														88	89	88	84	78	76	75	74	77
Houston Regional Office C81													95	94	88	88	84	81	74	72	73	77
Lynchburg Ferry C1015																96	89	82				76
Houston North Wayside C405	119	114	102	94	91	91	91	96	99	104	105	98	89	86	85	82	78	76	75	72	71	75
Houston Westhollow C410							95	101	95	102	102	104	95	87	87	89	96	92	89	79	75	74
Houston Monroe C406	108	105	102	96	93	97	102	109	112	113	106	93	90	90	95	97	99	91	81	71	72	74
Conroe Relocated C78/A321														78	85	86	85	84	80	71	71	74
Lake Jackson C1016																79	79	76	76	74	74	73
Galveston Airport C34/A109/X152									90	112	108	98	89	89	91	87	83					
Clute C11/A111			96	93	91	96	92	92	84	95	93	91	86	87								
Texas City C10		93	82	90	89	114	102	105	91	100	98	91	83	80								
Conroe C65												91										
Houston Crawford C407	117	105	98	89	89	95	91	97	96	100	100	81										
Manchester C22	103	103	104	104	103	106	102	103														
Houston Deer Park C18	113	107	96	85	89	107	116															
Number of monitors	11	12	13	13	12	12	13	13	13	14	15	16	15	20	18	20	20	19	19	20	19	21

Note: Missing values indicate a monitor was not operating during that year or did not produce a valid year of data. Three years of valid data are required to calculate an eight-hour ozone design value.

Table 5-3: One-Hour Ozone Design Values (in ppb) for Each Regulatory Monitor in the HGB Area

Monitor/CAMS #	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Houston East C1	210	210	200	200	202		177	182	182	198	180	180	171	171	165	154	137	119	119	111	121	125
Manvel Croix Park C84													143	132	142	134	138	128	128	120	119	123
Houston Bayland Park C53										189	185	173	154	163	148	148	143	142	139	112	118	122
Houston Aldine C8/C108/C150	220	220	190	197	197	189	173	189	187	187	180	166	166	143	136	139	125	122	122	120	122	121
Clinton C403/C113/C304	210	210	210	176	158	173	173	173	161	183	199	176	157	175	158	158	124	121	111	120	118	120
Houston Regional Office C81												185	178	175	170	169	135	131	119	111	112	120
Channelview C15/C115													154	141	140	135	134	128	120	118	118	119
Lang C408	200	200	183	158	159	159	159	158	155	155	175	175	149	128	128	127	126	108	108	111	118	118
Northwest Harris Co. C26	170	160	160	166	173	172	172	165	164	163	161	157	154	156	148	131	127	127	126	127	115	118
Lynchburg Ferry C1015															157	157	152	149	117	117	117	116
Houston Deer Park 2 C35/139								147	164	203	185	182	168	161	157	153	150	150	147	119	119	115
Park Place C416																		118	122	122	126	113
Houston Croquet C409	180	200	200	178	152	167	167	168	168	167	163	160	157	150	141	136	131	126	117	112	112	112
Houston North Wayside C405	220	210	190	173	173	155	143	155	158	189	190	168	153	131	138	138	118	100	102	102	105	112
Houston Texas Avenue C411													146	172	157	157	127	110	110	109	108	109
Seabrook Friendship Park C45													132	135	135	153	153	153	119	114	102	107
Houston Monroe C406	170	170	170	155	147	154	161	174	196	196	170	143	151	141	141	131	133	131	117	108	106	104
Galveston 99th St C1034/A320																		115	115	104	104	104
Houston Westhollow C410						164	155	164	155	165	150	150	141	141	128	126	131	127	126	111	103	100
Conroe Relocated C78													119	137	128	128	128	124	116	94	94	97
Lake Jackson C1016															119	113	105	99	101	97	92	89
Galveston Airport C34/C109								170	170	176	168	164	133	123	129	129	117	104				
Texas City C10	150	150	150	163	163	184	182	182	146	175	172	139	121	116	116							
Clute C11	170	150	150	132	129	144	144	148	134	154	161	154	136	133								
Houston Crawford C407	220	220	190	165	165	165	166	172	172	164	173	173										
Conroe C65											145	145										
Manchester C22	170	190	190	180	160	172	170	175	173													
Houston Deer Park C18	170	160	160	150	157	188	188															
Rosenberg	150																					
Number of monitors	14	13	13	13	13	13	14	15	15	15	16	17	20	20	21	20	20	22	21	21	21	21

Note: Missing values indicate a monitor was not operating during that year or did not produce a valid year of data. Only one year of valid data is required to calculate a one-hour ozone design value; therefore, some monitors that have a one-hour ozone design value may not have an eight-hour ozone design value.

Figure 5-2: *Eight-Hour Ozone Design Value Statistics for All Monitors in the HGB Area* and Figure 5-3: *One-Hour Ozone Design Value Statistics for All Monitors in the HGB Area* display three summary statistics for the eight-hour and one-hour design values, respectively: the maximum, median, and minimum design values computed across all monitors in the HGB area. These figures facilitate assessment of the range of design values observed within a year, as well as how these distributions change over time. From these figures, it appears that neither eight-hour nor one-hour design values exhibited a noticeable trend until about 1999, after which both began falling steadily. Before 2001, no monitors in the HGB area met either standard; since then, the area has seen a steady increase in the number of monitors attaining both standards. By 2009, all monitors in the HGB area were below the 1997 eight-hour ozone NAAQS and only one monitor was above the one-hour ozone NAAQS.

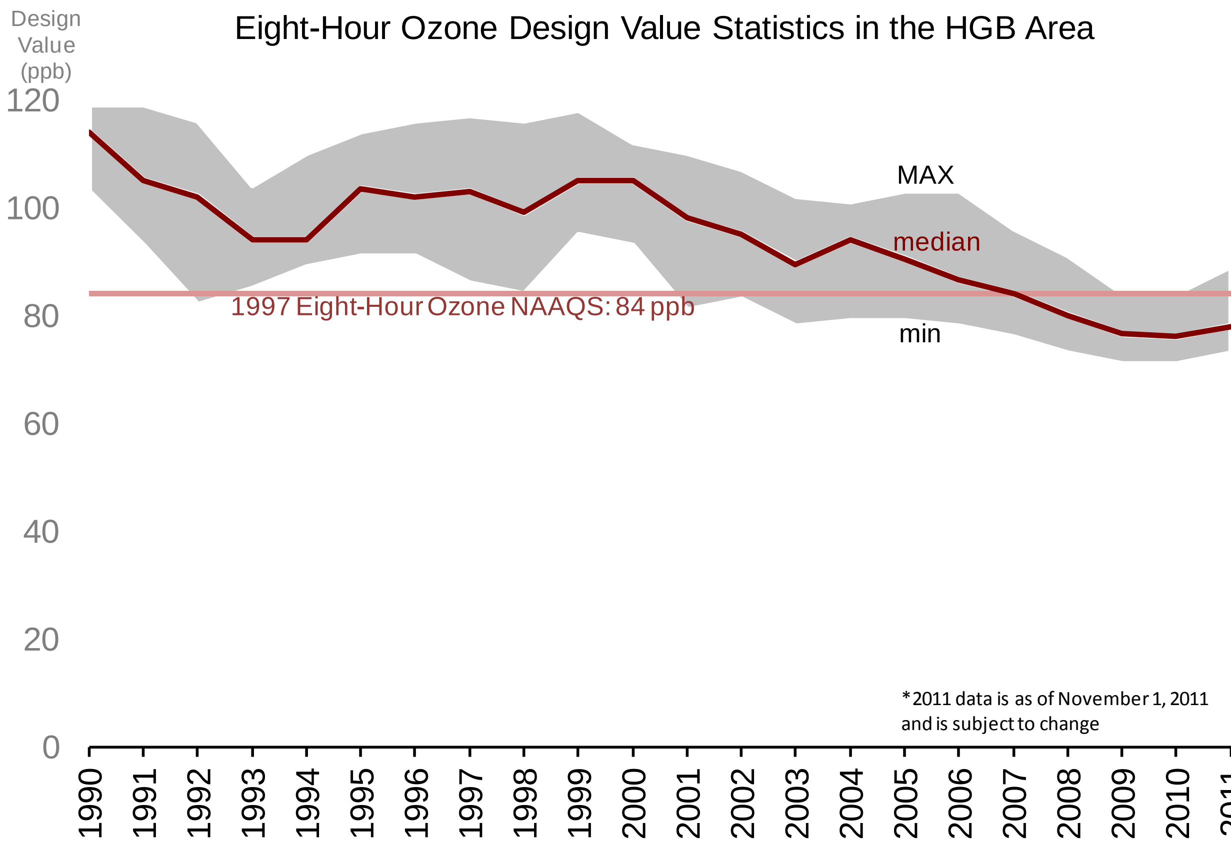


Figure 5-2: Eight-Hour Ozone Design Value Statistics for All Monitors in the HGB Area

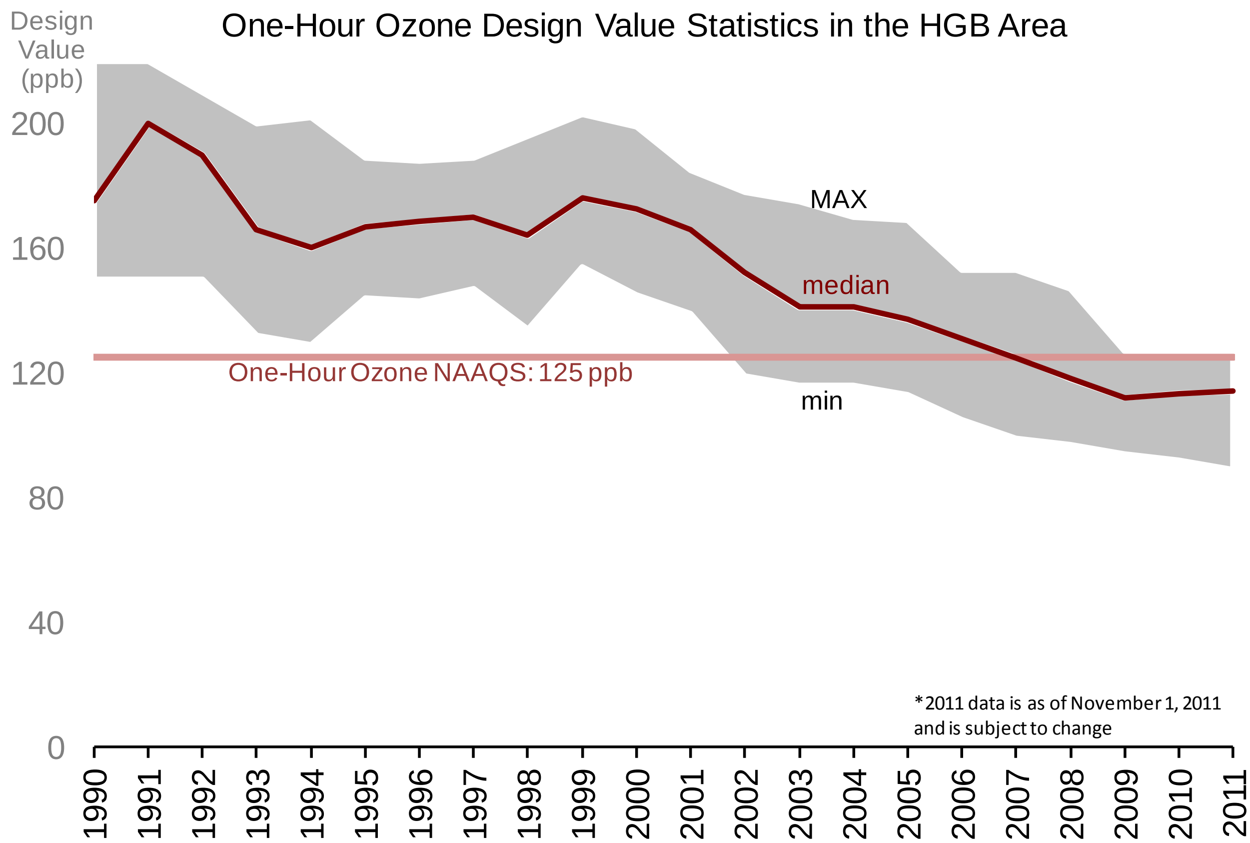


Figure 5-3: One-Hour Ozone Design Value Statistics for All Monitors in the HGB Area

Ozone trends can also be investigated by examining the number of days an exceedance of the ozone NAAQS was recorded, termed an exceedance day. An exceedance day for the 1997 eight-hour ozone NAAQS is any day that any monitor in the area measures an eight-hour average ozone concentration greater than or equal to 85 ppb over any eight-hour period. An exceedance day for the one-hour ozone NAAQS is any day that any monitor in the area measures a one-hour average ozone concentration greater than or equal to 125 ppb for at least one hour. Previous research (Savanich, unpublished, 2006) by the Texas Commission on Environmental Quality (TCEQ) has shown that, until 2006, the number of exceedance days was positively correlated with the number of monitors in a particular area. Generally, when the number of monitors increases within an area, so does the number of exceedance days recorded, at least until the area has been saturated with monitors or until ozone concentrations decrease.

Because of this correlation, when examining exceedance day trends, the number of monitors must always be considered. Therefore, the number of expected exceedances should increase with the increasing number of monitors. It is especially noteworthy that Figure 5-4: *Number of Monitors and Ozone Exceedance Days in the HGB Area* shows that, despite an increase in the number of monitors, the number of exceedance days for both one-hour and 1997 eight-hour ozone NAAQS has decreased, a decrease that is especially pronounced over the period 2005 through 2008. Since 1999, the number of 1997 eight-hour and one-hour ozone exceedance days occurring in the HGB area has fallen 77% and 92%, respectively. In just the last six years, the number of 1997 eight-hour and one-hour ozone exceedance days has fallen 67% and 87%, respectively.

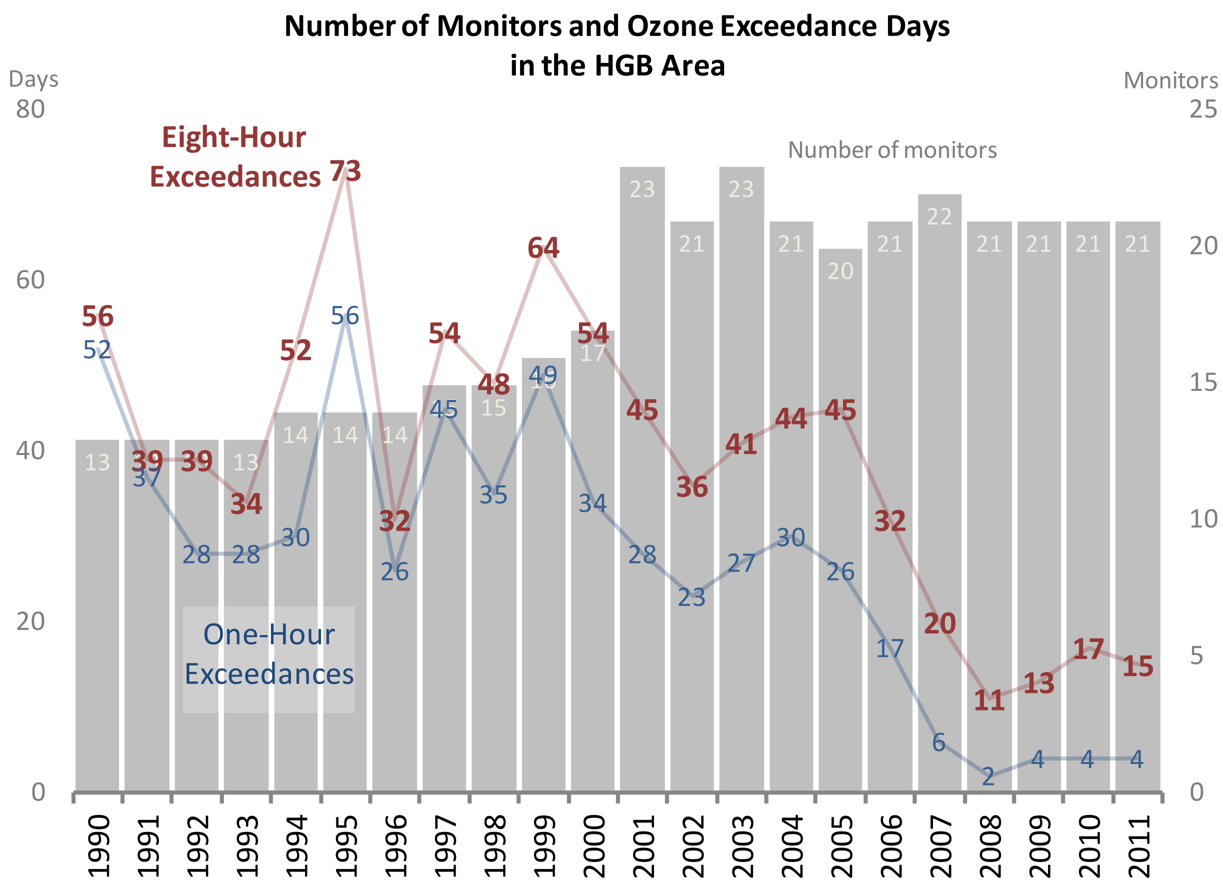


Figure 5-4: Number of Monitors and Ozone Exceedance Days in the HGB Area

Results for individual monitors, displayed in Figure 5-5: *Number of 1997 Eight-Hour Ozone Exceedance Days by Monitor* and Figure 5-6: *Number of One-Hour Ozone Exceedance Days by Monitor* support the conclusion that the number of exceedance days at individual monitors also appears to be decreasing. Since recent peaks in 1999 [31 days at Houston Bayland Park (CAMS 53) and Houston Croquet (CAMS 409)] and in 2000 [29 days at Houston Aldine (CAMS 8)], none of these monitors, in any year, has exceeded even 65% as often; in 2011 these monitors experienced 90% and 87% reductions from those recent peaks. While results for other monitors are less impressive, overall, the trend in ozone exceedance days at monitors throughout the HGB area is clearly downward. Due to the large number of monitors in the HGB area, data from Figure 5-5 and Figure 5-6 are presented for detailed inspection in Table 5-4: *Number of Days with a 1997 Eight-Hour Ozone Exceedance* and Table 5-5: *Number of Days with a One-Hour Ozone Exceedance*.

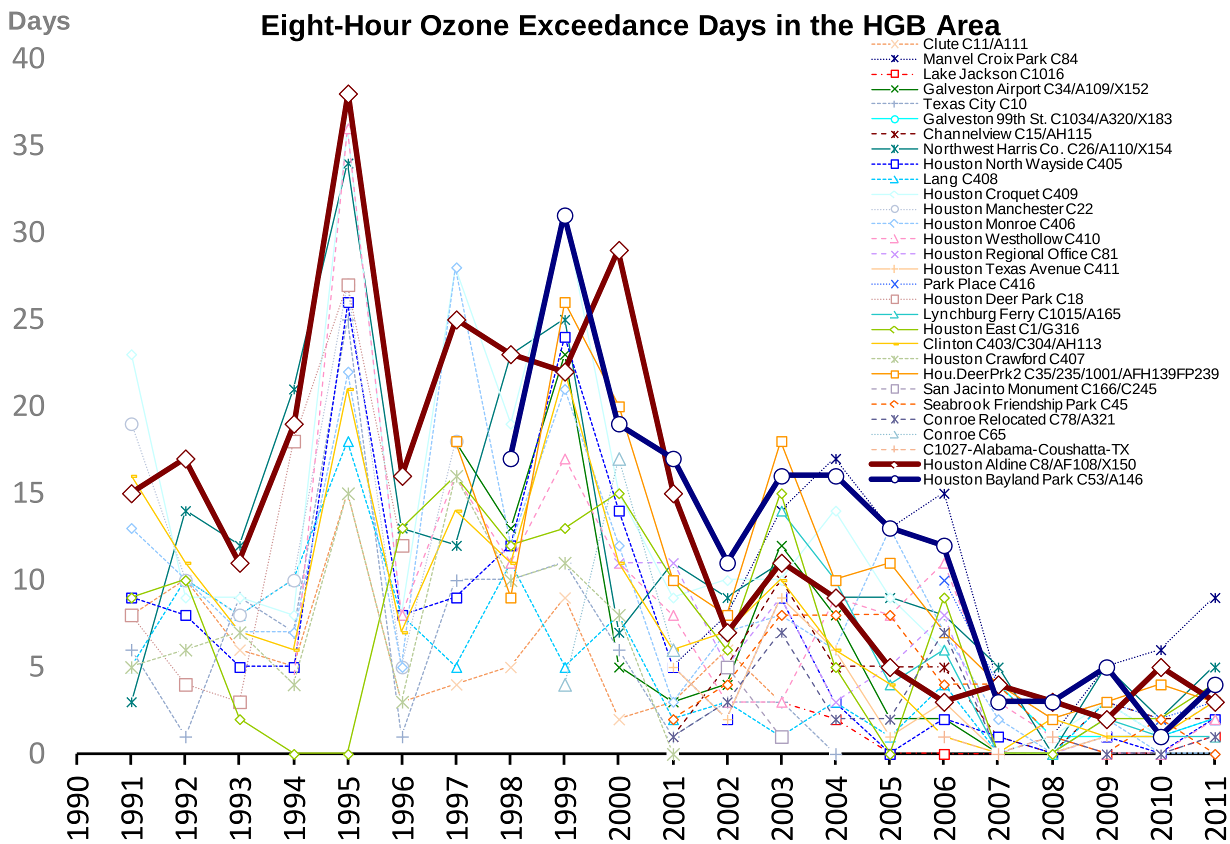


Figure 5-5: Number of 1997 Eight-Hour Ozone Exceedance Days by Monitor

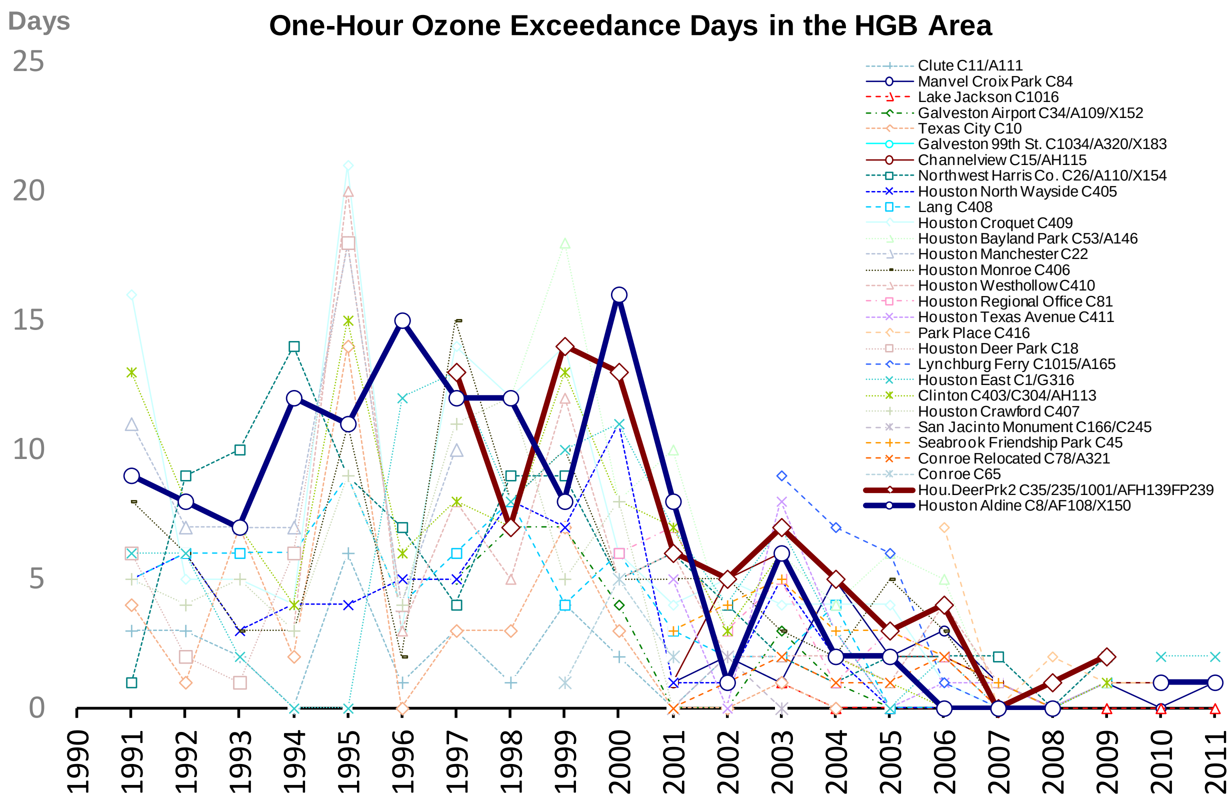


Figure 5-6: Number of One-Hour Ozone Exceedance Days by Monitor

Progress in recent years in reducing eight-hour and one-hour ozone concentrations in the HGB area is evident in Table 5-4 and Table 5-5. The number of unique days in which any monitor in the HGB area registered daily peak eight-hour ozone greater than or equal to 85 ppb decreased from a high of 73 occurrences in 1995, to a series low of 11 in 2008, and 15 in 2011. Prior to 2007, that number was never below 30. The number of monitors recording at least one exceedance of the 1997 eight-hour ozone standard decreased almost by half, from a peak of 23 monitors in 2003 to only 12 in 2008, before rebounding to 19 in 2011. Many of those monitors recorded exceedances on the same days, as the total number of unique days observing an eight-hour ozone exceedance in the HGB area in 2011 was 22.

A similar pattern is apparent with the number of total exceedances of the one-hour ozone NAAQS presented in Table 5-5. The table shows that the total number of one-hour ozone NAAQS exceedance occurrences decreased from a high of 165 in 1995 to only eight in 2011. Prior to 2005, the number of one-hour exceedances was never below 50.

In addition to decreases in the overall number of exceedances occurring, the number of monitors registering one or more one-hour exceedances also has generally decreased. The three exceedances in 2008 occurred at only two monitors. As recently as 2006, a total of 15 monitors recorded at least one exceedance. This significant progress has occurred in a fairly short amount of time in an area well known for its air quality challenges.

Table 5-4: Number of Days with a 1997 Eight-Hour Ozone Exceedance

Monitor	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Manvel Croix Park C84											5	8	14	17	13	15	4	1	5	6	9
Northwest Harris Co. C26	3	14	12	21	34	13	12	23	25	7	11	9	11	9	9	8	5	0	5	2	5
Houston East C1	9	10	2	0	0	13	16	12	13	15	10	6	15	5	0	9	0	0	2	2	4
Houston Bayland Park C53								17	31	19	17	11	16	16	13	12	3	3	5	1	4
Houston Croquet C409	23	9	9	8	36	8	28	19	31	15	9	10	10	14	9	6	0	1	3	1	4
Houston Aldine C8/C108/C150	15	17	11	19	38	16	25	23	22	29	15	7	11	9	5	3	4	3	2	5	3
Houston Deer Park 2 C35							18	9	26	20	10	8	18	10	11	7	4	2	3	4	3
Park Place C416																10	4	2	3	2	3
Clinton C403/C304/AH113	16	11	7	6	21	7	14	11	22	11	6	7	10	6	4	1	0	2	1	1	3
Houston Regional Office C81										11	11	5	9	3	5	8	0	0	1	1	3
Houston Texas Avenue C411											5	2	9	6	1	3	0	0	1	0	3
Channelview C15/AH115											1	5	10	5	5	5	1	0	3	2	2
Lang C408	5	10	8	10	18	8	5	11	5	8	2	3	1	3	1	4	0	0	3	1	2
Galveston 99th St.																	4	1	1	1	2
Houston North Wayside C405	9	8	5	5	26	8	9	12	24	14	5	2	9	3	0	2	1	0	1	0	2
Houston Westhollow C410				4	36	8	16	11	17	11	8	3	3	9	8	11	3	1	0	0	2
Lynchburg Ferry C1015													14	10	4	6	0	0	2	1	1
Lake Jackson C1016													3	2	0	0	0	1	0	0	1
Conroe Relocated C78											1	3	7	2	2	7	0	1		0	1
Seabrook Friendship Park C45											2	4	8	8	8	4	4	1	0	2	0
Houston Monroe C406	13	10	7	7	22	5	28	12	21	12	3	7	8	6	13	7	2	0	2	0	0
Galveston Airport C34/C109/X152							18	13	23	5	3	4	12	8	2	2	0				
Clute C11/A111	8	10	6	5	15	3	4	5	9	2	3	6	3								
Texas City C10	6	1	9	7	25	1	10	10	11	6	1	3	3	0							
Houston Manchester C22	19	10	8	10	27	5	18														
Houston Deer Park C18	8	4	3	18	27	12															
Houston Crawford C407	5	6	7	4	15	3	16	10	11	8	0										
San Jacinto Monument											0	5	1								
Conroe C65									4	17	6										
Number of Monitors	13	13	13	14	14	14	15	15	16	17	23	21	23	21	20	21	22	21	20	21	21

Note: Monitors with exceedance days do not necessarily have a complete year of ozone data; therefore, there may be years where a monitor has ozone exceedance days but no ozone design value.

Table 5-5: Number of Days with a One-Hour Ozone Exceedance

Monitor	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Houston East C1	6	6	2	0	0	12	13	8	10	11	7	4	7	3	0	2	0	0		2	2
Houston Aldine C8/C108/C150	9	8	7	12	11	15	12	12	8	16	8	1	6	2	2	0	0	0		1	1
Manvel Croix Park C84											1	2	1	5	2	3	1	0	1		1
Houston Bayland Park C53								12	18	8	10	3	6	4	6	5	0	0	1		1
Houston Regional Office C81										6	7	3	5	1	3	2	0	0			1
Houston North Wayside C405	5	6	3	4	4	5	5	8	7	11	1	1	5	2	0	0	0	0			1
Galveston 99th St.																	0	0			1
Park Place C416																7	0	2	1	1	
Channelview C15/AH115											1	5	6	2	2	2	1	0	1	1	
Lynchburg Ferry C1015													9	7	6	1	0	0		1	
Houston Deer Park 2 C35							13	7	14	13	6	5	7	5	3	4	0	1	2		
Northwest Harris Co. C26	1	9	10	14	9	7	4	9	9	5	6	4	2	1	2	2	2	0	2		
Houston Texas Avenue C411											5	0	8	3	0	1	1	0	1		
Houston Monroe C406	8	6	3	3	11	2	15	8	10	5	5	5	3	2	5	3	0	0	1		
Houston Croquet C409	16	5	5	4	21	3	14	12	14	6	4	5	4	4	4	1	0	0	1		
Clinton C403/C304/AH113	13	8	7	4	15	6	8	7	13	8	7	3	6	2	1	0	0	0	1		
Lang C408	5	6	6	6	9	4	6	8	4	6	3	2	2	4	0	0	0	0	1		
Houston Westhollow C410				3	20	3	8	5	12	5	6	2	2	2	1	4	1	0			
Seabrook											3	4	5	3	3	2	1	0			
Conroe Relocated C78											0	1	2	1	1	2	0	0			
Lake Jackson C1016													1	0	0	0	0	0			
Galveston Airport C34/C109/X152							5	7	7	4	0	0	3	1	0	0	0				
Clute C11/A111	3	3	2	0	6	1	3	1	4	2	0	2	1								
Texas City C10	4	1	7	2	14	0	3	3	7	3	0	0	1	0							
San Jacinto Monument											0	2	0								
Conroe C65									1	5	2										
Houston Crawford C407	5	4	5	3	9	4	11	12	5	8	0										
Houston Manchester C22	11	7	7	7	18	4	10														
Houston Deer Park C18	6	2	1	6	18	4															
Number of Monitors	13	13	13	14	14	14	15	15	16	17	23	21	23	21	20	21	22	21	20	21	21

Note: Monitors with exceedance days do not necessarily have a complete year of ozone data; therefore, there may be years where a monitor has ozone exceedance days but no ozone design value.

The ozone season spans the entire year in the HGB area; the period of elevated ozone concentrations, however, varies from year to year. Figure 5-7: *1997 Eight-Hour Ozone Exceedance Days in the HGB Area* shows the frequency of and variation in, the number of 1997 eight-hour ozone NAAQS exceedance days in the HGB area by month and year. While the duration and intensity of the ozone season does vary from year to year, in the past few years, the HGB area has experienced fewer ozone exceedance days over fewer months. The darker areas in the figure show that peak ozone season in the HGB area typically occurs from August through September, with a smaller, secondary peak occurring earlier, roughly in June.

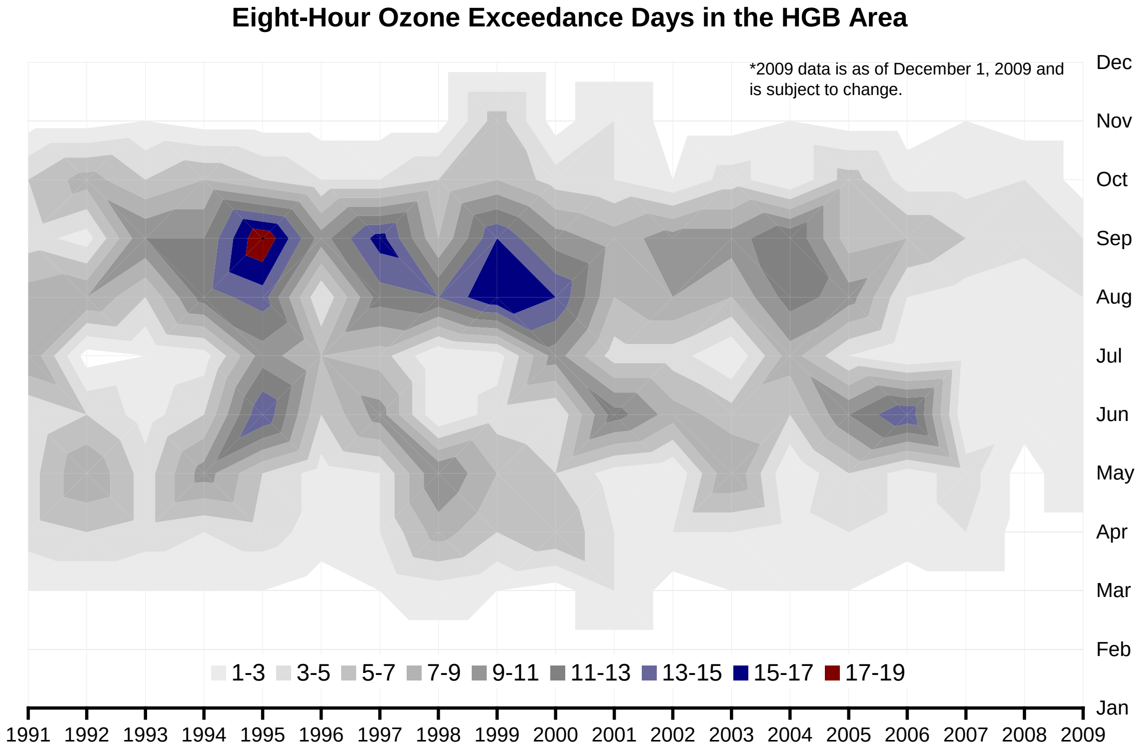


Figure 5-7: 1997 Eight-Hour Ozone Exceedance Days in the HGB Area

In summary, the number of ozone exceedances in the HGB area has been dropping, especially since 2000.

5.3.2 Ozone Trends at Regulatory and Non-Regulatory Monitors (Updated)

As of 2011, 23 monitors in the HGB area report ozone concentrations following EPA certification protocols and are used for attainment determinations for regulatory purposes. Since 2003, over 20 additional monitors have become operational in the HGB area that measure ozone concentrations following protocols that have not been certified to EPA standards. Table 5-6: *Eight-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors* (No change from 2010 HGB AD SIP revision) and Table 5-7: *One-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors* (No change from 2010 HGB AD SIP revision) list both the regulatory and non-regulatory monitors in the HGB area, along with ozone design values. Usually, non-regulatory monitors undergo fewer quality control checks than are performed for regulatory monitors. These non-regulatory monitors are located throughout the HGB area. Locations were chosen with the aim of ensuring that all episodes of elevated ozone and precursors are observed. These additional non-regulatory monitoring sites also help describe the spatial extent and distribution of high ozone more fully than regulatory monitors alone. While non-regulatory monitors are not acceptable for making regulatory determinations, these monitors help describe spatial patterns of ozone more completely and thus provide a broader perspective on trends in ozone concentrations across the HGB area. Figure 5-8: *Distributions of Eight-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors in the HGB Area* compares eight-hour ozone design values at regulatory and non-regulatory monitors in the HGB area from 2003 through 2011. This period was chosen because many non-regulatory monitors only became operational, or had complete data, in 2003 and later years. The distributions of eight-hour ozone design values decreased for both types of monitors over the nine-year period, and the interquartile range, a measure of spread between high and low values, narrowed considerably for both. This indicates that there has been less variability in eight-hour design values in recent years. The annual median eight-hour ozone design value decreased from 90 ppb in 2003 to 78 ppb in 2011 at regulatory monitors, a decrease of 13.3%. The median at non-regulatory monitors decreased from 89 ppb to 80 ppb over the same period, a 10.1% decrease.

While medians and other statistics from the distributions all decreased over the 2003 through 2011 period, the annual maximum of all eight-hour ozone design values, termed the design value of record, is most relevant as this value is the current standard used for regulatory attainment determinations. The annual maximum eight-hour ozone design value measured at regulatory monitors decreased from 102 ppb in 2003 to 89 ppb in 2011, a decrease of 12.7%. The annual maximum at non-regulatory monitors decreased from 96 ppb in 2005, when three-year design values were first computable, to 84 ppb in 2011, a decrease of 12.5%. Note the maximum eight-hour design values at non-regulatory monitors in 2006 and 2007 were substantially higher than in other years, 104 ppb and 100 ppb respectively. Ozone design values for those two years were influenced by the fourth high value observed at Wallisville Road (CAMS 617) in 2006 (111 ppb). Even though this 2006 fourth high value continued to influence the 2008 design value, when averaged with the 2008 fourth high value of 85 ppb, the three-year average decreased to 94 ppb, a 6% decline in a single year. An even larger decline occurred the next year, 2009. This pattern was also observed at regulatory monitors, with a 5.2% decline from 2007 through 2008 and a larger 7.7% decline from 2008 through 2009. These declines appear to have leveled off more recently, with increases of 5.9% and 1.2% observed in 2011 at regulatory and non-regulatory monitors, respectively. However, 2011 was a period of record drought and high temperatures.

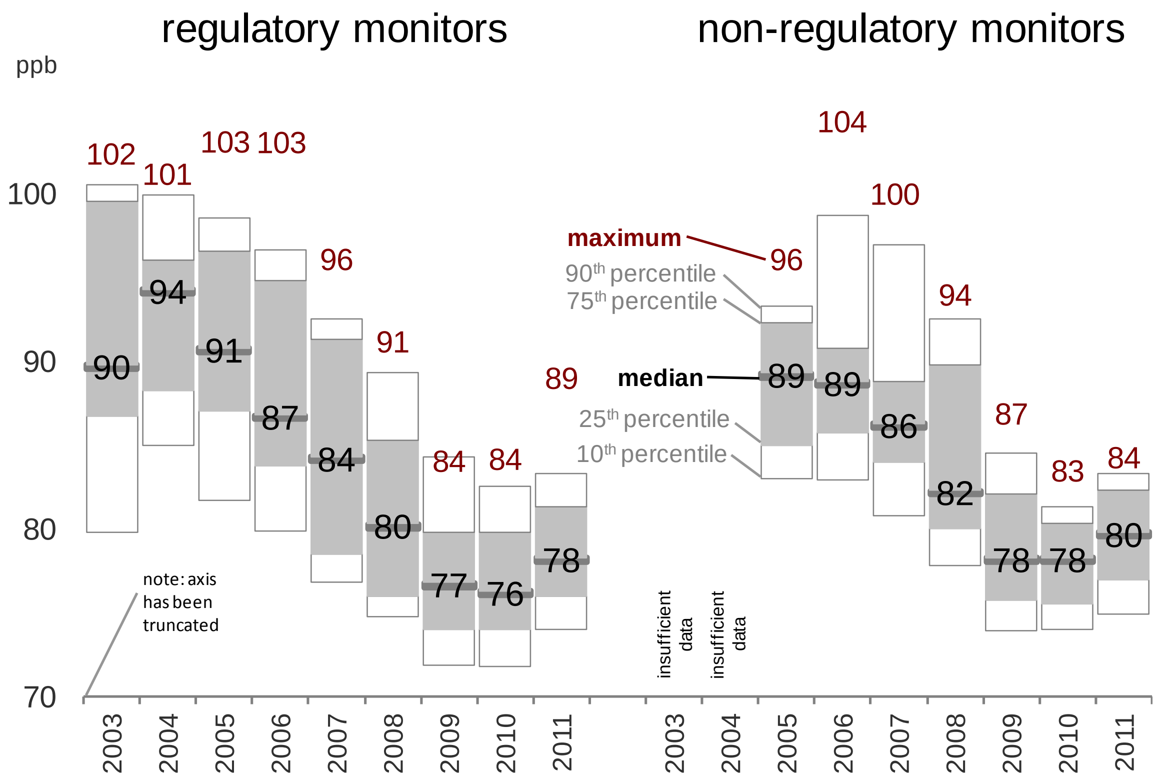


Figure 5-8: Distributions of Eight-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors in the HGB Area

From Figure 5-8, it appears that ozone design values computed for non-regulatory monitors are similar to design values computed for regulatory monitors. Though the sample size is small, a simple two sample t-test ($t = 0.11$, not significant at $\alpha = 0.05$) suggests that the means of the regulatory and non-regulatory monitors are not statistically different and, therefore, the two sets of monitors are measuring roughly the same phenomena. Figure 5-9: *Distributions of One-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors in the HGB Area* compares one-hour ozone design values at regulatory and non-regulatory monitors in the HGB area from 2003 through 2011. This period was chosen because many non-regulatory monitors became operational or had complete data only in 2003 and later years. The one-hour design value is computed as the fourth highest one-hour value observed among all values during each rolling three calendar-year period. The distributions of one-hour ozone design values decreased for both types of monitors over the nine-year period and the spread between high and low values narrowed for both. The annual median one-hour ozone design value decreased from 141 ppb in 2003 to 114 ppb in 2011 at regulatory monitors, a decrease of 19.1%. The median at non-regulatory monitors decreased from 137 ppb to 114 ppb over a shorter time period, 2005 through 2011, a 16.8% decrease. While medians and other statistics from the distributions all decreased over the period, the annual maximum one-hour ozone design value continues to be relevant, as this design value would be compared to the one-hour ozone NAAQS to determine attainment, were the one-hour standard still in effect. The annual maximum one-hour ozone design value measured at regulatory monitors decreased from 175 ppb in 2003 to 125 ppb in 2011, a decrease of 28.6%. The annual maximum at non-regulatory monitors decreased from 169 ppb to 125 ppb over the 2005 through 2011 period, or a decrease of 26.0%.

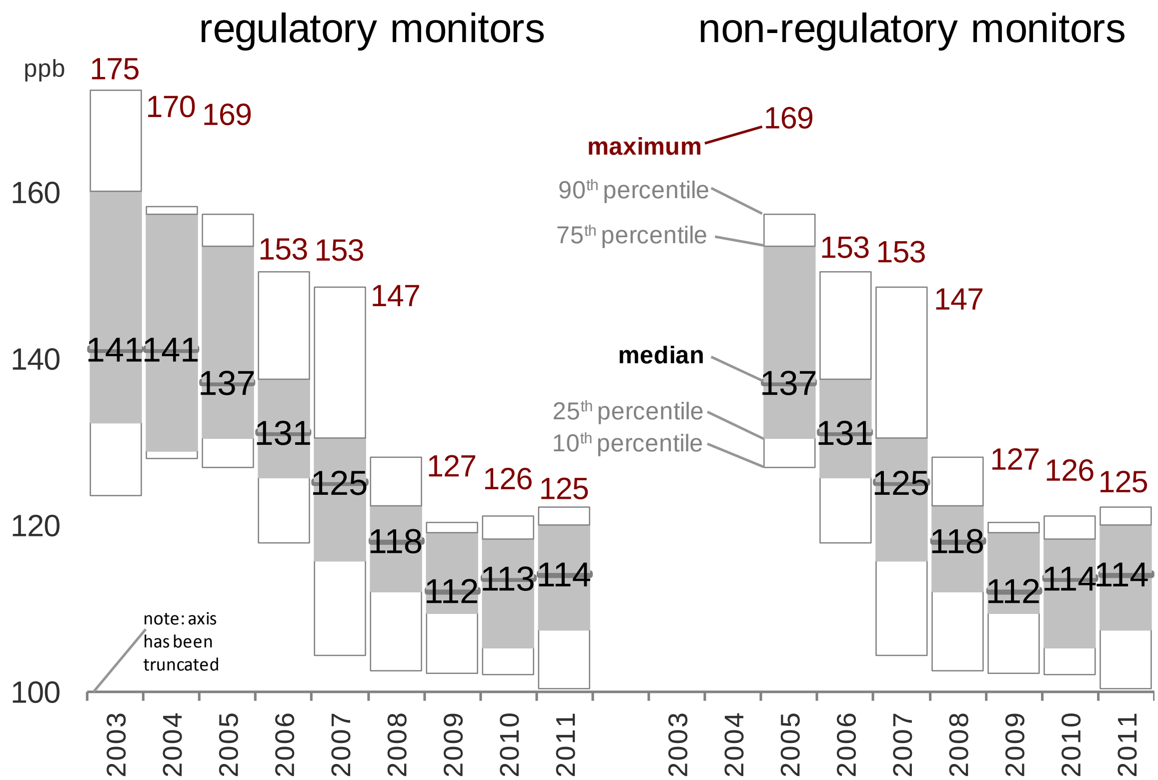


Figure 5-9: Distributions of One-Hour Ozone Design Values at Regulatory and Non-Regulatory Monitors in the HGB Area

Figure 5-10: *1997 Eight-Hour Ozone Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011* presents the number of days per year from 2003 through 2011 that the 1997 eight-hour ozone NAAQS was exceeded in the HGB area at regulatory monitors and at all monitors, both regulatory and non-regulatory. From 2005 through 2009, the combined network recorded a total of 19 additional exceedances of the 1997 eight-hour ozone standard that would not have been captured by the regulatory network, i.e., about four to five per year. This result confirms earlier findings that suggest as the monitoring network has expanded, fewer episodes of elevated ozone concentrations are likely to elude detection.

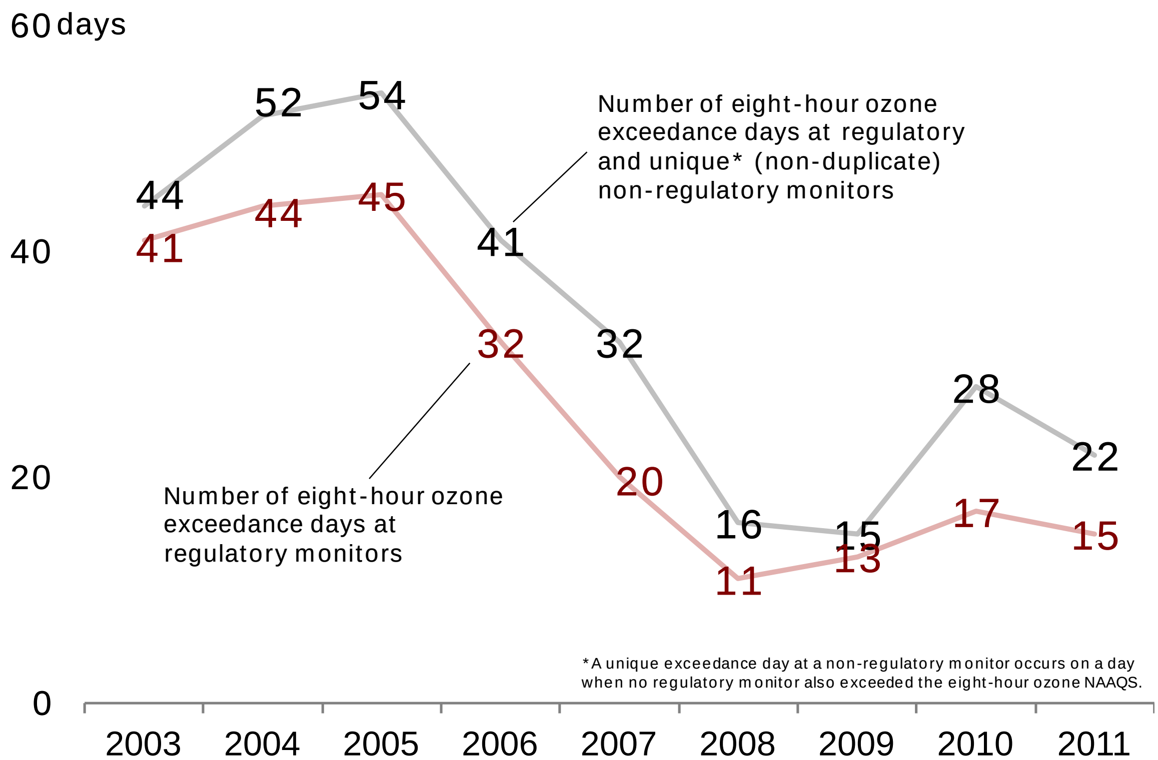


Figure 5-10: 1997 Eight-Hour Ozone Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011

Figure 5-11: *One-Hour Ozone Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011* presents the number of days per year from 2003 through 2011 that the one-hour ozone NAAQS was exceeded in the HGB area at all monitors, both regulatory and non-regulatory. The number of exceedance days is also illustrated in Table 5-8: *Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011*. Both series initially increased, then decreased at similar rates throughout the period, suggesting that the two sets of monitors measure broadly similar phenomena. During the first half of the period, non-regulatory monitors measured from five to eight additional exceedance days that were not detected by regulatory monitors. However, in the second half of the 2003 through 2011 period, that gap decreased to only two to three additional days, indicating that non-regulatory monitors are detecting fewer and fewer events not detected by regulatory monitors. This result confirms earlier findings suggesting that as the monitoring network expands, fewer episodes of elevated ozone concentrations are likely to elude detection. Monitors that recorded the maximum one-hour ozone design value are examined in Table 5-9: *Monitors Recording the Annual Maximum One-Hour Ozone Design Value*. In most instances, the maximum one-hour ozone design value is recorded by a regulatory monitor. During 2010, the peak one-hour ozone design value was at the non-regulatory Jones Forest (CAMS 698) monitor; this monitor samples air at the top of a 56-meter (184-foot) tall tower, and it routinely observes higher ozone concentrations than the regulatory monitors; therefore, it may not be representative of ground-level ozone.

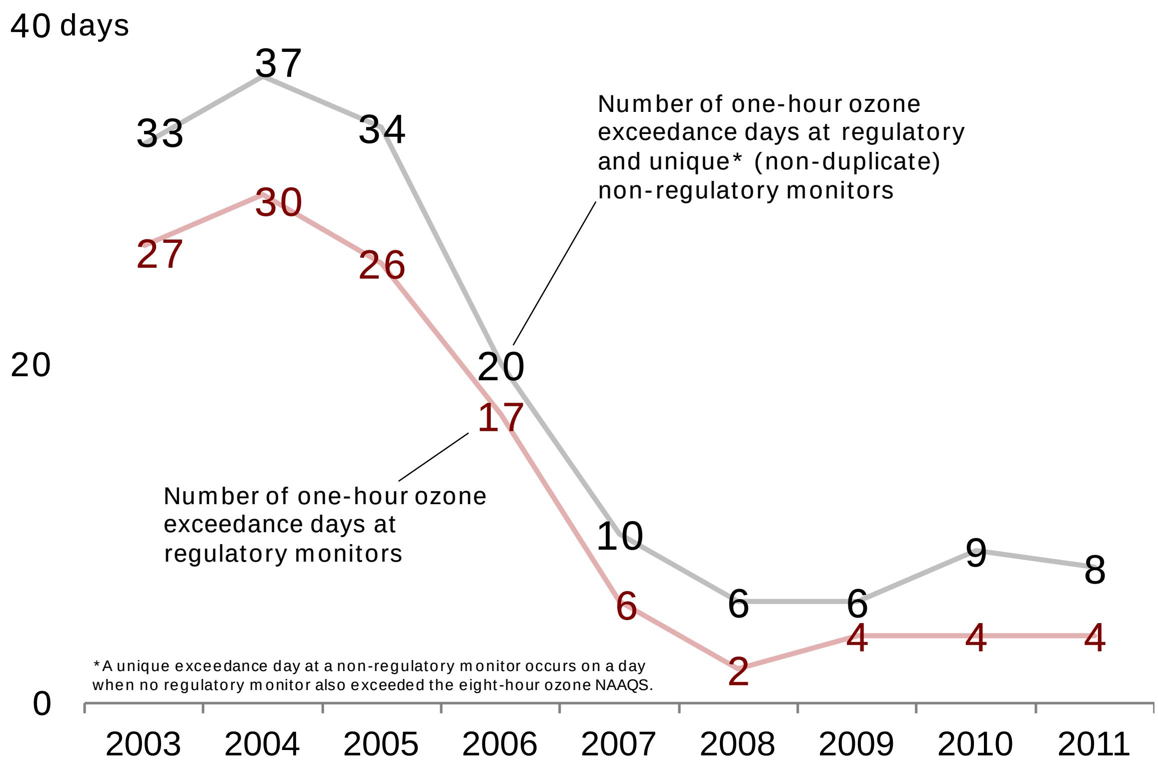


Figure 5-11: One-Hour Ozone Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011

Table 5-8: Exceedance Days at Regulatory and Non-Regulatory Monitors, 2003 through 2011

Year	Number of one-hour ozone exceedance days at regulatory monitors	Number of eight-hour ozone exceedance days at regulatory monitors	Total number of one-hour ozone exceedance days	Number of regulatory monitors	Number of non-regulatory monitors	Total number of monitors
2003	31	2	33	24	13	37
2004	32	5	37	23	19	42
2005	28	6	34	23	19	42
2006	18	2	20	24	19	43
2007	9	1	10	24	19	43
2008	3	3	6	24	19	43
2009				24	20	44
2010				24	24	48
2011				24	24	48

Source: Leading Environmental Analysis and Display System (LEADS).

Table 5-9: Monitors Recording the Annual Maximum One-Hour Ozone Design Value

Year	Regulatory monitors	Annual maximum one-hour ozone design value (ppb)	Non-regulatory monitors	Annual maximum one-hour ozone design value (ppb)
2003	Houston Bayland Park C53	163	HRM-3 Haden Road C603	161
2004	Houston Deer Park 2 C35/139	157	HRM-3 Haden Road C603	161
2005	Houston Deer Park 2 C35/139	153	Sheldon C551	150
2006	Houston Deer Park 2 C35/139	150	La Porte Sylvan Beach C556	149
2007	Houston Deer Park 2 C35/139	150	La Porte Sylvan Beach C556	149
2008	Houston Deer Park 2 C35/139	147	Tom Bass C558	138
2009	Houston Bayland Park C53/A146	157	Bunker Hill Village C562	146
2010	Lynchburg Ferry C1015/A165	130	UH WG Jones Forest C698	149
2011	Galveston 99th St. C1034/A320/X183	140	UH WG Jones Forest C698	132

Source: Leading Environmental Analysis and Display System (LEADS).

Another way to see the ozone trend in the HGB area is to examine how spatial distributions of ozone have changed over the years. Figure 5-12: *Eight-Hour Ozone Design Values for 2000, 2005, and 2011* shows the spatial distribution of eight-hour ozone design values in the HGB area, for regulatory monitors only, and the changes that have occurred from 2000 through 2005, and to 2011. In 2000, local peaks in design value were observed at Houston Aldine (CAMS 8), Houston Bayland Park (CAMS 53), and Deer Park (CAMS 35/139), and all three peaks were 110 ppb or higher.

By 2005, eight-hour ozone design values had decreased across the region. While the highest concentrations still occurred at Houston Bayland Park (CAMS 53) and Deer Park (CAMS 35/139), these concentrations were no longer observed in the Houston Aldine (CAMS 8) area. Further, the 2005 peaks were much lower, between 100 and 103 ppb. The lowest eight-hour ozone concentration was still observed at Lang (CAMS 408), but low ozone also occurred to the northeast at Houston North Wayside (CAMS 405), to the north at Conroe (CAMS 65) or Conroe Relocated (CAMS 78), and to the south at Galveston Airport (CAMS 34/CAMS 109/CAMS 154). The minimum eight-hour ozone concentration in 2005 was below the 1997 eight-hour NAAQS.

By 2011, eight-hour ozone design values had decreased even further. Ozone concentrations are substantially lower across a large part of the HGB area, with the kriging model predicting design values below the 1997 eight-hour ozone NAAQS at all locations. Maximum eight-hour ozone concentrations are now considerably lower, between 84 ppb and 89 ppb. The highest measurement of 89 ppb occurred at Manvel Croix Park (CAMS 84). Eight-hour ozone concentrations in 2011 are lower throughout the HGB area, with local ozone minimums located in the urban core area surrounding the Lang (CAMS 408), Houston North Wayside (CAMS 405), Houston Texas Avenue (CAMS 411), Clinton (CAMS 113/CAMS 304/CAMS 403), and the Houston Regional Office (CAMS 81) monitors. Across the board, the ozone concentrations have decreased substantially since 2000. Spatial interpolation shows that high ozone concentrations continue to occur south of downtown Houston, and stretch from the Houston Ship Channel in the east to west Houston, near Houston Bayland Park (CAMS 53). The lowest ozone values of 73 to 75 ppb are found to the south along the coast and at the northern edge of the nonattainment area towards Conroe (CAMS 65).

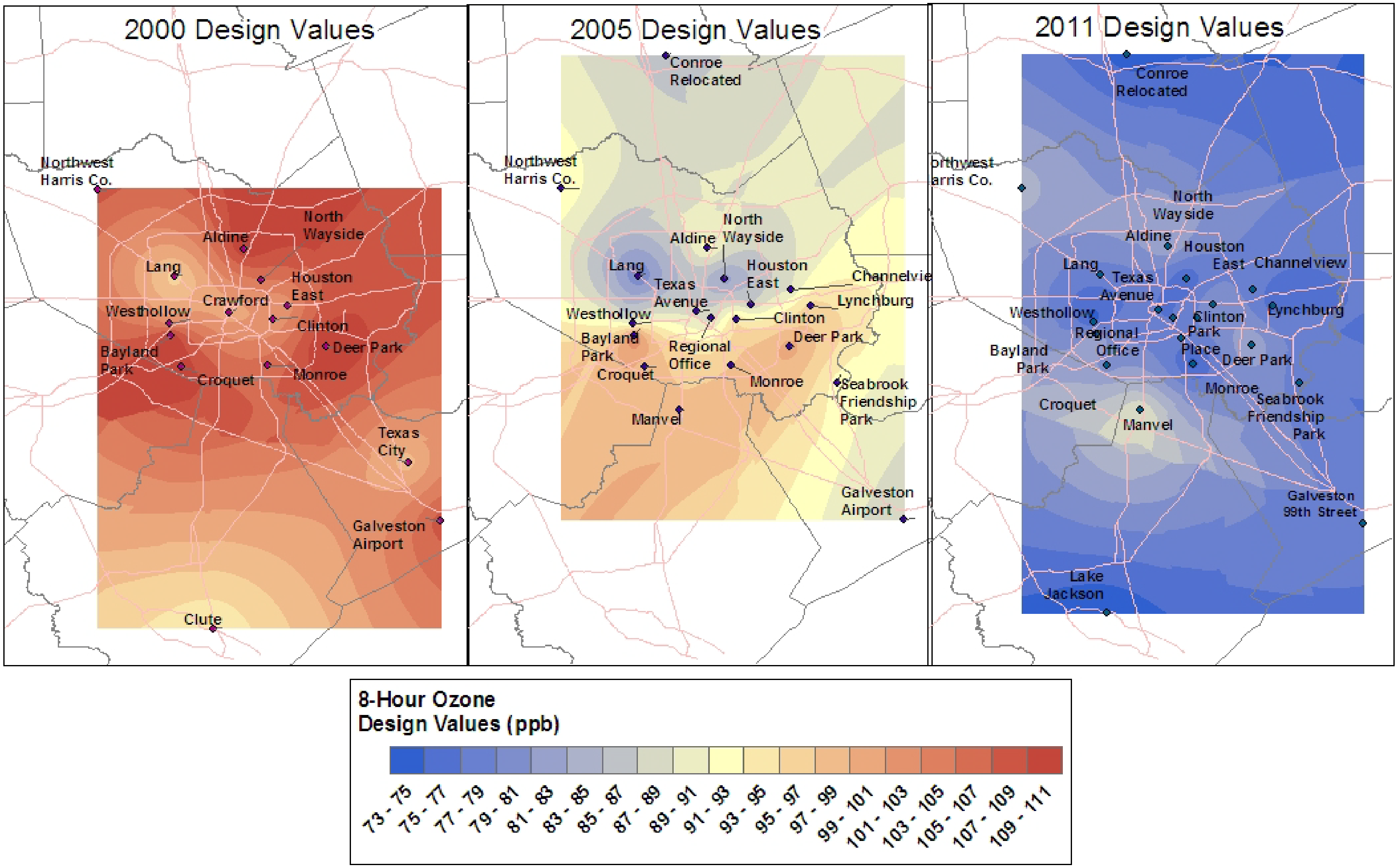


Figure 5-12: Eight-Hour Ozone Design Values for 2000, 2005, and 2011

The coastal and northern monitors are often influenced by low background concentrations; the Lang site is lower due to titration of ozone by fresh nitric oxide (NO) emissions from the urban core.

The kriging method can also be employed to investigate geographic origins of high ozone concentrations. Studies during the Texas Air Quality Study 2000 (TexAQS 2000) reported that the highest ozone in the HGB area occurs in plumes emanating from industrial areas (Daum et al., 2004; Kleinman et al., 2005; Ryerson et al., 2003; Berkowitz et al., 2005; Banta et al., 2005). As these plumes are transported across the region, they can be tracked by the high ozone concentrations recorded at successive downwind monitors as the day progresses. An analysis of the time of day of maximum ozone at each monitoring site can confirm or challenge conclusions of the field study about these origins by revealing spatial patterns of ozone formation and movement.

Yet another way to examine ozone behavior in the HGB area is to investigate the time of day that ozone peaks, on average, in each part of the monitoring network. Daily maximum ozone concentrations were divided into two groups: days with values exceeding the 1997 eight-hour ozone NAAQS, and days not exceeding the 1997 eight-hour ozone NAAQS. The time of day when peak ozone was recorded at each monitor was determined for each day and then averaged across the two groupings of days. Only monitors that report data to the EPA were included. Days were restricted to March through November to exclude months when few or no exceedance days occur in the HGB area.

Maps of the time of peak ozone in the HGB area, averaged from March through November 1998 through 2008, are found in Figure 5-13: *Time of Day of Peak Hourly Ozone on Low and High Ozone Days*. The left-hand map shows that on days with low eight-hour ozone values, daily maximum values are recorded in the Galveston area early in the day, between 11:30 a.m. and 11:45 a.m. Inland monitors record their highest daily values at progressively later times of day, as monitors are located farther inland from the Gulf Coast. On low ozone days, the earliest ozone maxima occur near the coast, and the latest occur in the Conroe area between 2:00 p.m. and 2:15 p.m. This pattern of ozone concentrations is consistent with occurrence of the sea breeze, which often dominates local weather during summers in the absence of strong synoptic-scale weather influences. After a plume is carried past a monitor, ozone levels often decrease, reflecting cleaner maritime air behind the sea breeze front.

By contrast, the right-hand map of the daily pattern on high eight-hour ozone days looks quite different. Daily maximum ozone concentrations are observed earliest in the industrial areas, and successively later at sites that are progressively farther away from these areas. This pattern indicates that high ozone is measured earliest in the industrial areas, and is measured later in the day at urban, suburban, and rural sites later in the day. Maximum ozone occurs latest at Lake Jackson (CAMS 1016), Clute (CAMS 11), Northwest Harris Co. (CAMS 26), Conroe (CAMS 65), and Conroe Relocated (CAMS 78), between 15:00 and 16:00, i.e., at the sites at the greatest distance from the industrial area.

The time of day of maximum ozone on high eight-hour ozone days represents a composite pattern; high ozone formed in industrial areas is carried by winds to Conroe (CAMS 65) and Conroe Relocated (CAMS 78) on some days, to Lake Jackson (CAMS 1016) on other days, and to western Houston [e.g., Bayland Park (CAMS 53), Manvel Croix (CAMS 84)] on other days. Combined with the earlier spatial analysis of design values, the patterns of peak ozone appear to show that the highest ozone concentrations are formed in the vicinity of the heavily industrialized areas of metropolitan Houston and are then transported throughout the area.

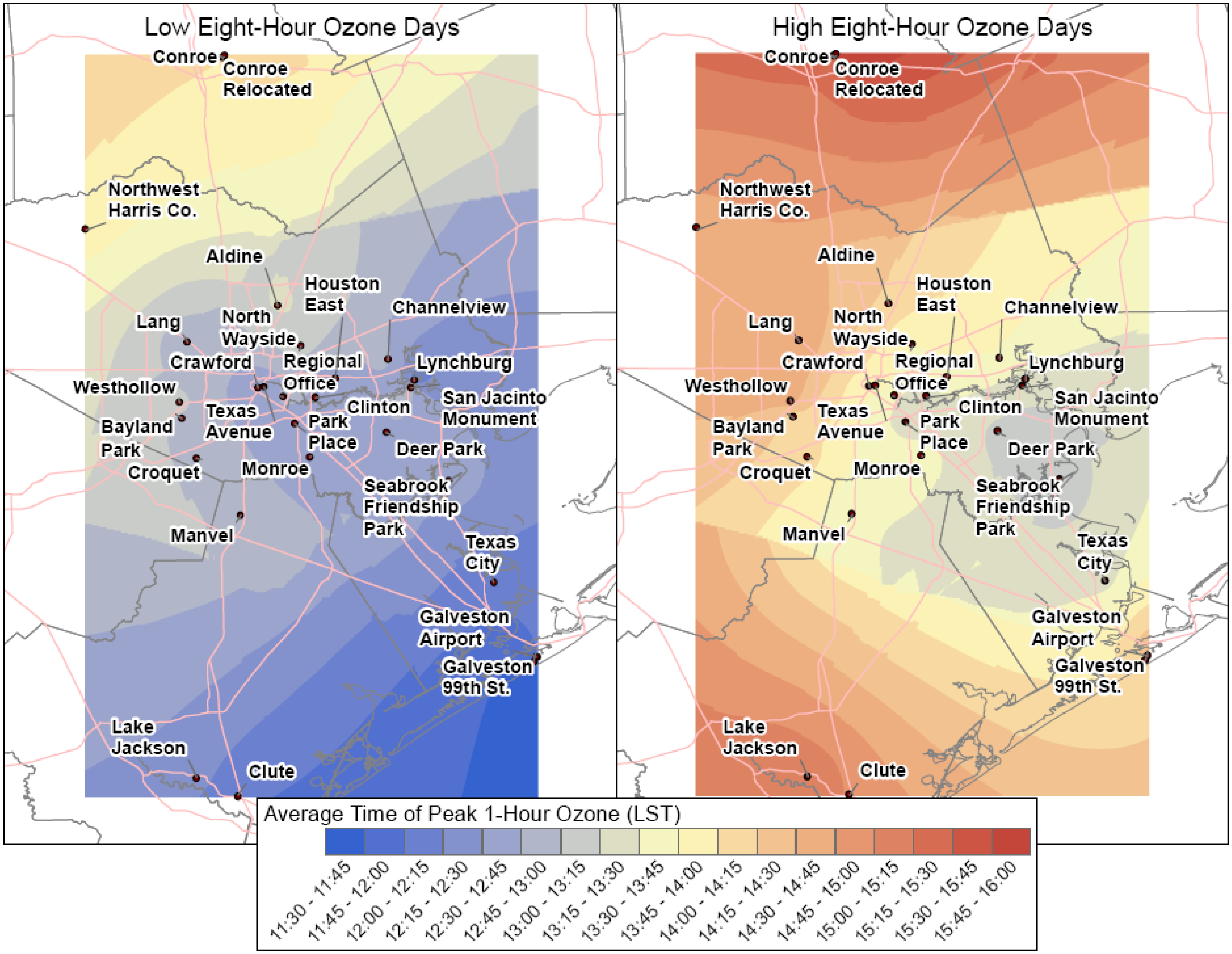


Figure 5-13: Time of Day of Peak Hourly Ozone on Low and High Ozone Days

5.3.3 Trends in the Strength of Observed Ozone Gradients in the HGB Area (Updated)

Rapid ozone increases, on the scale of less than one hour up to several hours, have been observed at HGB area monitoring sites for many years, but the phenomenon was not sufficiently explained until the TexAQS 2000. Researchers from Brookhaven National Laboratory and National Oceanic and Atmospheric Administration (NOAA) Aeronomy Laboratory were able to establish that rapid ozone increases were due to strong spatial ozone gradients that arose when ozone formed very rapidly in industrial plumes. Rapid ozone formation observed by Daum et al. (2003, 2004) allowed ozone to build up in plumes before ozone and its precursors could disperse. Shifting winds due to the coastal oscillation or bay/Gulf breeze phenomena pushed strong ozone gradients over monitoring sites, resulting in observations of rapid ozone increases (Banta et al., 2005). Rapid ozone formation occurs when industrial highly reactive volatile organic compounds (HRVOC) react with co-emitted NO_X (Ryerson et al., 2003; Wert et al., 2003). The following analysis examines whether the strength of these ozone gradients has lessened, as measured by the magnitude of one-hour changes in ozone observed at monitoring sites.

One-hour changes in ozone concentrations examined for each hour at each site for each year. The maximum daily peak change in ozone concentration was chosen for each day, and various statistical measures were calculated from those values. Not all sites were included in this analysis; only those with long operating histories were included.

Figure 5-14: *Trends in the Strength of Ozone Gradients Measured in the HGB Area from 1995 through 2011* shows how the daily maximum one-hour change in ozone has changed since 1995 in the HGB area. While at the mean and median, the change is slight, the steepest observed ozone gradients have declined dramatically since 1995, decreasing by 30 to 40%.

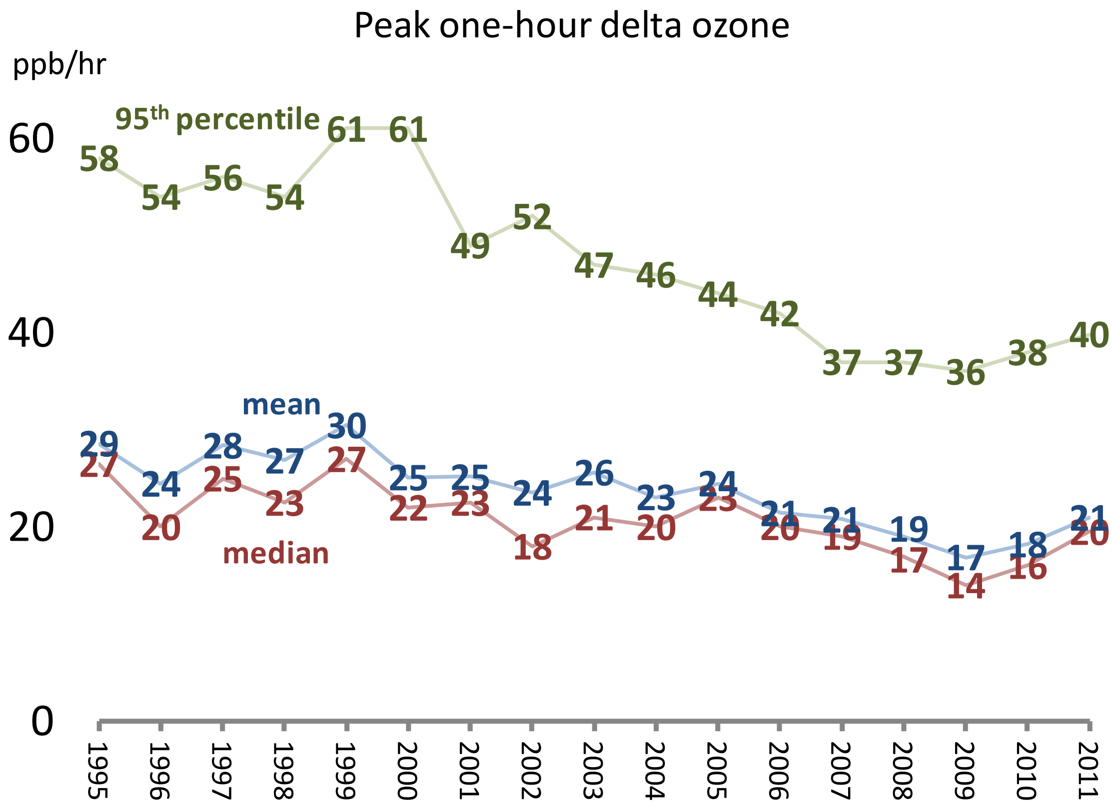


Figure 5-14: Trends in the Strength of Ozone Gradients Measured in the HGB Area from 1995 through 2011

Figure 5-15: *The Number of Occurrences of One-Hour Increases in Ozone Greater Than 40 ppb/hr in the HGB Area for the Subset of Monitors with Long Historical Records* shows that the number of strong ozone gradients observed by monitoring sites in the HGB area has also decreased substantially since the 1990s, matching the general trends in decreasing ozone concentrations. The intensity of ozone gradients has decreased, and the frequency of strong ozone gradient observations has also decreased, which strongly suggests that ozone is forming less rapidly in the HGB area than in previous years. This change in ozone behavior is consistent with decreasing reactivity of VOC emitted in the HGB area. Note that the intensity of ozone gradients can depend upon meteorological factors as well as chemical factors. This analysis has not examined the importance of meteorological factors upon the observed trends. Subsequent sections will discuss trends in HRVOC concentrations.

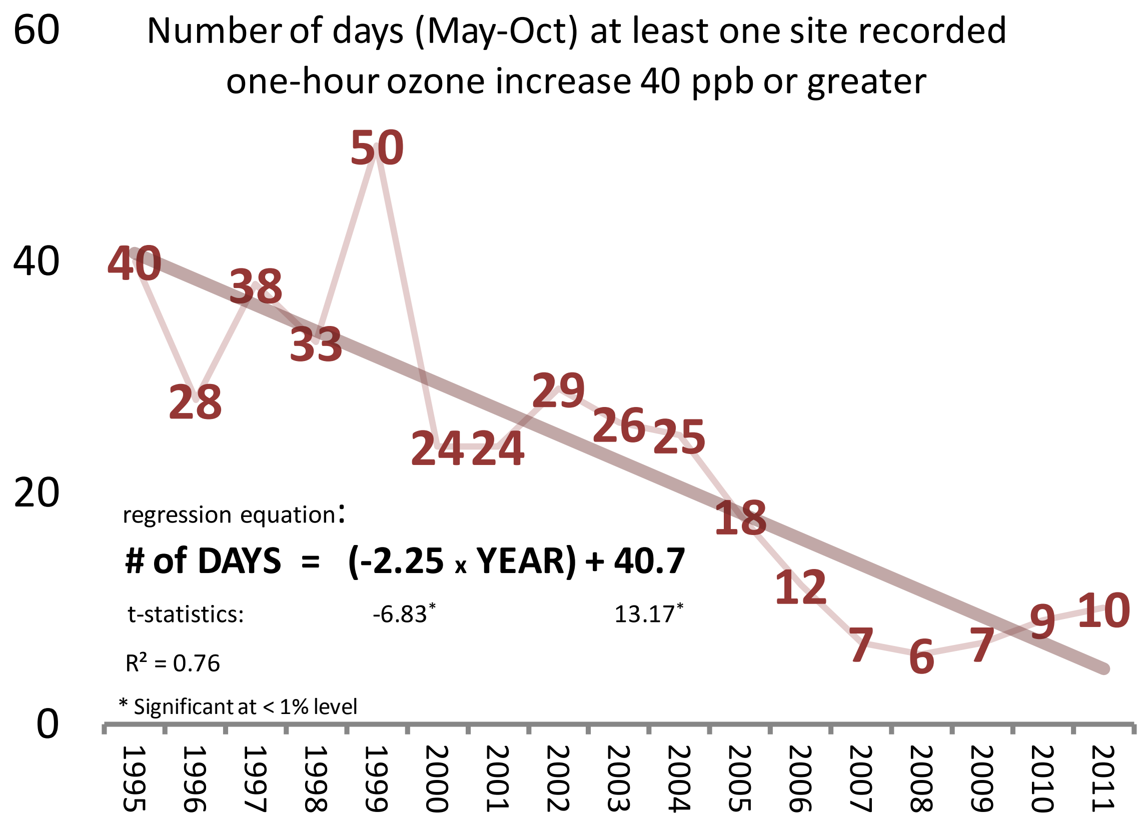


Figure 5-15: The Number of Occurrences of One-Hour Increases in Ozone Greater Than 40 ppb/hr in the HGB Area for the Subset of Monitors with Long Historical Records

5.3.4 The Impact of Hurricane Ike on Ozone Observations in the HGB Area (No change from 2010 HGB AD SIP Revision)

5.3.5 NO_X Trends (Updated)

NO_X, or nitrogen oxides, are a variable mixture of NO and nitrogen dioxide (NO_2) and are critical precursors to ozone formation. As NO_X emissions decrease, ambient concentrations of these compounds should also decrease. NO_X are primarily created by fossil fuel combustion, lightning, biomass burning, and microbial action in soil.

Previous analyses performed using aircraft measurements and emission inventories obtained during the TexAQS 2000 and Texas Air Quality Study 2006 (TexAQS II) indicate that NO_X emissions in the Houston Ship Channel area have decreased between 2000 and 2006 (Cowling et al., 2007). Furthermore, aircraft data obtained during the two field studies were in agreement with data measured by continuous emission monitoring systems (CEMS) located at regulated facilities. Analyses done by the Rapid Science Synthesis Team of the TexAQS II indicate that NO_X emissions at several electric generating units (EGU) have decreased by factors ranging from two to four between 2000 and 2006 (Cowling et al., 2007). These reductions were seen at EGUs that implemented NO_X control features, such as selective catalytic reduction, between 2000 and 2006, which suggests these control strategies are effective. The two field studies effectively describe emissions during two short time windows, six years apart. To complement these analyses, the TCEQ has performed a more comprehensive investigation of long-term trends in NO_X concentrations.

Daily peak one-hour NO_X from all monitors in the HGB area from 1990 through 2011 is plotted in logarithmic format in Figure 5-19: *Daily Peak Hourly NO_X in the HGB Area*. A logarithmic transformation is often used when a data series is highly skewed, with a few very high values and many very low ones. The increasing density of NO_X data points shows that the number of NO_X monitors in the HGB area has greatly increased since 1990. Annual maxima, annual 90th percentile and annual average NO_X values are also plotted in the figure. Three insets show these three measures in linear, not logarithmic, format to highlight downward trends. Note that the scales are different for each. All three measures have decreased markedly over the 1990 through 2011 period, declining 52% (maximum), 72% (90th percentile), and 73% (mean). Even more remarkable may be the 37%, 49%, and 47% declines just since 1999.

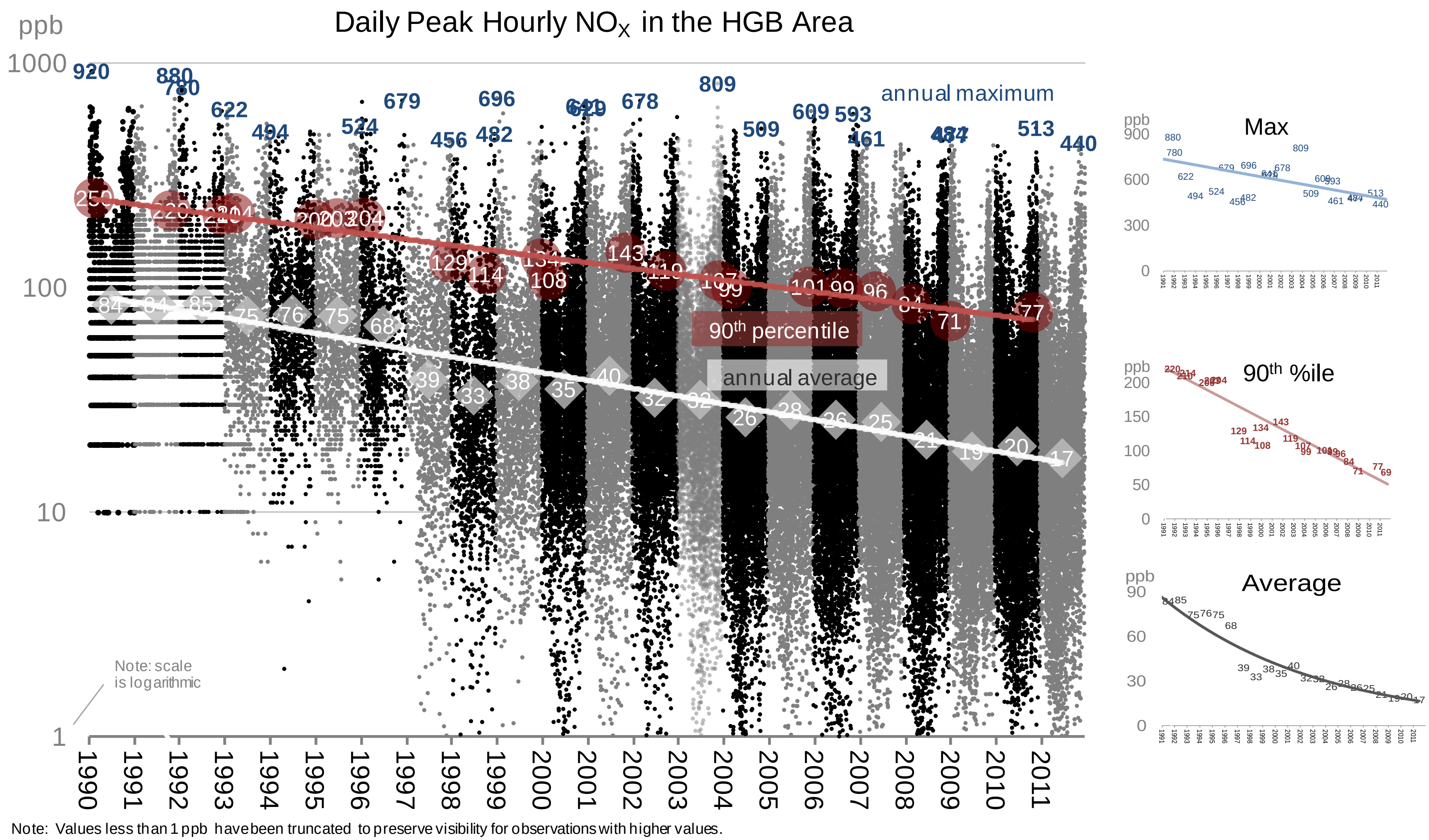


Figure 5-19: Daily Peak Hourly NO_X in the HGB Area

Table 5-13: *NO_X Values in the HGB Area by Year* shows the degree of decrease in NO_X concentrations from 1990 through 2011 and 1999 through 2011.

Table 5-13: NO_X Values in the HGB Area by Year

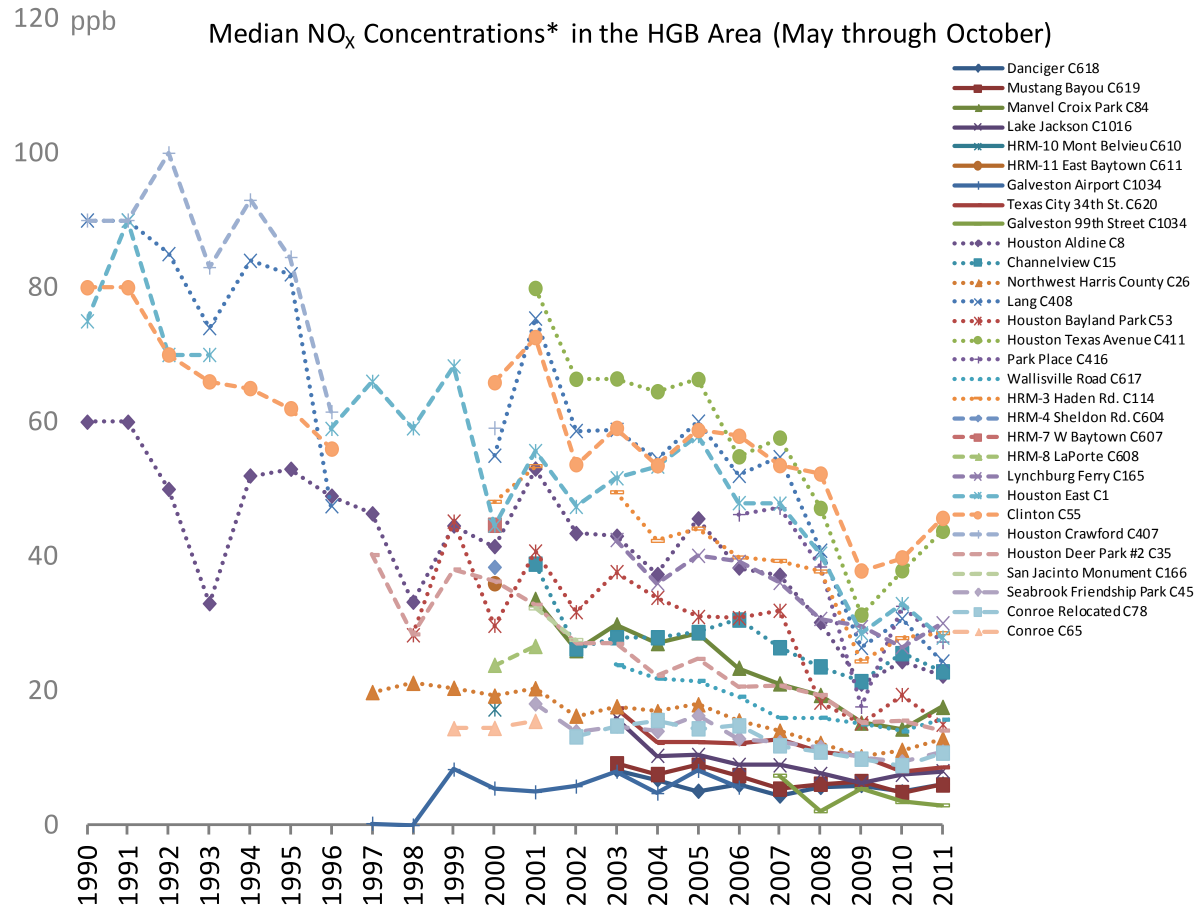
Year	Annual average NO_X (ppb)	Annual maximum NO_X (ppb)
1990	115	920
1991	110	880
1992	110	780
1993	103	622
1994	98	494
1995	99	524
1996	94	679
1997	58	456
1998	49	482
1999	58	696
2000	53	641
2001	65	629
2002	54	678
2003	50	809
2004	44	509
2005	46	609
2006	45	593
2007	43	461
2008	37	484
2009	32	477
2010	34	513
2011	31	440
	Overall decrease, through 2011 (%)	**Overall decrease through 2011 (%)**
Since 1990	-73.5	-52.2
Since 1999	-47.2	-36.8
	Annual decrease through 2011 (%)	**Annual decrease through 2011 (%)**
Since 1990	-6.1	-3.5
Since 1999	-5.2	-3.8

Note: Annual decreases are computed as compound annual rates.

Though highly variable from season to season, daily peak hourly NO_X also shows a general decreasing trend since 1990 through 2011. Maximum NO_X concentrations have decreased overall by 36.8% since 1999, an average of roughly 23 ppb, or 3.8%, per year. The decrease since the 1990 high of 920 ppb is 52.2% or 3.5% annually through 2011.

Average daily peak hourly NO_X has decreased even more precipitously, declining 73.5%, or 6.1% per year since the series high of 115 ppb in 1990 through 2011. Since 1999, average daily peak hourly NO_X has decreased 47.2% or 5.2% annually, from 58 ppb to 31 ppb through 2011.

While the highest NO_X values tend to occur in winter, NO_X values during summer months, when ozone production is highest, are of particular interest. Trends in median hourly NO_X concentrations at individual monitors in the HGB area from May through October, 1998 through 2011, are shown in Figure 5-20: *Median NO_X Concentrations in the HGB Area*. Sites with less than 75% complete data for a year were not plotted for that year.



*Computed as the median of all peak daily NO_X concentrations.

Figure 5-20: Median NO_X Concentrations in the HGB Area

Median NO_X values tend to vary from year to year, but most monitors show overall decreases in median NO_X since 1998. Monitors that show the smallest decreases or show no change are at sites that have traditionally had lower NO_X concentrations. Some of the largest median NO_X concentrations were measured at the Lang (CAMS 408) monitor [in close proximity to United States (U.S.) Highway 290], and at the Houston Texas Avenue (CAMS 411) monitor (in downtown Houston) from 2000 through 2011. These monitors are both near major roadways. Similar trends from these monitors suggest there may be measured decreases in NO_X emissions from mobile sources. Monitors that are influenced by the sea breeze [e.g., Galveston Airport

(CAMS 34/C109/C154), Seabrook Friendship Park (CAMS 45), and Lake Jackson (CAMS 1016)] generally measured the lowest median NO_X concentrations from 2000 through 2011.

Sites recording the highest ozone design values, for example, Houston Bayland Park (CAMS 53) and Park Place (CAMS 416), are not necessarily the sites with the highest median NO_X concentrations. Sections 5.3.2: *Ozone Trends at Regulatory and Non-Regulatory Monitors* and 5.3.5: *NO_X Trends* showed that, in 2008, Houston Bayland Park (CAMS 53) had the highest eight-hour ozone design value in the HGB area of 91 ppb, yet during that year, it had a lower median NO_X concentration than many other sites in the area. This observation is consistent with behavior expected from ozone chemistry; in addition to being an ozone precursor, NO also reacts directly with ozone and in areas with high NO emissions, can destroy more ozone than it creates. Downwind from the high emission areas, however, ozone destroyed by reaction with NO can re-form.

The largest decreases in NO_X since 1998 (see Table 5-14: *Median and 90th Percentile Hourly NO_X Values*) were observed at monitors primarily influenced by mobile source emissions, rather than industrial sources. Clinton (CAMS 403/CAMS 113/CAMS 304) and Houston East (CAMS 1), which are located near both industrial sources and highways, have seen larger decreases in median NO_X values than in 90th percentile values since 1998. At Houston East (CAMS 1), the 90th percentile value decreased 60%, while the median decreased 65% between 1998 and 2011. The Clinton (CAMS 403/CAMS 113/CAMS 304) monitor experienced a decrease of 47% in the 90th percentile, with a 57% decrease in the median, between 1998 and 2011.

Table 5-14: Median and 90th Percentile Hourly NO_X Values

Monitor	Median NO_X, 1990 (ppb)	Median NO_X, 1998 (ppb)	Median NO_X, 2007 (ppb)	Median NO_X, 2011 (ppb)	Percentage change, 1990-2011 (%)	Percentage change, 1998-2011 (%)	Percentage change, 2007-2011 (%)	90th percentile NO_X, 1990 (ppb)	90th percentile NO_X, 1998 (ppb)	90th percentile NO_X, 2007 (ppb)	90th percentile NO_X, 2011 (ppb)	Percentage change, 1990-2011 (%)	Percentage change, 1998-2011 (%)	Percentage change, 2007-2011 (%)
Galveston 99th Street			4	1			-75			9	5			-44
Lang C408	20		16	6	-70		-63	80		48	28	-65		-42
Manvel Croix Park			5	2			-60			17	13			-24
Houston East C1	20	19	15	7	-65	-63	-53	70	56	46	28	-60	-50	-39
Houston Bayland Park C53		8	8	4		-50	-50		33	30	16		-52	-47
Seabrook Friendship Park			4	2			-50			12	10			-17
Park Place C416			11	6			-45			47	25			-47
Texas City 34th Street			5	3			-40			12	8			-33
Houston Aldine C8/AF108/X150	10	3	10	6	-40		-40	60	30	32	22	-63		-31

Monitor	Median NO_X, 1990 (ppb)	Median NO_X, 1998 (ppb)	Median NO_X, 2007 (ppb)	Median NO_X, 2011 (ppb)	Percentage change, 1990-2011 (%)	Percentage change, 1998-2011 (%)	Percentage change, 2007-2011 (%)	90th percentile NO_X, 1990 (ppb)	90th percentile NO_X, 1998 (ppb)	90th percentile NO_X, 2007 (ppb)	90th percentile NO_X, 2011 (ppb)	Percentage change, 1990-2011 (%)	Percentage change, 1998-2011 (%)	Percentage change, 2007-2011 (%)
Clinton C403/C113/C304	30		19	13	-57		-32	70		47	37	-47		-21
Houston Texas Avenue C411			17	13			-24			53	38			-28
Channelview C15/C115			9	7			-22			24	19			-21
Houston Deer Park #2 C18		3	5	4		33	-20		25	21	13		-48	-38
Lynchburg Ferry C1015			11	10			-9			33	25			-24
Northwest Harris Co. C26/A110/C154		10	5	4		-60	-20		21	12	12		-43	0
Lake Jackson C1016			2	2			0			7	6			-14
Mustang Bayou			2	2			0			6	6			0
Wallisville Road			6	6			0			14	14			0
Conroe Relocated			4	4			0			10	10			0
Danciger			2	2			0			5	6			20

Monitors are sorted in increasing order by percentage change in median values. Monitors with indeterminate trends began operating after 1998.

While many monitors recorded large decreases from 2007 through 2011, lack of measurements from earlier years suggests caution should be used in interpreting trends. Decreases in median concentrations also appear to be larger than decreases in 90th percentile concentrations for most monitors. This suggests that while the distribution of ambient NO_X concentrations over-all is shifting lower over time, the high end is not falling as fast as the middle. Disparities in patterns of ambient NO_X concentrations across the region are appropriate for further investigation, suggesting that larger decreases are not due solely to variations in meteorological conditions, which would be expected to influence all monitors similarly, though not identically. Differences seem to be related to the relative magnitudes of overall concentrations. Sites with the highest concentrations, which tend to be urban sites, showed the greatest decreases. More rural sites like Lake Jackson (CAMS 1016), Conroe (CAMS 65), and Conroe Relocated (CAMS 78) may reflect slight changes in background values, while more urban sites may reflect actual emission changes.

Similar to ozone, NO_X concentrations in the HGB area appear to be decreasing over time, in large measure the result of the comprehensive suite of NO_X-targeted controls implemented since 2000. Stringent point source NO_X standards have been adopted along with numerous factors affecting mobile source NO_X emissions. Appendix I: *Corroborative Analysis for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard* of the 2010 HGB AD SIP Revision includes a description of NO_X emission trends, by source type. Strong downward trends in ambient NO_X concentrations are evidence for the effectiveness of the emission controls depicted in the emission-trend data. Decreasing NO_X is a primary cause of decreasing ozone in the HGB area.

5.3.6 Ambient VOC Concentrations (Updated)

The other major class of compounds that are ozone precursors are VOC emissions. TexAQS 2000 researchers identified a specific subset of VOC emissions that were closely associated with rapid and efficient ozone formation, i.e., light alkenes (Ryerson et al., 2003; Daum et al., 2003, 2004; Jobson et al., 2004). The TCEQ examined the historical data for these compounds, and decided to regulate several light alkenes emitted by industry that were particularly reactive, and that often had particularly high concentrations: ethylene, propylene, 1,3-butadiene, and butenes.

Since the mid-1990s, the TCEQ has collected 40-minute measurements, on an hourly basis, of over 40 VOC compounds using automated gas chromatograph (auto-GC) instruments. Initially, measurements were collected at just one site [Clinton (CAMS 403/CAMS 113/CAMS 304)], but in subsequent years, auto-GC monitors have been added to new sites (see Figure 5-21: *Houston Ship Channel Auto-GC Monitors and 2006 Reported Point Source HRVOC Emissions Points and Plant Boundaries*). Currently, eight sites, listed in Table 5-15: *Auto-GC Monitors in the Houston Ship Channel Area*, along or near the Houston Ship Channel, along with three in Brazoria County and one in Texas City, are collecting VOC emission measurements with auto-GCs.

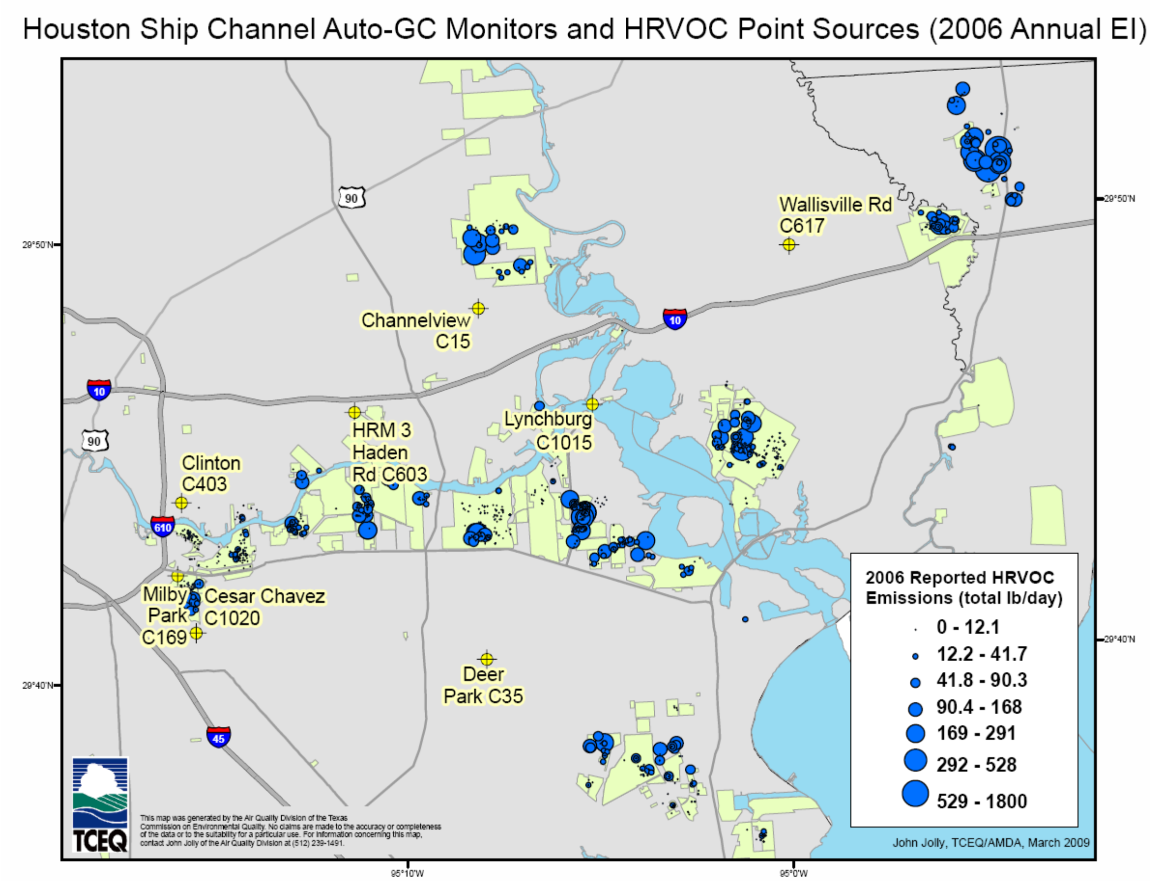


Figure 5-21: Houston Ship Channel Auto-GC Monitors and 2006 Reported Point Source HRVOC Emissions Points and Plant Boundaries

Table 5-15: Auto-GC Monitors in the Houston Ship Channel Area

Site name	CAMS	AIRS code	Latitude	Longitude	City	Start date
Channelview	C15/C115	482010026	29.8025	-95.1256	Channelview	8/3/2001
Houston Milby Park	A169	482010069	29.7062	-95.2611	Houston	2/19/2005
HRM-3 Haden Road	C603	482010803	29.7483	-95.1811	Houston	8/20/2001
Lynchburg Ferry	C1015	482011015	29.7646	-95.0780	Houston	5/24/2003
Clinton	C403/113/304	482011035	29.7337	-95.2576	Houston	7/1/1995
Houston Deer Park 2	C35/139	482011039	29.6700	-95.1285	Deer Park	1/5/1997
Cesar Chavez	C1020/175	482016000	29.6844	-95.2536	Houston	4/13/2004
Wallisville Road	C617	482010617	29.8214	-94.99	Baytown	6/5/2003

Ambient concentrations of ethylene and propylene were analyzed from 1995 through 2011. Trends at each of the eight Houston Ship Channel monitors were examined. Data from the four other auto-GC monitors were analyzed only for trend slope and possible statistical significance of trends. Daily geometric means were computed from valid ambient hourly measurements for days with at least 18 valid hours of data. A geometric mean was calculated by computing the natural logarithm of each measurement, averaging these logarithms, then calculating the antilogarithm of this mean logarithmic value. Geometric mean is a preferable statistic to median or arithmetic (ordinary) mean for evaluating the central tendency of data when the data are skewed, that is, when the data are not symmetrically, or normally, distributed, but clustered around extreme high or low values. It is more robust than an ordinary average, meaning its value is not greatly influenced by one or a few very high or very low values. Many distributions of pollutant measurements in the HGB area are skewed. Monthly geometric means were also computed with a 75% data completeness criterion for valid days in a month.

Figure 5-22: *Monthly Geometric Mean Ethylene Concentrations at the Eight Houston Ship Channel Monitors, July 1995 through December 2011* shows monthly geometric mean ethylene concentrations, ordered according to the monitor location from west to east. Grey bars denote the range of values from the 25th through 75th percentile concentrations, using the combined data from all monitors. Noteworthy in this figure is the frequency of relatively high values recorded during the 1990s at Clinton (CAMS 403/CAMS 113/CAMS 304), at the western end of the Houston Ship Channel, and Deer Park (CAMS 35/139), in the south central Houston Ship Channel. These were the only monitors operating during the early years of this period; this pattern suggests that high ethylene concentrations were not restricted to certain areas of the Houston Ship Channel, but were somewhat geographically widespread.

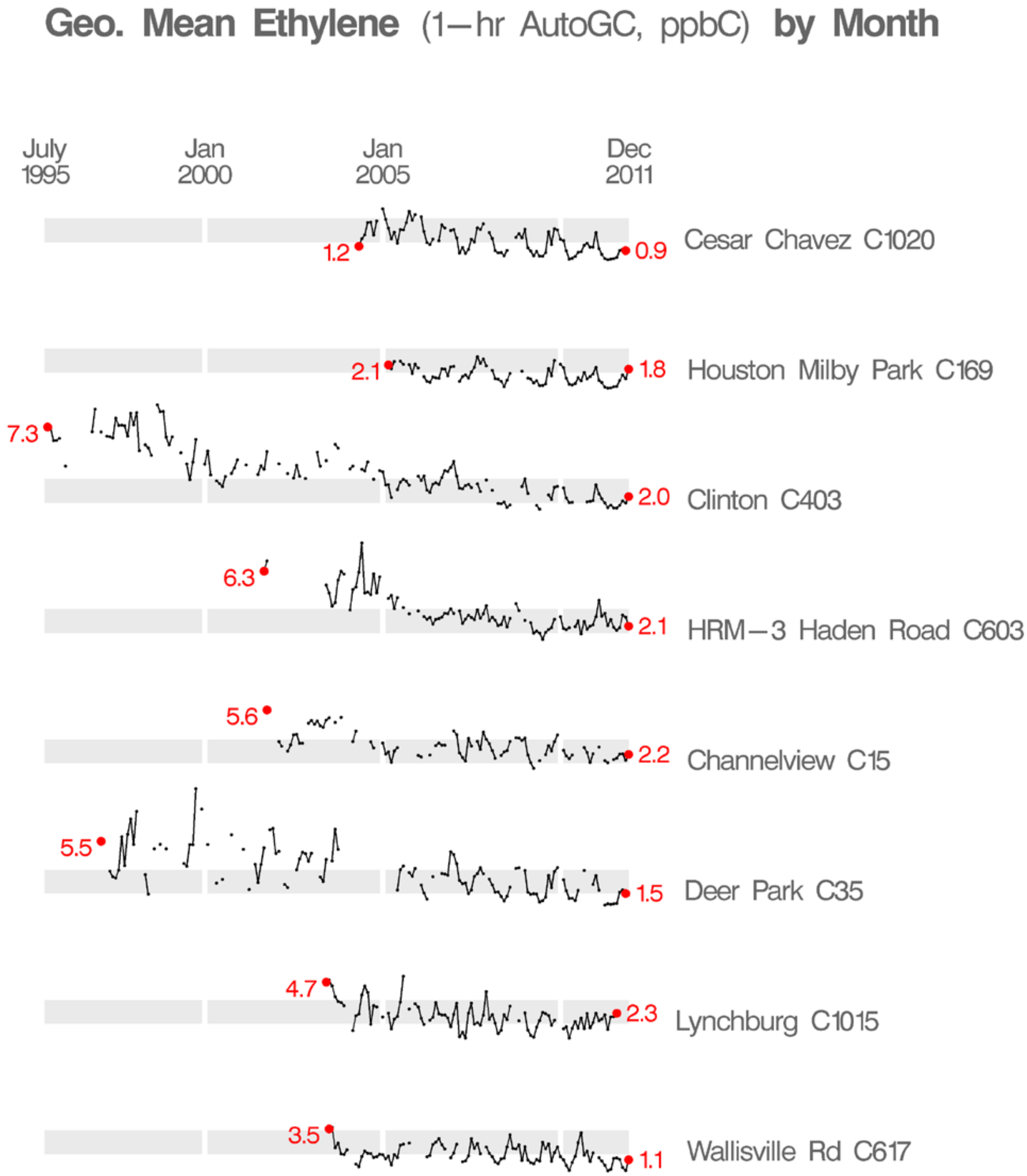


Figure 5-22: Monthly Geometric Mean Ethylene Concentrations at the Eight Houston Ship Channel Monitors, July 1995 through December 2011

For four consecutive years, July 1995 through July 1999, every valid monthly geometric mean ethylene concentration at Clinton (CAMS 403/CAMS 113/CAMS 304) exceeded the 75th percentile of the multi-decade series. Deer Park (CAMS 35/139) also exhibited high concentrations in the first several years, including the highest mean value for any complete month, 9.6 parts per billion carbon (ppbC) in October 1999. From 1995 through 2003, at least 64% of each year's monthly geometric mean values (all monitors combined) exceeded the 75th percentile; however, this statistic changed considerably starting the following year. In 2004, 42% exceeded the 75th percentile, in 2005, 20% exceeded this percentile, and no more than 14% exceeded this value from 2006 through 2011.

These data were analyzed for possible trends and their statistical significance. Figure 5-23: *Monthly Geometric Mean Propylene Concentrations at the Eight Houston Ship Channel Monitors, July 1995 through December 2011* displays monthly geometric mean concentrations of propylene for the eight Houston Ship Channel area auto-GC monitors. Again, Clinton (CAMS 403/CAMS 113/CAMS 304) and Deer Park (CAMS 35/139) show higher concentrations in earlier years compared to recent ones; however, the magnitude of concentrations at the two monitors are dissimilar, with considerably higher peaks at Deer Park (CAMS 35/139) from 2000 through 2004. This suggests that unlike ethylene, propylene emissions are greater in the eastern Houston Ship Channel than in the western part. Buttressing this argument is the fact that 14 of the top 15 monthly means recorded by any monitor during the entire study period were recorded at two eastern Ship Channel monitors, Deer Park (CAMS 35/139) and Lynchburg Ferry (CAMS 1015).

As with ethylene, monthly propylene concentrations exceeding the 75th percentile have decreased from the start to the end of the study period. From 1995 to 2003, no year had fewer than 62% of its measurements exceed the 75th percentile. As with ethylene, 2004 was a transitional year for this statistic, with 50% of its measurements exceeding this percentile, and no more than 24% exceeded this percentile from 2005 through 2011.

Though still variable from month to month, these long-term decreases in ambient concentrations of ethylene and propylene suggest overall industrial emissions of these compounds have decreased considerably since 1995. This finding agrees with analyses from TexAQS II (Cowling et al., 2007) that indicate that ethylene emissions along the Houston Ship Channel have decreased approximately 40% from 2000 through 2006.

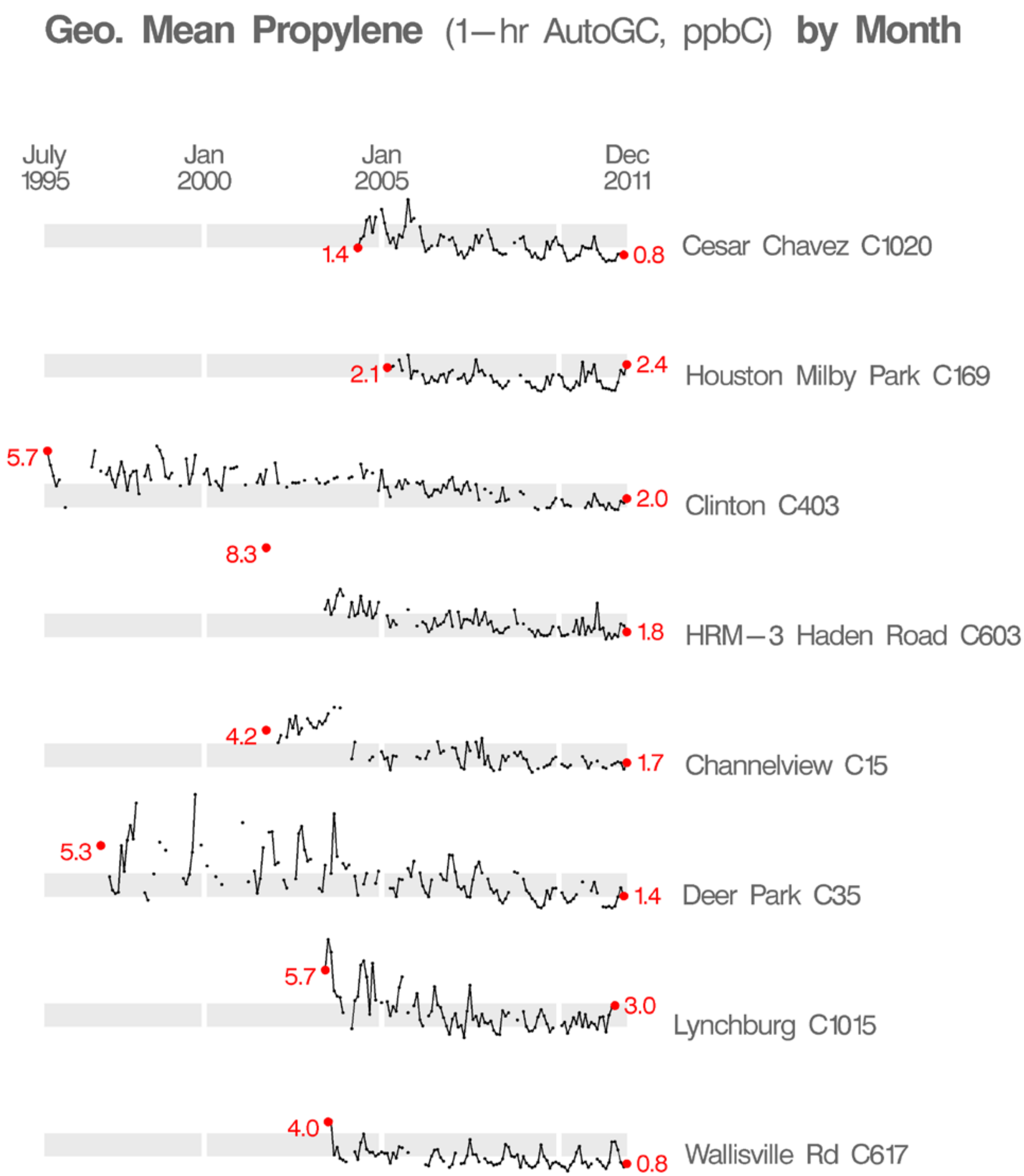


Figure 5-23: Monthly Geometric Mean Propylene Concentrations at the Eight Houston Ship Channel Monitors, July 1995 through December 2011

To verify whether observed decreases were statistically significant, ordinary least squares regression lines were fit to the monthly geometric mean ethylene and propylene concentrations, using an index of month. Results of these fits are reported in Table 5-16: *Parameter Estimates* *of Monthly Geometric Mean Concentrations Trends*. In all 24 regressions (12 monitors times two compounds), concentrations decreased across the respective study periods, with correlation coefficients (r^2) ranging from 0.08 to 0.75. Decreases ranged from -0.002 to -0.03 for ethylene and -0.004 to -0.032 for propylene. Standard interpretation of coefficients of ordinary least squares models with log-transformed dependent variables and non-transformed independent variables is that a one-unit change in the independent variable corresponds to a percentage change equal to the coefficient multiplied by 100. Thus, responses of ambient ethylene measured at the monitors in and near the Houston Ship Channel are estimated to be on the order of -0.20% to -3.00% per month, because a non-transformed index of month was used as the independent variable. Likewise for propylene, estimated responses of ambient propylene measured at the monitors were in the range of -0.40% to -3.20% per month decreases.

In all cases, these decreases were statistically significant at p=.01. However, caution must be exercised when interpreting these results. First, some of the computed r^2 values are very low, confirming there is a substantial degree of variation in the measured values, with only a portion of it explained by a simple linear model. Further statistical testing and verification, such as testing for and correcting possible autocorrelation, is necessary to fully validate these models.

Table 5-16: Parameter Estimates of Monthly Geometric Mean Concentrations Trends

Monitoring site	Houston Ship Channel area monitor	Ethylene N[1]	Ethylene slope[2]	Ethylene intercept[3]	Ethylene r2 [4]	Propylene N[5]	Propylene slope[6]	Propylene intercept[7]	Propylene r2 [8]
Cesar Chavez C1020/175	yes	84	-0.024	2.80	0.43	83	-0.024	2.80	0.44
Channelview C15/C115	yes	84	-0.017	4.05	0.38	84	-0.028	4.45	0.59
Clinton C403/C113/C304	yes	133	-0.030	7.14	0.75	134	-0.015	4.63	0.57
Deer Park C35/139	yes	115	-0.022	5.34	0.44	126	-0.020	4.88	0.34
HRM-3 Haden Road C603	yes	97	-0.028	7.32	0.65	95	-0.025	6.28	0.62
Houston Milby Park A169	yes	72	-0.012	1.87	0.28	72	-0.010	1.78	0.15
Lynchburg Ferry C1015	yes	87	-0.019	3.11	0.28	87	-0.032	4.19	0.38
Wallisville Road C617	yes	90	-0.008	1.98	0.11	90	-0.010	1.91	0.19
Mustang Bayou C619	no	67	-0.004	0.63	0.14	67	-0.006	0.81	0.22
Danciger C618	no	83	-0.002	0.57	0.08	81	-0.005	0.75	0.48
Lake Jackson C1016	no	84	-0.005	1.04	0.10	85	-0.004	0.69	0.10
Texas City 34th St. C620	no	93	-0.019	2.26	0.62	92	-0.014	2.05	0.51

[1]Number of ethylene observations (i.e., months)
[2]Slope of estimated ethylene trend line
[3]Intercept of estimated ethylene trend line
[4]Correlation coefficient (r^2) of estimated ethylene trend line
[5]Number of propylene observations (i.e., months)
[6]Slope of estimated propylene trend line
[7]Intercept of estimated propylene trend line
[8]Correlation coefficient (r^2) of estimated propylene trend line

All slope coefficients were significant at the 5% level ($\alpha = 0.05$). Parameter estimates are from ordinary least squares fits of monthly geometric mean concentrations of ethylene and propylene on an index of month, by monitoring site and compound.

5.3.7 Geographic Patterns in Ambient HRVOC Concentrations Near the Houston Ship Channel (No change from 2010 HGB AD SIP Revision)

5.3.8 Ambient Total VOC Concentrations (No change from 2010 HGB AD SIP Revision)

5.3.9 Meteorologically Adjusted Ozone Trends (No change from 2010 HGB AD SIP Revision)

5.3.10 Background Ozone Concentrations: Transport of Ozone into the HGB Area (No change from 2010 HGB AD SIP Revision)

5.3.11 Transport and Surface Wind Trajectories (No change from 2010 HGB AD SIP Revision)

5.3.12 Background Ozone in Texas (No change from 2010 HGB AD SIP Revision)

5.3.13 Air Quality Trends Conclusions (Updated)

Ozone concentrations have decreased dramatically in the HGB area since the 1990s, and in 2009 and 2010, the design value was below the 1997 eight-hour standard of 0.08 ppm, or less than or equal to 84 ppb. Although the preliminary 1997 eight-hour ozone design value for 2011 rose slightly above the standard to 89 ppb, the long-term trend is still downward. Examination of trends in one-hour ozone, eight-hour ozone, the number of exceedances, the spatial distribution of ozone, the seasonal distribution of ozone, and the strength of ozone gradients all show substantial downward trends. Causes of these trends were investigated by examining meteorological variations that have occurred over the years, by evaluating local changes in ozone precursor concentrations, and by examining trends in background ozone. These analyses found that inter-annual meteorological variations cannot explain the observed decreases in ozone, and that ozone precursors are on statistically significant downward trends. In addition, the analyses found that background ozone in southeast Texas has not decreased substantially since 2000, suggesting that the significant ozone reductions achieved in the HGB area are probably due primarily to local emission controls, not background ozone decreases.

5.4 QUALITATIVE CORROBORATIVE ANALYSIS (UPDATED)

5.4.1 Introduction (No change from 2010 HGB AD SIP Revision)

5.4.2 Federal Preemption Issues (No change from 2010 HGB AD SIP Revision)

5.4.3 Additional Measures (Updated)

5.4.3.1 New International Marine Diesel Engine and Marine Fuel Standards for Oceangoing Vessels and Emissions Control Areas (Updated)

In March 2009, the U.S. submitted a request to the International Maritime Organization (IMO) for the creation of an emissions control area (ECA) around the nation's coastlines. The request was granted and the North American ECA was officially designated by the IMO on March 26, 2010, and became enforceable in August 2012. All marine diesel fuels used by oceangoing vessels (OGV) in the North American ECA will be limited to a maximum sulfur content of 1,000 ppm beginning January 1, 2015, and all new engines on OGV operating in these areas must use emission controls that achieve an 80% reduction in NO_X emissions beginning January 1, 2016.

The EPA regulations for marine diesel fuel and new marine engines less than 30 liters per cylinder displacement and the new International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI standards for marine residual fuels and new marine diesel engines above 30 liters per cylinder displacement will apply to all OGV flagged and registered in the U.S. The EPA's new regulations for new Category 3 marine engines and new sulfur limits for marine diesel fuel will also apply to all OGV flagged and registered in the U.S. In addition, the new MARPOL Annex VI standards will apply to all new marine diesel engines and fuels on foreign marine vessels that operate near U.S. coasts and ports.

The new marine diesel engine and fuel standards will provide a 96% reduction in sulfur in marine diesel fuels, as well as an 85% reduction in particulate matter emissions and an 80% reduction in NO_X emissions, when compared to current standards[3].

Cumulatively, these new marine diesel engine and fuels standards will result in a 0.5 to 1.0 ppb reduction of ozone in the ambient air of the HGB ozone nonattainment area by 2020 (EPA, 2009b).

5.4.3.2 SmartWay Transport Partnership and the Blue Skyways Collaborative (Updated)

Among its various efforts to improve air quality in Texas, the TCEQ continues to promote two voluntary programs in cooperation with the EPA: the SmartWay Transport Partnership and the Blue Skyways Collaborative.

Since the 2010 HGB AD SIP Revision, SmartWay Transport partnerships have increased to include over 2,900 corporations in the U.S., including most of the nation's largest truck carriers, all the Class 1 rail companies, and many of the top Fortune 500 companies. SmartWay has provided over $30 million in financing to help truck owners, especially small and medium-sized firms, buy cleaner, more fuel efficient trucks. Environmental, state, and community groups rely upon SmartWay's clean air achievements to help protect the health and well-being of citizens. Ports in the U.S. rely on SmartWay's Port Drayage Truck program to help reduce pollution in and around major national ports. The Port of Houston Authority's (PHA) partnership with the Houston-Galveston Area Council (H-GAC) and the Environmental Defense Fund in the Port Drayage Truck Bridge Loan Program received $9 million from the EPA's Diesel Emission Reduction Act (DERA) SmartWay Program in 2009. On average, four trucks a month, or 50 trucks a year, were approved for replacement funding. Several workshops have been sponsored by the PHA for trucking companies and independent owner/operators to learn about funding opportunities.

Approximately 160 Texas companies are SmartWay partners. The SmartWay Transport Partnership will continue to benefit the HGB area by reducing emissions as more companies and affiliates join, and additional idle reduction, aerodynamic, low rolling resistance tire, and retrofit technologies are incorporated into SmartWay verified technologies.

The Blue Skyways Collaborative was created to encourage voluntary air emissions reduction in North America's heartland by planning or implementing projects that use innovations in diesel engines, alternative fuels, and renewable energy technologies. The Blue Skyways Collaborative partnerships include international federal, state, and local governments, non-profit organizations, environmental groups, and private industries. Since the 2010 HGB AD SIP Revision, the H-GAC has continued to help achieve Blue Skyways Collaborative goals to reduce air emissions through technological innovation by working with these organizations and participating in Blue Skyways subcommittees.

5.4.3.3 Car Allowance Rebate System (CARS) (No Change from 2010 HGB AD SIP Revision)

5.4.3.4 Control of VOC Emissions from Storage Tanks (Updated)

In May 2007, the commission adopted revisions to the rules in 30 Texas Administrative Code (TAC) Chapter 115, Subchapter B, Division 1 for VOC storage tanks located in the HGB 1997 eight-hour ozone nonattainment area. The revised requirements reduce uncontrolled VOC flash

[3] EPA, 2009a. Emission Control Area Designation.
http://www.epa.gov/otaq/oceanvessels.htm#emissioncontrol.

emissions at oil and gas exploration and production sites and other VOC emissions from storage tanks. These amendments to Chapter 115 are described in more detail in the preamble of the adopted rule (32 TexReg 3178) (http://www.tceq.texas.gov/assets/public/implementation/air/rules/texas-register/32-texreg-3178.pdf).

Although these rules will result in actual reductions in flash emissions, no credit is claimed in the 2010 HGB AD SIP Revision. At the time the rules were adopted, it was unknown how many affected sites would be required to install controls. In 2010, ENVIRON International Corporation (ENVIRON) Project 06-17477T quantified the VOC emission reductions resulting from the implementation of these Chapter 115 requirements to control VOC flash emissions from crude oil and condensate storage tanks in the HGB 1997 eight-hour ozone nonattainment area. ENVIRON Project 06-17477T estimated the Chapter 115 rules will result in 10,683 tons of VOC reductions per year (29.3 tons of VOC reductions per day) in the HGB area. More information on ENVIRON Project 06-17477T can be found on the TCEQ Web site (http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/5820784005FY1022-20100831-environ-flash_emission.pdf).

5.4.3.5 Energy Efficiency and Renewable Energy (EE/RE) Measures (Updated)

The Texas Legislature has enacted a number of EE/RE measures and programs. This section provides Texas EE/RE legislation updates since the 2010 HGB AD SIP Revision. Information on previous legislation regarding EE/RE measures and programs is available in the 2010 HGB AD SIP Revision.

Renewable Energy

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

State Building Projects

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

University Building Projects

HB 51, 82nd Legislature, 2011, Regular Session, requires, if practical, that certain new and renovated state funded university buildings comply with approved high-performance building standards.

Commercial Building Codes

HB 51, 82nd Legislature, 2011, Regular Session, requires municipalities to report implementation of residential and commercial building codes to the State Energy Conservation Office.

Electric Utility Sponsored Programs

SB 1125, 82nd Texas Legislature, 2011, Regular Session, amends the Texas Utilities Code, §39.905 to require energy efficiency goals to be at least 30% of annual growth beginning in

2013. The metric for the energy efficiency goal remains at 0.4% of peak summer demand when a utility program accrues that amount of energy efficiency. SB 1150, 82nd Texas Legislature, 2011, Regular Session, extends the energy efficiency goal requirements to utilities outside the Electric Reliability Council of Texas area.

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

5.4.3.6 Clean Air Interstate Rule (CAIR) and Cross State Air Pollution Rule (CSAPR) (Updated)

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

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

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

A December 2008 court decision found flaws in CAIR, but kept CAIR requirements in place temporarily while directing the EPA to issue a replacement rule. In July 2011, the EPA finalized CSAPR to meet FCAA requirements and respond to the court's order to issue a replacement program. Texas is included in CSAPR for ozone season NO_X, annual NO_X, and annual SO_2 due to the EPA's determination that Texas significantly contributes to nonattainment or interferes with maintenance of the 1997 eight hour ozone NAAQS and the 1997 and 2006 $PM_{2.5}$ NAAQS in other states. As a result of numerous EGU emission reduction strategies already in place in Texas, the annual and ozone season NO_X reduction requirements from CSAPR are relatively small but still significant. The CSAPR requires an approximate 7% reduction in annual NO_X emissions and less than 5% reduction in ozone season NO_X emissions.

On August 21, 2012, the U.S. Court of Appeals for the District of Columbia Circuit vacated the CSAPR. Under the court's ruling, CAIR will remain in place until the EPA develops a valid replacement to CAIR.

5.4.3.7 Texas Emission Reduction Plan (TERP) (Updated)

The TERP program was created in 2001 by the 77th Texas Legislature to provide grants to offset the incremental costs associated with reducing NO_X emissions from high-emitting heavy-duty internal combustion engines. As of July 2012, the TERP program has funded $859 million in grants for projects in Texas ozone nonattainment areas and other areas where ground-level ozone is a concern. Almost $369 million of that amount has been awarded to projects in the HGB area since 2001, which are projected to help reduce over 75,900 tons of NO_X emissions, with an estimated 29 tons per day (tpd) NO_X emissions reductions during 2012. Of that $369 million, $5 million was awarded to H-GAC through a third-party grant to administer subgrants in the HGB area. H-GAC has used this funding to target the replacement of drayage trucks operating in and from the Port of Houston with newer, cleaner models.

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

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

SB 12, 80th Texas Legislature, 2007, expanded LIRAP participation criteria by increasing the income eligibility to 300% of the federal poverty rate and increasing the amount of assistance toward the replacement of a retired vehicle. HB 3272, 82nd Texas Legislature, 2011, Regular Session, expanded the class of vehicles eligible for a $3,500 voucher to include hybrid, electric, natural gas, and federal Tier 2, Bin 3 or cleaner vehicles. The program provides $3,500 for a replacement hybrid, electric, natural gas, and federal Tier 2, Bin 3 or cleaner vehicle of the current model year or the previous three model years; $3,000 for cars of the current or three model years; and, $3,000 for trucks of the current or previous two model years. The retired vehicle must be 10-years old or older or have failed an emissions test. In the HGB area, the LIRAP is available to vehicle owners in five counties: Brazoria, Fort Bend, Galveston, Harris, and Montgomery. In the HGB area, between December 2007 and May 31, 2012, the program has retired and replaced 21,117 vehicles at a cost of $63,399,313. An additional 11,622 vehicles have had emissions-related repairs at a cost of $6,427,890. The total repair and retirement/replacement expenditure for the HGB area between December 12, 2007, and May 31, 2012, is $69,827,203. HB 1, General Appropriations Bill, 82nd Texas Legislature, 2011, Regular Session, continued program funding but at a reduced level. HB 1 appropriated $5.58 million for Fiscal Years (FYs) 2012 and 2013 to continue this clean air strategy in the 16 participating counties. The HGB area was allocated approximately $2.5 million for FYs 2012 and 2013.

5.4.3.9 Clean School Bus Program (Updated)

HB 3469, 79th Texas Legislature, 2005, established the Clean School Bus Program. The Clean School Bus Program was established to provide monetary incentives for school districts in the state for reducing emissions of diesel exhaust from school buses.

As of August 2012, the TCEQ Clean School Bus grant program has reimbursed approximately $19 million in grants for over 6,692 school buses across the state, with $4.4 million being used for 2,435 school buses in the HGB area.

5.4.3.10 81st and 82nd Texas Legislature (Updated)

There are no updates to this section from the 81st Texas Legislature, 2011, since the 2010 HGB AD SIP Revision. Summaries of the bills passed during the 82nd Texas Legislature, 2011, Regular Session, that have the potential to impact the HGB 1997 eight-hour ozone nonattainment area are discussed in this section. For legislative updates regarding EE/RE measures and programs, see Section 5.4.3.5: *Energy Efficiency and Renewable Energy (EE/RE) Measures*.

HB 2694, under the Sunset Commission, continues the TCEQ for 12 years, until 2023. This bill includes changes to several program areas in the agency.

HB 3268 requires the TCEQ to issue a standard permit (SP) or permit by rule (PBR) for stationary "natural gas engines." The PBR or SP is permitted to consider geographic location including proximity to nonattainment areas, total annual hours of operation, technology used, type of fuel, and other emission control policies of the state. The TCEQ is prohibited from distinguishing between the end-use functions powered by the stationary natural gas engine, and the emission limits must be in terms of air contaminant emission per unit of total energy output. To implement this bill, the commission adopted amendments to 30 TAC §106 to create a PBR, authorizing natural gas powered engines used for electric generation and industry heating on July 25, 2012.

HB 3272 expands the $3,500 LIRAP replacement assistance that was reserved for hybrid vehicles to include hybrid, electric, natural gas, and federal Tier 2, Bin 3 or cleaner vehicles for the current model year or the previous three model years. This bill increases the total allowable cost of a replacement vehicle from $25,000 to $35,000 for cars and trucks certified to Tier 2 Bin 5 or cleaner and up to $45,000 for hybrid vehicles certified to Tier 2 Bin 3 or cleaner. This bill also changes the length of time that a vehicle must be registered in a LIRAP county to be eligible for the program to "at least 12 of the 15 months preceding the application for participation in the program". This bill was effective September 1, 2011.

HB 3399 revised some of the criteria for the Emissions Reduction Incentive Grant Program and the Texas Clean Fleet Program under the TERP. For both programs, the bill revised criteria for the destruction of a heavy-duty motor vehicle or engine, established provisions for the executive director to waive certain eligibility requirements on a finding of good cause, and established or clarified other criteria. The bill also reduced the number of vehicles that must be included in an application under the Texas Clean Fleet Program from 25 to 20 vehicles, and reduced the total number of vehicles that must be operated in Texas by an applicant in order to be eligible for a grant from 100 vehicles to 75 vehicles. To implement this bill, the commission adopted amendments to 30 TAC §§114.650 - 114.654 and §114.622 on March 28, 2012.

SB 385 established three new grant programs under the TERP, the Alternative Fueling Facilities Program (AFFP), Texas Natural Gas Vehicle Grant Program (TNGVGP), and Clean Transportation Triangle (CTT) Grant Program. Of the money appropriated to the TCEQ from the TERP Fund, at least 16% is to be allocated to the TNGVGP, no more than 4% is to be allocated to the CTT Program, and up to 2% can be used for the AFFP. This bill was effective September 1, 2011.

The AFFP funds the construction, reconstruction, or acquisition of facilities in nonattainment areas to store, compress, and dispense alternative fuels, including: natural gas, propane, biodiesel, hydrogen, electricity, and fuels containing at least 85% methanol by volume. The grants will reimburse the lesser of $500,000 or 50% of the eligible costs of the facility.

The CTT Grant Program funds new fueling facilities for compressed and/or liquefied natural gas along the interstate highways connecting the cities of Houston, San Antonio, Fort Worth, and Dallas. The program will reimburse up to $100,000 of the costs of a facility providing compressed natural gas, $250,000 of the costs for a liquefied natural gas facility, and $400,000 of the cost of a facility providing both types of fuel.

The TNGVGP provides incentive grants to pay a percentage of the incremental cost of replacing an existing medium- or heavy-duty vehicle with a natural gas vehicle. The grant-funded vehicles must be operated for at least 75% of annual mileage in a nonattainment area and/or the counties containing part of an interstate highway connecting the cities of Houston, San Antonio, Fort Worth, and Dallas.

To implement this bill, the commission adopted new sections, 30 TAC §§114.670 - 114.672 and §§114.660 - 114.662 on March 28, 2012.

SB 493 specifies that the TCEQ may not prohibit or limit the idling of any motor vehicle with a gross vehicle weight rating greater than 8,500 pounds that is equipped with a 2008 or subsequent model year heavy-duty diesel engine, or liquefied or compressed natural gas engine that has been certified by the EPA or another state environmental agency to emit no more than 30 grams of NO_X emissions per hour when idling. To incorporate this bill, the commission adopted amendments to 30 TAC §114.517 on August 8, 2012.

SB 1134 prohibits the TCEQ from promulgating new or amending existing authorizations via PBR or SP for the oil and gas industry without performing a regulatory impact analysis (RIA), extensive monitoring, and correlated modeling. This bill limits the use of worst-case modeling inputs and requires actual credible air quality monitoring data. Air quality monitoring data and the evaluation of that data are required to be scientifically credible and could be generated by an ambient air monitoring program conducted by or on behalf of the TCEQ, by a local or federal government entity, or by a private organization. This bill provides a definition of planned maintenance, startup, and shutdown (MSS) activities and extends the deadline for filing an application to authorize MSS activities until the earlier of January 5, 2014, or the 120th day after the effective date of a new or amended permit under the provisions of the bill necessary to maintain certain affirmative defense criteria. This bill requires that any PBR or SP adopted or amended by the agency that authorizes planned MSS activities must also conduct an RIA, perform monitoring, and perform correlated monitoring. This bill includes limitations on aggregation, which is a process used to determine if a site is a major source (Title V), as defined under federal law. This bill prohibits the TCEQ from requiring a person who applies for a permit or authorization under the provisions of the bill to demonstrate that the activity to be permitted and/or authorized complies with a NAAQS. This bill was effective July 17, 2011.

5.4.3.11 American Waterways Operators Tank Barge Emissions Best Management Practices (No change from 2010 HGB AD SIP Revision)

5.4.3.12 Local Initiative Projects (LIP) (Updated)

Funds are provided to LIRAP-participating counties for implementation of air quality improvement strategies through local projects and initiatives. In the HGB area, LIP funding is available to the five counties participating in LIRAP: Brazoria, Fort Bend, Galveston, Harris, and Montgomery.

In FYs 2008 and 2009, the participating counties implemented clean vehicle fleet strategies that retired and replaced 232 light-duty and heavy-duty vehicles. Retired vehicles were required to be destroyed and replaced with cleaner, current model-year vehicles. Brazoria County elected not to participate in FYs 2010 through 2012.

Fort Bend County used LIP funds to purchase six buses and initiate a new park-and-ride transit service in 2010. The transit service links Fort Bend County residents with the Texas Medical Center area and creates immediate and long-term benefits for reducing emissions and congestion by removing single occupancy vehicle trips from U.S. Route 59.

Harris County used LIP funds to initiate an emissions enforcement program and an emissions task force in 2010. The enforcement program targets high-emitting vehicles, smoking vehicles, and suspicious vehicles to verify that the state inspection certificates attached to these vehicles are legitimate and in compliance with air quality standards. The Harris County Clean Air Emissions Task Force's objective is to reduce the number of fraudulent, fictitious, or improperly issued safety and emissions inspection certificates. The task force partners with local and state agencies to enforce state laws, codes, rules, and regulations regarding air quality and mobile emissions in Harris County. The citizens of Harris County and the entire southeast Texas region stand to benefit from this program as a result of the reduction in NO_X emissions from each vehicle brought into emissions compliance.

Montgomery County used LIP funds for a signal light synchronization project in FY 2010. Synchronizing traffic signalization reduces idling by reducing the number of times a vehicle must stop at a traffic light. The "Exhaust Phase" of an engine emits the most emissions during starting, idling, and breaking stationary inertia. Synchronizing traffic signalization reduces both idling and the number of times a vehicle must resume travel (break stationary inertia). The project increases the emissions reduction benefits by synchronizing the traffic signalization upon real-time traffic flow instead of a stagnate model to better manage peak-hour congestion, while minimizing cross-traffic congestion, and reducing emissions.

5.4.3.13 Other Local Programs (Updated)

In the 2010 HGB AD SIP Revision, the H-GAC submitted the following programs that were not committed to as transportation control measures or Voluntary Mobile Emission Reduction Program measures, but may be implemented locally in the HGB area. For a detailed analysis of these programs, see Appendix F: *Evaluation of Mobile Source Control Strategies for the Houston-Galveston-Brazoria State Implementation Plan (With Detailed Strategies)* of the 2010 HGB AD SIP Revision. This section includes updates to these programs since the 2010 HGB AD SIP Revision.

Scrappage and Buy-Back Plan

This measure was built on the existing LIRAP program and implemented as part of the AirCheckTexas Vehicle Emissions Testing program by increasing the number of on-road light-duty gasoline vehicles scrapped. The program has been significantly reduced due to the funding cuts made to LIRAP during the 82nd Texas Legislature, 2011, Regular Session. Due to the decrease in funding, the program has temporarily focused on vehicle repair rather than vehicle replacement.

Pay-As-You-Drive Insurance

The Pay-As-You-Drive Insurance measure was not successfully implemented in the HGB area despite pilot program efforts. The success of this measure is highly dependent on strong public and insurance industry participation, which is lacking in the HGB area.

Limitations on Idling of Heavy-Duty Vehicles; Creation of Regional Government Idling Restrictions

Idling of vehicles is an inherently inefficient operation that can produce unnecessary air pollutants. Idling also occurs during normal driving and other operations such as when an engine powers necessary accessories, known as power take-off, including man-lifts or concrete tumblers. It is not possible to eliminate all idling, but idle reduction programs are typically low in cost and may result in a net savings to the owner/operator of the vehicle while also reducing air emissions.

H-GAC has developed a voluntary regional idling policy for public and private entities that operate on- and off-road, diesel-powered vehicles in the HGB area. This policy is intended to reduce diesel-engine idling and emissions by limiting idling to five minutes with minor exceptions. Since March 15, 2011, H-GAC's Clean Vehicles program has required the adoption of an idling reduction policy as part of program eligibility. Numerous school district applicants adopted similar policies based on the EPA's Clean School Bus program anti-idling policy. In addition, H-GAC continues to recognize Clean Air Champions for anti-idling commitments from both the public and private sectors. In recent years, several school districts, local governments, and private sector companies in the HGB area have been recognized as Clean Air Champions for adopting some form of anti-idling policy for fleets and/or employees. A number of these Clean Air Champions also explored and implemented anti-idling instructional training for operators of light-duty and heavy-duty vehicles and/or installed automatic shut-off devices on fleets. H-GAC continues to provide sample policies, information, and implementation tools to public and private entities.

Encourage/Mandate Livable Centers

H-GAC and a consortium of community partners received a $3.75 million Sustainable Communities Regional Planning Grant from the United States Department of Housing and Urban Development, which is also supported by the United States Department of Transportation and the EPA, to develop a regional plan for sustainable development for the 13-county H-GAC service region, which encompasses the HGB area. The Houston Galveston Regional Plan for sustainable development will be a high-level, long-range plan for enhancing the region's quality of life and economic opportunity for residents. This effort is being led by a partnership of 25 organizations, including H-GAC, local governments within the 13-county H-GAC service region, non-profit organizations, academic institutions, and other partners. Through receipt of this grant, H-GAC has earned "preferred sustainability status," which provides bonus points for certain federal funding opportunities.

H-GAC has also developed a livable centers program that funds both studies and implementation projects. However, emission reductions resulting from this program are particularly difficult to isolate and quantify. In particular, H-GAC is concerned about double counting emissions from this program that are already counted under other documented emission control measures, such as public transit improvements, bicycle and pedestrian actions, etc.

Enhanced Enforcement of Smoking Vehicles

This measure encourages local law enforcement officers to enforce existing smoking vehicle laws. Within the HGB area, Harris County (including the Sheriff's Department, Precinct 4 Constable's Office, and Precinct 5 Constable's Office) successfully implemented a smoking vehicles and emissions enforcement task force through a local initiative project in 2010 to investigate inspection stations and individuals offering fraudulent inspections and counterfeit stickers. These departments have also implemented an emissions enforcement program to ensure that vehicles on Harris County roads are in compliance with air quality standards. A reporting tool, Clean Air Online, has also been developed to encourage public participation in this enforcement program. H-GAC will continue to explore the potential expansion of this program within the HGB area.

Limitation on Idling of Heavy-Duty Construction Equipment

Idling is an inefficient use of equipment and generates unnecessary air emissions; however, it cannot be avoided in all cases, such as during normal work, when work is performed intermittently, and when the time to restart the engine would be considered a significant delay.

This measure would seek to limit excessive idling when equipment is not required immediately. Many on-road trucks have factory-installed engine shutdown systems that automatically shut down the engine after a set period. Engine shutdown devices that could be added to existing equipment are also available. To implement this measure, engine shutdown systems could be employed with idle timers set to a period that would not cause typical operational problems. Operator training could provide significant idle reduction, perhaps beyond engine shutdown systems. H-GAC will continue to make efforts to assist equipment owners and to explore heavy-duty idling limitation measures.

5.4.3.14 Additional Strategies Not Included in the 2010 HGB AD SIP Revision (Added)

Airport Emission Reduction Strategy

Airport-related activities produce emissions that contribute to the formation of ozone; however, these emissions are declining due to the implementation of various control strategies and technological improvements. For example, the strategic effort to provide changes in ground support equipment (GSE) and gate electrification, and an increased number of runways will maximize emission reductions at the local airports. Technological improvements at Hobby Airport and George Bush International Airport include an increase in the number of runways, use of single-engine runway taxiing, reduced use of reverse thrust, replacement of most of the gasoline and diesel engine GSE with electric GSE, and the installation of electric preconditioned air and converter units on all gates.

Congestion Pricing/High Occupancy Vehicle (HOV) Lanes and High Occupancy Toll (HOT) Lane Conversion

H-GAC, in conjunction with the Metropolitan Transport Authority of Harris County and the Texas Department of Transportation, has operated HOV lanes since 1979 (Interstate 45). Currently, these lanes are offered along sections of Interstate 10, U.S. Highway 290, Interstate 45, and U.S. Route 59. While most urban areas operate HOV lanes for limited periods of time, Houston operates its HOV lanes nearly all day: 5:00 a.m. to 11:00 a.m. for the morning peak period, and 2:00 p.m. to 8:00 p.m. for the evening peak period.

Through HOV to HOT lane conversions, single-occupant motorists may now pay a fee to use the HOV lanes. The additional use of the HOV lanes helps improve traffic flow in the non-HOV lanes and improve the utilization of HOV lanes. The first HOT lane experiment in Houston began with QuickRide in 1998 on the Katy Freeway, followed by the Northwest Freeway in 2000. There are three tiers of HOT lane value pricing, which are based on peak periods of traffic congestion. Prices increase hourly approaching historical levels of peak demand and decrease following the peak periods. No single-occupancy vehicles are permitted during highest peak hours (7:00 a.m. to 8:00 a.m. and 4:00 p.m. to 6:00 p.m.).

The Houston region plans to expand activities on the Katy and Northwest Freeways and add tolling to the rest of the existing HOV lanes to develop a fully-integrated network of HOT lanes. Plans are being implemented and construction of transponder stations is underway to optimize the entire network of HOV lanes to provide the maximum benefits for Houston travelers through reduced congestion and delays.

Consent Decrees with Refineries

The EPA's *National Petroleum Refinery Initiative* has resulted in multi-issue settlement agreements with the nation's major petroleum refineries. As of April 2012, 107 refineries representing more than 90% of total domestic refining capacity are under settlement, and negotiations are underway with other refiners not currently under settlement. The EPA consent decrees limit emissions from fluidized catalytic cracking units, sulfur recovery units, heaters and boilers, and flares. The EPA estimates that full implementation of the current settlements will result in more than 92,000 tons per year (tpy) of NO_X emission reductions. The EPA also anticipates VOC emission reductions will result from consent decree requirements that reduce hydrocarbon flaring including:

- installing CEMS or predictive emissions monitoring systems;
- operating a flare gas recovery system to control continuous or routine flaring;
- limiting flaring to only process upset gases, fuel gas released as a result of relief valve leakage, or gas released due to a malfunction; and
- eliminating the routes of generated fuel gases and monitoring the flare with CEMS or a flow meter.

Although some of the estimated NO_X and VOC emission reductions may have occurred prior to 2006, full implementation of the settlements is not expected until the end of 2015.

Flextime

Flextime refers to employers offering or encouraging their employees to choose the option of arriving at and leaving the workplace on flexible schedules in order to avoid peak traffic congestion. Generally, the option requires that employees are at the workplace during specified key hours. It is estimated that over 2.8 million employees in Houston work for companies that offer flextime.

Mass Emissions Cap and Trade (MECT) Program

The MECT program uses an annual cap to limit the amount of NO_X emissions from all applicable sources in the HGB area. The MECT program allocated NO_X allowances to applicable facilities in the HGB area based on actual levels of activity from the years 1997 through 1999. These allowances are referred to as actual allowances. The program also allocated allowances to certain facilities based on their permit limit. These allowances are referred to as allowable allowances and were allocated to facilities that had not yet been built or had not been operational long enough to establish baseline data. Applicable facilities that do not meet the criteria for receiving an allocation of actual or allowable allowances must acquire allowances equal to their annual NO_X emissions from facilities in the program that receive an allocation of actual allowances. Additionally, facilities that were allocated allowable allowances are required to revise their allocation to be based on actual operating data after an operational baseline period has been established.

The photochemical modeling for the 2010 HGB AD SIP Revision includes 120.0 tpd of NO_X emissions based on the October 2009 MECT cap. The modeled MECT cap is a function of the actual allowance allocations, allowable allowance allocations, and the conversion of emission reduction credits to allowance allocations. The MECT cap, as of May 2012, is 112.4 tpd of NO_X emissions, which is a reduction of 7.6 tpd of NO_X emissions from the modeled MECT cap. This reduction can be attributed to facilities revising allowance allocations based on permit limits to allocations based on actual operating data since typically most facilities operate below their permit limits. Further NO_X emission reductions can be expected in the future because there are still facilities that have yet to convert their allowable allowances into actual allowances.

Parking Pricing

Parking is generally free and abundant for most commuters in the HGB area; however, parking pricing has been implemented in certain targeted major employment centers in the HGB area. Changing the price of parking can affect mode choice and reduce vehicle miles traveled by shifting commute and other trips to alternative modes. Parking pricing creates an incentive for drivers to reduce their number of vehicle trips to the downtown area, and therefore, their vehicle miles traveled. The two main types of parking pricing are parking cash-out and parking surcharges. In parking cash-out, certain employers who provide subsidized parking for their employees can offer a cash allowance in lieu of a free or subsidized parking space. Parking cash-out offers the opportunity to improve air quality and reduce traffic congestion by reducing vehicle trips and emissions.

Port of Houston Authority Automated Gate Systems

Many port and rail intermodal yards have been installing Automated Gate Systems (AGS) using Optical Character Recognition (OCR) to speed processing of container traffic at intermodal facilities. The OCR technology automates the identification of vehicles and equipment, including containers, chassis, license plates, and hazardous/IMO labels. The benefit of automating the identification and processing system is a significant reduction in the amount of time that each truck spends at the gate. This processing time benefit will also reduce queue lengths at gates multiplying the benefit to all trucks.

The PHA modified the truck entry system at the Barbours Cut Container Terminal with a pre-check entry gate in December 2007, which minimized truck wait times. The PHA also installed OCR technology at the “out-gates” of the Bayport and Barbours Cut Container Terminals beginning in 2010. The OCR technology automates the identification of vehicles and cargo leaving the terminals. Of the 1,800 vehicles exiting the Bayport Terminal and the 1,000 exiting the Barbours Cut Terminal daily, approximately 70% are able to expeditiously exit through the OCR gates. The OCR out-gate automation is roughly estimated to save one minute per vehicle exiting the PHA terminals (out of an average exit time of 30 minutes), thereby reducing the idling time of these heavy-duty vehicles. The PHA continues to explore the potential to expand this OCR technology to the Barbours Cut and Bayport Terminals' “in-gates” in future years, thereby further reducing truck idling and emissions. The reconfigured gate was estimated to reduce operational time from the existing gate time of 22 minutes to six minutes, perhaps including an estimate of reduced queue lengths.

The emission reductions from the OCR would include reduced idling time and, if the queue length is reduced, that would also reduce the stop-and-go driving as the queue lurches forward with each truck entrance. In 2010, the PHA moved 1,341,897 twenty-foot equivalent units as containers requiring nearly one million truck trips. Using an approximate number of truck trips at one million per year, the emission reduction from the idle reduction alone could be significant. The EPA’s MOVES2010a provides the average short term idle emission rates for combination long-haul trucks at 6.00 grams per hour (g/hr) of VOC and 44.97 g/hr of NO_X for calendar year 2018. Using the estimated 16 minutes of idle time reduction for trucks in the queue, approximately 1.8 tpy of VOC and 13.2 tpy of NO_X would be reduced from the use of AGS installations at the PHA.

Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

The TCEQ previously adopted NO_X emission standards for stationary diesel reciprocated internal combustion engines in 30 TAC Chapter 117 for the HGB area. The NO_X emission standards for stationary diesel engines in §117.310 and §117.2010 are used in conjunction with the MECT program for sources subject to MECT. For sources subject to §117.2010 that are not in MECT, the NO_X emission standards apply on a unit-by-unit basis. Additionally, the TCEQ adopted requirements in the exemption criteria for stationary diesel reciprocated internal combustion engines in §117.303 and §117.2003 that require engines installed, modified, reconstructed, or relocated on or after October 1, 2001, to meet the corresponding emission standards for non-road engines in 40 Code of Federal Regulations (CFR) Part 89, §89.112(a),

Table 1 to be in effect at the time of the installation, modification, reconstruction, or relocation of the engine. The combination of the emission standards, the MECT program, and the provisions to meet EPA's Tier standards in 40 CFR Part 89 to qualify for exemption makes the Chapter 117 requirements for stationary diesel reciprocated internal combustion engines equivalent, or superior to, most of the requirements in EPA's New Source Performance Standards in 40 CFR Part 60, Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. However, the NO_X emission standards in 40 CFR §60.4204(c)(3) for large-cylinder non-emergency stationary compression ignition internal combustion engines (i.e., diesel-fired engines) installed on or after January 1, 2016, are more stringent than the lowest NO_X emission standards for stationary diesel reciprocated internal combustion engines in §117.310 and §117.2010 and 40 CFR Part §89.112(a) Table 1. The exact amount of NO_X reductions resulting from 40 CFR §60.4204(c)(3) will be dependent on the turnover of existing engines and new installations after 2015 and cannot be estimated at this time. However, the requirements for new non-emergency stationary diesel-fired engines in the large-cylinder category starting in 2016 should ultimately result in additional NO_X reductions in the attainment year beyond that already relied upon in the 2010 HGB AD SIP Revision.

Third-Party TERP Grants

Since 2001, over $380 million has been awarded to TERP projects in the HGB area. Of that $380 million, H-GAC has been awarded $5 million through a third-party grant to administer sub-grants in the HGB area. H-GAC has used this funding to target the replacement of drayage trucks operating in and from the Port of Houston with newer, cleaner models. For further information about the TERP program, see Section 5.4.3.7: Texas Emission Reduction Plan (TERP).

H-GAC has also investigated other funding sources and incentives separate from TERP. This funding constitutes additional emission reductions beyond those credited to the TERP program benefits. In particular, H-GAC continues to explore DERA project funding (National Clean Diesel Funding Assistance Program) to support construction equipment replacement, marine engine repower, drayage truck replacements, and alternative fuel school bus replacements. H-GAC will work to identify additional funding sources as they become available to provide additional emission reduction projects. Additional funding sources, such as DERA funding, would allow increased participation in the TERP and Congestion Mitigation and Air Quality Clean Vehicles programs by further leveraging program funds.

5.5 CONCLUSIONS (UPDATED)

The TCEQ has employed several sophisticated technical tools to evaluate the past and present causes and effects of high ozone in the HGB area in an effort to predict the area's future air quality. Photochemical grid modeling performance has been rigorously evaluated. Historical trends in ozone and ozone precursor concentrations and their causes have been investigated exhaustively. The following conclusions can be reached from these evaluations.

First, the photochemical grid modeling performs relatively well. Problems observed with the modeling are those that are known to exist in all photochemical modeling exercises. In spite of the known shortcomings, the model can be used carefully to predict ozone concentrations. The photochemical grid modeling predicts that the control strategy package chosen by the TCEQ can lower the ozone design value in the HGB area down to a value very near the 0.08 ppm 1997 eight-hour ozone standard. The dynamic model evaluations show that the model response to emission decreases is less than the response observed in the atmosphere, suggesting that the proposed emission controls are more likely to yield attainment of the 1997 eight-hour ozone standard than the absolute modeled design values indicate.

Second, the ozone trend analyses show that ozone has decreased significantly since the late 1990s. Meteorological variations alone cannot explain the significant downward trend. Decreases in background ozone cannot explain the downward trend either. Significant decreases in ozone precursors, however, coincide with the decreases in ozone, indicating that the ozone decreases observed in the HGB area are due to local emission controls.

Third, many additional air quality improvement measures are being adopted in the HGB area that cannot be included in the photochemical modeling analysis because they cannot be accurately quantified. These measures can provide additional assurance that the HGB area is on the path toward attainment.

Based upon the photochemical grid modeling results and these corroborative analyses, the weight of evidence indicates that the HGB area will attain the 1997 eight-hour ozone standard by June 15, 2019.

5.6 REFERENCES (NO CHANGE FROM 2010 HGB AD SIP REVISION)

CHAPTER 6: ONGOING AND FUTURE INITIATIVES (UPDATED)

6.1 INTRODUCTION (UPDATED)

This chapter is an update to Chapter 6: *Ongoing and Future Initiatives* of the *Houston-Galveston-Brazoria Attainment Demonstration State Implementation Plan for the 1997 Eight-Hour Ozone Standard* (2010 HGB AD SIP Revision).

6.2 ONGOING WORK (UPDATED)

6.2.1 Flare Task Force (Updated)

The Texas Commission on Environmental Quality (TCEQ) conducted the 2010 Flare Study to assist in the agency's ongoing evaluation of flares. For further information on the Flare Study, see Section 6.2.2.3: *Flare Study* or refer to the TCEQ's 2010 Flare Study Web page (http://www.tceq.texas.gov/airquality/stationary-rules/stakeholder/flare_stakeholder.html).

6.2.2 Technologies for Detecting VOC (Updated)

6.2.2.1 Optical Gas Imaging Technology (Updated)

Optical gas imaging technology offers a unique technological advancement in pollution detection capability and has proved to be highly effective in detecting volatile organic compounds (VOC) emissions. Optical gas imaging technology also has the potential to advance leak detection and repair (LDAR) work practices and enable monitoring of components that are difficult to monitor with traditional LDAR methods. Optical gas imaging technology provides opportunities for more rapid detection and repair of VOC emission leaks. The TCEQ encourages the use of optical gas imaging technology to find sources of VOC emissions in a manner that ensures that the technology is being used effectively.

On June 2, 2010, the commission adopted rulemaking to allow the optional use of optical gas imaging technology as an alternative work practice for several LDAR rules in 30 Texas Administrative Code (TAC) Chapter 115 (35 TexReg 5293) (http://www.tceq.texas.gov/assets/public/implementation/air/rules/texas-register/35-texreg-5293.pdf). This rulemaking allows an alternative work practice similar to the federal alternative work practice adopted in December 2008 by the United States Environmental Protection Agency (EPA) in 40 Code of Federal Regulations (CFR) Part 60, §60.18.

6.2.2.2 Open Path Sensing Technology (Updated)

The TCEQ performed a five-week emissions monitoring study in the Texas City area during the summer of 2007 and used mobile Differential Absorption Lidar (DIAL) remote sensing technology to measure emissions from unique sources at industrial sites. The final report is available on the TCEQ's DIAL Study Final Report (http://www.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/ei/DIAL.pdf).

Conclusions drawn from the DIAL Study include the following.

- Compliance with 40 CFR §60.18 does not automatically ensure that the expected flare destruction and removal efficiency (DRE) of 98% will be achieved.
- Reliance on EPA default data to determine emissions for complex liquid mixtures such as crude oil and mid-refined petroleum products could potentially lead to underestimation of emissions.
- Tank condition issues and unique tank processes such as mixing may contribute to underestimation of emissions.

The TCEQ has presented summary technical DIAL study information at five meetings, including the Texas City-La Marque Community Advisory Council meeting in January 2009 and at TCEQ Emissions Inventory and Advanced Air Permitting seminars.

6.2.2.3 Flare Study (Updated)

The TCEQ presented the preliminary TCEQ 2010 Flare Study results at the Flare Task Force Stakeholder Group Meeting held on June 1, 2011. The TCEQ also solicited informal comments on the 2010 Flare Study Draft Final Report. The final report, along with comments received, and other associated documents are available on the TCEQ's 2010 Flare Study Web page (http://www.tceq.texas.gov/airquality/stationary-rules/stakeholder/flare_stakeholder.html#2010-flare-study).

Conclusions drawn from the TCEQ 2010 Flare Study include the following.

- Emergency-sized flares in routine service demonstrated greater than 98% DRE for vent gas streams with low heat content at low flow rates under limited assist-to-vent gas flow rate ratios and operating conditions.
- There was a narrow operating range of assist rates demonstrating 98% DRE for vent gas stream test conditions of low to average heating value even though the flares tested were operated in accordance with 40 CFR §60.18 criteria. When outside of this operating range (i.e., over-assisted), the measured flare DRE was well below 98% DRE (20% to 90% DRE).
- Vent gas heat content had the most impact on increasing the range of operating conditions (assist and vent gas flow rates) capable of achieving 98% DRE.
- A slow-rolling, bright orange flame near the incipient smoke point was observed when flare DRE was measured to be greater than 98%.

The TCEQ has conducted outreach by presenting summary study information at over 23 meetings, including presenting the TCEQ 2010 Flare Study results to over 12 citizen advisory panels in the Gulf Coast area. Several of these meetings included technical presentations to other regulatory agencies and interested stakeholders. The TCEQ has also developed and distributed a general information pamphlet, Visible Flames on Industrial Flares, summarizing key information from the study (http://www.tceq.texas.gov/publications/gi/gi-419.html/at_download/file).

The TCEQ has worked with industry and environmental groups to educate the public and industry in the flare study findings. The TCEQ is currently working with these groups and a contractor to develop a flare training module to further help industry improve flare destruction efficiency under routine, high turndown, operation of assisted flares.

6.2.2.4 Study of Houston Atmospheric Radical Precursors (SHARP) (No Change from 2010 HGB AD SIP Revision)

6.3 FUTURE INITIATIVES (UPDATED)

6.3.1 Mid-Course Review (MCR) (Updated)

In the 2010 HGB AD SIP Revision, the commission included a commitment to provide an MCR by December 2013, to coincide with a state implementation plan (SIP) revision submittal date for the EPA's proposed 2010 ozone standard. The EPA changed course in reconsidering the 2008 eight-hour ozone standard and the proposed 2010 eight-hour ozone standard was not finalized. Instead, the EPA promulgated designations for the 2008 eight-hour ozone standard effective July 20, 2012. The Houston-Galveston-Brazoria (HGB) area was designated nonattainment with a marginal classification. Further, the 1997 eight-hour ozone standard will be revoked effective July 20, 2013. Given these changes to the circumstances surrounding submittal of an MCR, the TCEQ, has focused its review on specific elements that bear the most relevance for supporting the previously submitted attainment demonstration regarding the 1997 eight-hour ozone standard. This SIP revision meets the primary obligations of the MCR commitment.

This SIP revision includes updates to the on-road mobile source emissions inventories for nitrogen oxides (NO_X) and VOC using the EPA's Motor Vehicle Emission Simulator (MOVES) 2010a model. Minor updates to the point, area, and non-road source categories would not change the overall conclusion of the 2010 HGB AD SIP Revision. Emission inventory updates for all source categories will be included as part of the emissions inventory submittal for the 2008 eight-hour ozone standard, which is anticipated to be submitted to the EPA by July 20, 2014. For example, the EPA's final rule for National VOC Emission Standards for Aerosol Coatings mentioned in Chapter 4: *Control Strategies and Required Elements* of the 2010 HGB AD SIP Revision will be updated as part of the emissions inventory submittal for the 2008 eight-hour ozone standard.

This SIP revision also includes:

- updates to the statistical, graphical, and sensitivity analyses of the photochemical modeling, supporting the adequacy of the model's performance evaluation;
- updates to the attainment year (2018 target) ozone projections, including the unmonitored area analysis;
- updates to the matrix modeling, which assesses the change in ozone to the change in VOC and NO_X emissions;
- updates to the source apportionment analyses (Ozone Source Apportionment Technology and Anthropogenic Precursor Culpability Assessment), which identifies the contribution of various emission source categories in various source regions to the 2018 projected ozone concentration; and
- reviews and assessments of the quantitative corroborative analyses used as weight of evidence, in particular, the trends in ozone and precursor emissions.

In addition, the TCEQ has provided an updated analysis regarding the contingency requirement to demonstrate that the 2019 contingency reductions exceed the 3% contingency reduction requirement; therefore, the attainment demonstration contingency requirement for the 1997 eight-hour ozone standard is fulfilled for the HGB area. Additional control measures are not needed to fulfill the 3% contingency requirement of the 2010 HGB AD SIP Revision; however, control measures were reviewed and updated as part of the qualitative corroborative analysis used as weight of evidence in this SIP revision.

The TCEQ has also provided an update on state and federal control measures, including the following measures:

- control of VOC emissions from storage tanks;
- new international marine diesel engine and marine fuel standards for oceangoing vessels and emissions control areas;
- standard of performance for stationary compression ignition internal combustion engines; and
- the Mass Emissions Cap and Trade Program.

The TCEQ's ongoing assessment of new technologies and innovative ideas in this SIP revision includes information regarding the completion of the 2010 Flare Study and subsequent public and industry outreach. Updated information on technologies for detecting VOC such as optical gas imaging technology and open path sensing technology are also included as part of this SIP revision.

6.3.2 2008 and 2010 National Ambient Air Quality Standard (NAAQS) (Updated)

Since the 2010 HGB AD SIP Revision, President Obama requested the EPA withdraw the proposed reconsideration of the 2008 ozone NAAQS. In a September 22, 2011, memo, the EPA announced that it would proceed with initial area designations under the 2008 eight-hour ozone standard, starting with the recommendations states made in 2009 and updating them with the most current, certified air quality data (2008 through 2010). In the May 21, 2012, *Federal Register* (77 FR 30160), the EPA published a final rule to establish thresholds for classifying nonattainment areas for the 2008 eight-hour ozone NAAQS, establish December 31 of each relevant calendar year as the attainment date for each classification, and revoke the 1997 eight-hour ozone NAAQS for purposes of transportation conformity one year after the effective date of the designations for the 2008 ozone NAAQS.

A detailed history is included in Section 1.2.3: *2008 Eight-Hour Ozone NAAQS* of this SIP revision.

CHAPTER 7: REASONABLE FURTHER PROGRESS (RFP) MOTOR VEHICLE EMISSIONS BUDGET (MVEB) UPDATE (ADDED)

7.1 INTRODUCTION

On March 10, 2010, the commission adopted the *Houston-Galveston-Brazoria Reasonable Further Progress State Implementation Plan Revision for the 1997 Eight-Hour Ozone Standard* (2010 HGB RFP SIP Revision). To satisfy the RFP requirements of the Federal Clean Air Act (FCAA), states with nonattainment areas classified as moderate or above are required to submit plans demonstrating reasonable further progress toward attainment of the ozone National Ambient Air Quality Standard (NAAQS). The 2010 HGB RFP SIP Revision is not required or intended to demonstrate attainment of the 1997 eight-hour ozone standard but rather to demonstrate that nitrogen oxide (NO_X) and volatile organic compounds (VOC) emissions, i.e., ozone precursors, in the Houston-Galveston-Brazoria (HGB) nonattainment area will be reduced by:

- 18% from 2002 through 2008;
- 9% from 2009 through 2011;
- 9% from 2012 through 2014;
- 9% from 2015 through 2017;
- 3% in 2018; and
- 3% in 2019 for contingency purposes.

The 2010 HGB RFP SIP Revision demonstrates reasonable further progress toward attainment of the 1997 eight-hour ozone standard by showing FCAA-required, incremental NO_X and VOC emissions reductions from the base year (2002) to attainment of the standard (2018).

The 2010 HGB RFP SIP Revision also contains on-road mobile source emissions inventories, a NO_X MVEB, and a VOC MVEB developed using the United States Environmental Protection Agency's (EPA) MOBILE6.2 mobile source emissions estimation model. The MVEBs determine the allowable on-road mobile emissions an area can produce while continuing to demonstrate reasonable further progress. On March 2, 2010, the EPA officially released a new mobile source emissions estimation model, the Motor Vehicle Emission Simulator (MOVES) model, to replace the MOBILE model for state implementation plan (SIP) applications.

Beginning March 2, 2013, transportation conformity must be conducted using the MOVES mobile source emissions estimation model. To demonstrate transportation conformity, a nonattainment area must show that its metropolitan transportation plans, transportation improvement programs, and projects funded by the Federal Highway Administration or the Federal Transit Administration conform to the MVEBs established in the SIP. Updating MVEBs using MOVES-based on-road mobile emissions inventories requires a SIP revision. This proposed SIP revision would facilitate future MOVES-based transportation conformity determinations by providing MVEBs based on the latest version of the MOVES model, MOVES2010a.

This proposed SIP revision would replace the 2010 HGB RFP SIP Revision on-road mobile source emissions inventories for NO_X and VOC based on the EPA's MOBILE6.2 model with those based on the EPA's MOVES2010a model. On-road mobile source emissions inventory updates include those for 2002, 2008, 2011, 2014, 2017, and 2018. In addition, 2008, 2011, 2014, 2017, and 2018 NO_X and VOC MVEBs would be updated with the MOVES-based emissions inventories.

This proposed SIP revision would incorporate the strategy outlined in an October 13, 2011, letter to the EPA and satisfy the EPA's MOVES implementation policy guidance[4] concerning updating MVEBs in attainment demonstrations.

Growth and control strategy assumptions continue to be valid for the point, area, and non-road mobile source categories in the 2010 HGB RFP SIP Revision. Minor updates have occurred to some of these source categories since the 2010 revision; however, these updates would not change the overall conclusion of the 2010 RFP SIP Revision. Therefore, updates to the point, area, and non-road mobile source categories are not being included in this SIP revision. Updates to these source categories will be addressed as part of the emissions inventory submittal to the EPA for the 2008 eight-hour ozone standard.

This chapter is an update to the 2010 HGB RFP SIP Revision; therefore, major sections in Chapter 7 represent chapters of the 2010 HGB RFP SIP Revision. For example, Section 7.2: *Emissions Inventories* represents Chapter 2: *Emissions Inventories* of the 2010 HGB RFP SIP Revision. The tables and figures in Chapter 7 correspond to, but may be formatted differently than those in the 2010 HGB RFP SIP Revision. References to chapters and sections of the 2010 HGB RFP SIP Revision have been made for additional information.

7.2 EMISSIONS INVENTORIES

7.2.1 Introduction

On March 10, 2010, the commission adopted the 2010 HGB RFP SIP. The on-road mobile source emissions inventories for the 2010 HGB RFP SIP Revision were developed using MOBILE6.2, the mobile source emissions estimation model required by the EPA at the time. The EPA officially released the MOVES mobile source emissions estimation model on March 2, 2010, as a replacement to MOBILE6.2 for SIP and transportation conformity applications. The EPA released a revised version of MOVES, MOVES2010a, on September 23, 2011. In order to have MOVES-based transportation conformity MVEBs, the on-road mobile emissions inventories adopted in the 2010 HGB RFP SIP Revision must be updated.

Updates have not occurred to the point and biogenic emissions inventories since the 2010 HGB RFP SIP Revision. Updates have occurred to the area and non-road emissions inventories since the 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB RFP SIP Revision. Therefore, the updates to point, biogenic, area, non-road inventories are not being included in this SIP revision. Any updates to these source emissions inventories will be addressed as part of the emissions inventory submittal to the EPA for the 2008 eight-hour ozone standard.

States are required by Phase II of the EPA's implementation rule for the 1997 eight-hour ozone standard to demonstrate an average of 3% annual reductions of VOC and/or NO_X emissions out to a severe nonattainment area's attainment date[5]. Demonstration of the reductions is required for the six-year period following the base year, 2002 through 2008, and every subsequent three-

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[4] EPA, 2009. "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes." Transportation and Regional Programs Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, EPA-420-B-09-046, December 2009.

[5] *Federal Register*, Tuesday, November 29, 2005, Environmental Protection Agency, 40 CFR Parts 51, 52, and 80, Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard-Phase 2; Final Rule.

year period: 2011, 2014, 2017, and the attainment year, 2018. In accordance with this requirement, this SIP revision includes an anthropogenic emissions inventory from the 2002 base year and projected anthropogenic (area, point, non-road, and on-road sources) emissions inventories for the RFP milestone years 2008, 2011, 2014, 2017, and 2018 to provide a basis for demonstrating how the required emissions reductions will be met.

To develop an RFP SIP revision, states must:

1. determine the base year emissions for NO_X and VOC, which includes adjusting the inventory to remove certain emissions reductions for which credit cannot be taken;
2. calculate RFP target emissions reductions levels based on the 3% per year requirement; and
3. subtract post-control emissions reductions from milestone year uncontrolled NO_X and VOC emissions growth.

When the RFP post-control emissions reductions meet or exceed the calculated target emissions reductions, then RFP is demonstrated.

This SIP revision includes:

- a 2002 base year emissions inventory;

  The base year emissions inventory is the starting point for calculating the target levels of emissions. Only the base year emissions inventory for on-road mobile sources has been updated since the 2010 HGB RFP SIP revision. A discussion of the on-road mobile emissions inventory is provided in Section 7.2.5: *On-Road Mobile Sources*.

- 2002, 2008, 2011, 2014, 2017, and 2018 adjusted base year (ABY) emissions inventories;

  The 2002, 2008, 2011, 2014, 2017, and 2018 RFP ABY emissions inventories represent the 2002 base year emissions inventory adjusted to account for reductions from non-creditable control programs that were promulgated prior to the 1990 FCAA Amendments. For this SIP revision, the on-road mobile source ABY inventories have been updated using MOVES2010a. A discussion of the on-road mobile source ABY inventory is provided in Section 7.2.5.

- 2008, 2011, 2014, 2017, and 2018 uncontrolled emissions inventories;

  Uncontrolled milestone year emissions inventories represent what emissions inventories for each milestone year would be if no further action to control emissions were taken beyond the controls already accounted for in the 2002 base year emissions inventory. For this SIP revision, the uncontrolled on-road mobile inventories have been updated using MOVES2010a. A discussion of the uncontrolled on-road mobile inventories is provided in Section 7.2.5.

- 2008, 2011, 2014, 2017, and 2018 milestone year control reductions;

  The RFP analysis requires the calculations of emissions reductions for control strategies, which are then subtracted from the uncontrolled emissions to determine the post-control RFP inventory values. This SIP revision updates the estimates for all on-road mobile source control reductions using MOVES2010a. A discussion of RFP control strategies is provided in Section 7.4: *Control Measures to Achieve Target Levels*.

- 2008, 2011, 2014, 2017, and 2018 post-control emissions inventories; and

  The post-control milestone year emissions inventories represent each milestone year, along with growth from the 2002 base year, with all RFP controls taken into account. The post-control milestone year emissions inventories include pre-2002 FCAA controls, growth in activity from the base year to the milestone year, and post-2002 FCAA controls used to meet RFP target emissions levels, but the inventories do not include post-2002 FCAA controls that are not used to meet RFP target emissions levels. A discussion of MOVES-based updates to the on-road mobile source post-control inventories is provided in Section 7.4.

- 2018 attainment year RFP contingency control reductions.

  The RFP analysis requires the calculation of the emissions reductions for control strategies for the year following the attainment year. These control reductions can be implemented in case there is a failure to meet a milestone requirement. A discussion of the RFP contingency control strategies for this SIP revision is provided in Section 7.4.7: *Contingency Measures*.

For a full discussion regarding the emissions inventory RFP elements required for the HGB 1997 eight-hour ozone nonattainment area, refer to Chapter 2 of the 2010 HGB RFP SIP Revision.

7.2.2 Point Sources

Updates have not occurred to the point source emissions inventory since the 2010 HGB RFP SIP Revision.

7.2.3 Area Sources

Updates have occurred to the area source emissions inventory since the 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB RFP SIP Revision.

7.2.4 Non-Road Mobile Sources

Updates have occurred to the non-road mobile source emissions inventory since the 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB RFP SIP Revision.

7.2.5 On-Road Mobile Sources

On-road mobile source category emissions inventories presented in the 2010 HGB RFP SIP Revision were developed using the EPA's MOBILE6.2 model. The EPA officially released the MOVES model on March 2, 2010, as a replacement to MOBILE6.2 for SIP and transportation conformity applications. The EPA released a revised version of MOVES, MOVES2010a, on September 23, 2011. In order to have MOVES-based transportation conformity MVEBs, the on-road mobile emissions inventories used in the 2010 HGB RFP SIP Revision are being updated in this SIP revision. This section documents the MOVES-based inventories developed for this SIP revision.

The development of on-road mobile source emissions inventories used for SIP revisions includes use of the latest available data, most current models, and the most current planning assumptions. Changes in the base and milestone year inventories of a SIP revision can occur if there have been changes to any of the underlying tools or data used in inventory development. Details of the inventory development are provided in Appendix D: *Revisions to Appendix 9, Houston-Galveston-Brazoria 1997 Eight-Hour Ozone Nonattainment Area Reasonable Further Progress On-Road Mobile Source Emissions Inventories, Adopted March 10, 2010*.

7.2.5.1 Emissions Inventory Development

In March 2010, the EPA replaced the MOBILE model with MOVES as the mobile source emissions estimation model for developing on-road mobile source emissions inventories. Although MOVES represents a new approach to assessing on-road emissions, the sources and the opportunity to use local inputs for meteorological conditions, control programs, and fleet characteristics are the same. The primary approach to developing an on-road inventory is the same with either MOVES or MOBILE. With both models, emissions rates are produced for subsets of the on-road fleet, and the emissions rates are multiplied by the activity level of each vehicle type or source-use type. The development of on-road mobile SIP inventories requires that the level of disaggregation of the vehicle miles traveled (VMT) be done at the roadway link level. The methods used and the results of the MOVES mobile source inventory assessment are documented in Appendix D.

Emission factors for this SIP revision were developed using MOVES2010a. MOVES2010a may be run using default information, or the default information may be modified to simulate the driving behavior, meteorological conditions, and vehicle characteristics specific to the HGB area. Because modifications to the inputs significantly influence the emission factors calculated by MOVES2010a, every effort was made to input parameters reflecting local conditions rather than relying on national default values. The localized inputs used for the HGB RFP on-road mobile source emissions inventory development include vehicle speeds for each roadway link, temperature, humidity, vehicle age distributions for each vehicle type, percentage of miles traveled for each vehicle type, type of inspection and maintenance (I/M) program, fuel control programs, and gasoline vapor pressure controls.

To estimate on-road mobile source emissions, emission rates calculated using MOVES2010a must be multiplied by the level of vehicle activity. On-road mobile source emission factors are expressed in units of grams per mile; therefore, the activity information that is required to complete the inventory calculation is VMT in units of miles per day. The level of vehicle travel activity for the HGB area is developed using a travel demand model (TDM) run by the Houston-Galveston Area Council, the local metropolitan planning organization for the HGB area. The TDM is validated against a large number of ground counts, i.e., traffic passing over counters placed in various locations throughout a county or area. For SIP inventories, VMT estimates are calibrated against outputs from the federal Highway Performance Monitoring System, a model built from a different set of traffic counters.

In addition to the number of miles traveled on each roadway link, the speed on each roadway type or segment is also needed to complete an on-road emissions inventory. Roadway speeds, required inputs for MOVES2010a, are calculated by using the activity volumes from the TDM and a post-processor speed model.

A summary of the on-road mobile source VMT used to develop the various NO_X and VOC emissions levels is presented in Table 7-1: *HGB RFP Ozone Season Weekday On-Road Mobile Source VMT (miles per day)*. The on-road mobile source ABY emissions inventories are summarized in Table 7-2: *HGB RFP Ozone Season Weekday On-Road Mobile Source Adjusted Base Year NO_X and VOC Emissions (tons per day)*. The RFP uncontrolled and post-control on-road mobile source emissions inventories are summarized in Table 7-3: *HGB RFP Ozone Season Weekday On-Road Mobile Source Uncontrolled and Post-Control NO_X and VOC Emissions (tons per day)*. For complete documentation of the development of the on-road mobile source emissions inventories for this SIP revision, refer to Appendix D. The complete set of input and output files are available from the Texas Commission on Environmental Quality (TCEQ) Air Quality Division upon request.

Table 7-1: HGB RFP Ozone Season Weekday On-Road Mobile Source VMT (miles per day)

RFP Analysis Year	Adjusted Base Year	Uncontrolled Emissions Inventory	Post-control Emissions Inventory
2002	128,145,285	128,145,285	128,145,285
2008	128,145,285	145,079,180	145,079,180
2011	128,145,285	157,480,120	157,480,120
2014	128,145,285	168,350,216	168,350,216
2017	128,145,285	179,999,154	179,999,154
2018	128,145,285	184,065,162	184,065,162

Table 7-2: HGB RFP Ozone Season Weekday On-Road Mobile Source Adjusted Base Year NO_X and VOC Emissions (tons per day)

RFP Analysis Year Inventory	ABY NO_X	ABY VOC
2002	552.30	205.76
2008	578.29	205.89
2011	601.92	214.76
2014	600.98	210.66
2017	599.24	208.69
2018	598.95	208.33

Table 7-3: HGB RFP Ozone Season Weekday On-Road Mobile Source Uncontrolled and Post-Control NO_X and VOC Emissions (tons per day)

RFP Analysis Year Inventory	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
2002 Base Year	552.30	371.89	205.76	124.47
2008	653.33	238.13	233.94	92.91
2011	744.52	213.57	266.44	85.05
2014	793.84	156.03	279.29	65.04
2017	850.60	118.17	298.20	54.34
2018	870.89	109.98	304.27	51.84

7.2.5.2 Updated 2002 Base Year Inventory

The 2002 base year emissions inventory for on-road mobile sources was updated using emission factors calculated using MOVES2010a. Additional updates were made to incorporate the latest activity estimates from the HGB TDM network. Only control strategies implemented prior to 2002 were included in the input to the emissions inventory development for the 2002 on-road mobile source base year emissions inventory. Those controls include: pre-1990 Federal Motor Vehicle Control Program (FMVCP); post-1990 FMVCP; federal reformulated gasoline (RFG); and the HGB vehicle I/M program. The activity levels used to calculate the emissions inventory reflect the 2002 roadway network with 2002 VMT and speeds. A summary of the emissions inventory is presented in Table 7-3. For complete documentation of the development of the emissions inventory and details on MOVES2010a model inputs, refer to Appendix D.

7.2.5.3 Updated 2002 Adjusted Base Year Inventories for the Base and Milestone Years

An ABY emissions inventory for on-road mobile sources, which reflects only control strategies implemented prior to 1990, was developed for each milestone year using emission factors from MOVES2010a. A summary of the emissions inventories and associated non-creditable emissions reductions is presented in Table 7-4: *Summary of HGB RFP On-Road Mobile Source Non-Creditable NO_X Reductions (tons per day)* and Table 7-5: *Summary of HGB RFP On-Road Mobile Source Non-Creditable VOC Reductions (tons per day)*. Creditable controls are discussed in Section 7.2.4.5: *Updated Post-Control Milestone Year Emissions Inventories*. For complete documentation of the development of the emissions inventory and details on MOVES2010a model inputs, refer to Appendix D.

Table 7-4: Summary of HGB RFP On-Road Mobile Source Non-Creditable NO_X Reductions (tons per day)

Analysis Year	ABY NO_X	Non-creditable NO_X Emission Reductions
2002	552.30	N/A
2008	578.29	-25.99
2011	601.92	-23.63
2014	600.98	0.94
2017	599.24	1.74
2018	598.95	0.29

Table 7-5: Summary of HGB RFP On-Road Mobile Source Non-Creditable VOC Reductions (tons per day)

Analysis Year	ABY VOC	Non-creditable VOC Emission Reduction
2002	205.76	N/A
2008	205.89	-0.13
2011	214.76	-8.87
2014	210.66	4.10
2017	208.69	1.97
2018	208.33	0.36

7.2.5.4 Updated Uncontrolled Milestone Year Emissions Inventories

The uncontrolled on-road mobile emissions inventories for each RFP milestone year were developed using emission factors that reflect only control strategies implemented prior to 2002. MOVES2010a was used to develop the emissions inventories for this SIP revision. The activity levels were updated to include the latest output from the HGB TDM. The activity levels used to calculate the emissions inventory reflect the milestone roadway network, with milestone year VMT and speeds. Summaries of the on-road emissions inventories for 2008, 2011, 2014, 2017, and 2018 are presented in:

- Table 7-6: *2008 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions*;
- Table 7-7: *2011 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions*;
- Table 7-8: *2014 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions*;
- Table 7-9: *2017 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions*; and
- Table 7-10: *2018 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions*.

For complete documentation of the development of the emissions inventory and details on MOVES2010a model inputs, refer to Appendix D.

7.2.5.5 Updated Post-Control Milestone Year Emissions Inventories

The post-control on-road mobile emissions inventories for each RFP milestone year were developed using emission factors that reflect both the control strategies implemented prior to 2002 and the control strategies used to demonstrate compliance with RFP requirements. Those controls include pre-1990 FMVCP, fleet turnover to Tier 1 of the FMVCP, fleet turnover to Tier 2 of the FMVCP, the 2007 heavy duty diesel FMVCP, summer RFG, the HGB vehicle I/M program, the anti-tampering program, and Texas Low Emission Diesel (TxLED). Control scenario inventory values include both the post-control emissions inventory and the level of reductions for each control strategy. Uncontrolled on-road mobile emissions inventories, on-road mobile control reductions, and the resulting post-control on-road mobile emissions inventories for 2008, 2011, 2014, 2017, and 2018 are summarized in Table 7-6, Table 7-7, Table 7-8, Table 7-9, and Table 7-10. MVEB calculations for the 2008, 2011, 2014, 2017, and 2018 milestone years are documented in Section 7.5: *Motor Vehicle Emissions Budgets*.

The activity levels used to calculate the emissions inventory reflect the milestone roadway network with milestone year VMT and speeds. For complete documentation of the development of the emissions inventory and details on MOVES2010a model inputs, refer to Appendix D.

Table 7-6: 2008 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
2008 uncontrolled inventory	653.33	233.94
RFG	150.64	22.03
FMVCP	241.17	109.17
I/M	17.35	9.56
TxLED	6.03	0.00
2008 post-control inventory	238.13	92.91

Table 7-7: 2011 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
2011 uncontrolled inventory	744.52	266.44

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
RFG	189.54	22.79
FMVCP	319.72	148.83
I/M	16.62	9.77
TxLED	5.08	0.00
2011 post-control inventory	213.57	85.05

Table 7-8: 2014 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
2014 uncontrolled inventory	793.84	279.29
RFG	213.44	17.27
FMVCP	409.05	188.98
I/M	11.80	7.99
TxLED	3.52	0.00
2014 post-control inventory	156.03	65.04

Table 7-9: 2017 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
2017 uncontrolled inventory	850.60	298.20
RFG	235.00	14.12
FMVCP	486.84	222.89
I/M	8.03	6.86
TxLED	2.55	0.00
2017 post-control inventory	118.17	54.34

Table 7-10: 2018 HGB RFP Ozone Season Weekday On-Road Mobile Source NO_X and VOC Emissions and Control Strategy Reductions

On-Road Mobile Emissions Inventory Strategies	NO_X (tons per day)	VOC (tons per day)
2018 uncontrolled inventory	870.89	304.27
RFG	241.29	13.48
FMVCP	510.15	232.44
I/M	7.10	6.51
TxLED	2.36	0.00
2018 post-control inventory	109.98	51.84

7.2.6 Biogenic Sources

Updates have not occurred to the biogenic source emissions inventory since the 2010 HGB RFP SIP Revision. Biogenic emissions are excluded from the RFP methodology because biogenic emissions inventories are not used for RFP determinations; therefore, biogenic emissions were subtracted from the 2002 base year emissions inventory for this SIP revision.

7.2.7 Emissions Summary

The only change to the RFP demonstration since the 2010 HGB RFP SIP Revision is that on-road mobile sources have been updated using the EPA's on-road mobile source inventory development tool, MOVES2010a. The emissions summary tables for the RFP base year and each RFP milestone year have been updated with the new on-road emissions values and the corresponding new total emissions. The uncontrolled and post-control base year NO_X and VOC emissions in the HGB area for each RFP source category are summarized in Table 7-11: *Summary of the 2002 Base Year Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)*. HGB-area uncontrolled and post-control NO_X and VOC emissions for each RFP source category and milestone year are summarized in:

- Table 7-12: *Summary of the 2008 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day);*
- Table 7-13: *Summary of the 2011 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)*;
- Table 7-14: *Summary of the 2014 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)*;
- Table 7-15: *Summary of the 2017 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day);* and
- Table 7-16: *Summary of the 2018 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day).*

Where there is no difference between the uncontrolled and post-control emissions for the base year and all milestone years, there were no controls applied to the projected source inventories.

Table 7-11: Summary of the 2002 Base Year Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	339.29	339.29	316.62	316.62
Area Sources	89.11	89.11	407.61	407.61
Non-Road Mobile Sources	166.98	156.98	100.15	84.32
On-Road Mobile Sources with MOVES2010a	552.30	371.89	205.76	124.47
Total of All Sources	1147.68	957.27	1030.14	933.02

Table 7-12: Summary of the 2008 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	375.56	155.73	333.14	170.05

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Area Sources	89.63	89.63	371.82	371.82
Non-Road Mobile Sources	202.72	149.44	113.68	69.23
On-Road Mobile Sources with MOVES2010a	653.33	238.13	233.94	92.91
Total of All Sources	1321.24	632.93	1052.58	704.00

Table 7-13: Summary of the 2011 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	383.85	156.21	338.75	164.33
Area Sources	93.90	93.90	382.72	379.04
Non-Road Mobile Sources	210.01	138.83	120.10	64.03
On-Road Mobile Sources with MOVES2010a	744.52	213.57	266.44	85.05
Total of All Sources	1432.28	602.51	1108.01	692.45

Table 7-14: Summary of the 2014 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	401.05	157.17	347.70	172.31
Area Sources	96.01	96.01	393.07	383.42
Non-Road Mobile Sources	220.48	128.45	126.28	61.42
On-Road Mobile Sources with MOVES2010a	793.84	156.03	279.29	65.04
Total of All Sources	1511.38	537.67	1146.34	682.18

Table 7-15: Summary of the 2017 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	421.57	158.33	358.79	181.86
Area Sources	98.23	98.23	404.84	394.74
Non-Road Mobile Sources	230.99	121.15	132.38	60.05
On-Road Mobile Sources with MOVES2010a	850.60	118.17	298.20	54.34
Total of All Sources	1601.38	495.88	1194.21	691.00

Table 7-16: Summary of the 2018 Ozone Season Weekday NO_X and VOC Emissions for the HGB RFP (tons per day)

Emissions Inventory Source	Uncontrolled NO_X	Post-control NO_X	Uncontrolled VOC	Post-control VOC
Point Sources	428.69	158.75	362.90	185.38
Area Sources	99.38	99.38	408.82	398.57
Non-Road Mobile Sources	237.25	119.88	134.29	59.84
On-Road Mobile Sources with MOVES2010a	870.89	109.98	304.27	51.84
Total of All Sources	1636.21	487.99	1210.28	695.63

7.3 TARGET EMISSIONS LEVELS AND RFP DEMONSTRATION

7.3.1 Introduction

This section describes how the HGB RFP demonstration is calculated, documents the RFP calculations, and provides a summary of the HGB RFP demonstration for all RFP milestone years.

The RFP analyses presented in this SIP revision are based on HGB area inventories that have been updated to include on-road mobile emissions inventories based on MOVES2010a that were developed by the Texas Transportation Institute (TTI) working under contract for the TCEQ.

7.3.2 Target Level Methodology

There have been no changes to the six-step process used to calculate the maximum amount of emissions the HGB nonattainment area can emit for each RFP milestone year since the 2010 HGB RFP SIP Revision. For a full discussion regarding the RFP target level methodology, refer to Chapter 3: *Target Emissions Levels and Reasonable Further Progress Demonstration* of the 2010 HGB RFP SIP Revision.

7.3.3 Calculations of Target Emissions Levels

A summary of the six-step process described above for 2008 target calculations is presented in Table 7-17: *Summary of the Calculation Process for 2008 HGB RFP Target Levels*. The summary table serves as an example of how all target levels for each milestone year are calculated. Summaries of all target levels are found in Table 7-21: *Post-2002 RFP Target Level of NO_X Emissions (tons per day)* and Table 7-22: *Post-2002 RFP Target Level of VOC Emissions (tons per day)*.

Table 7-17: Summary of the Calculation Process for 2008 HGB RFP Target Levels

Description	NO_X	VOC
1: Step 1: 2002 base year emissions inventory (see Table 7-11)	957.27 tpd	933.02 tpd
2: Step 2: Add or subtract emissions that are to be included from outside the nonattainment area	0.00 tpd	0.00 tpd
3: Revised 2002 RFP Base Year emissions inventory (see Table 7-16) (Line 1 minus Line 2)	957.27 tpd	933.02 tpd
4: Step 3: 2002 On-road ABY emissions inventory (see Table 7-4 and Table 7-5)	552.30 tpd	205.76 tpd

Description	NO_X	VOC
5: 2008 On-road ABY emissions inventory (see Table 7-4 and Table 7-5)	578.29 tpd	205.89 tpd
6: Step 4: Calculate non-creditable reductions 2002 to 2008 (see Table 7-4 and Table 7-5) (Line 4 minus Line 5)	-25.99 tpd	-0.13 tpd
7: 2008 ABY emissions inventory for eight HGB counties	983.26 tpd	933.15 tpd
8: Percent of NO_X (PN) and VOC (PV) to meet 18% reduction requirement, PN + PV = 18	17%	1%
9: Step 5: Calculate the 2002-to-2008 18% NO_X and VOC reduction requirement (Line 7 x Line 8)	167.15 tpd	9.33 tpd
10: Step 6: Calculate the target level of emissions (Line 3 minus Line 6 minus Line 9)	**816.10 tpd**	**923.82 tpd**

Step one of the RFP target calculation process involves the development of the 2002 base year emissions inventory. The EPA guidance specifies the method states must use to develop the base year emissions inventory and all other SIP emissions inventories.[6] Details of the development of the 2002 HGB base year emissions inventory are discussed in Section 7.2. Summaries for the 2002 HGB base year NO_X and VOC emissions inventory are presented in Table 7-11.

Step two of the RFP target calculation process adds or subtracts any emissions from outside the nonattainment area that need to be included with or excluded from the nonattainment area emissions inventory. For this SIP revision, the revised 2002 RFP base year emissions inventory is the same as the 2002 base year emissions inventory.

Step three of the RFP target calculation process involves the development of the on-road ABY emissions inventories for 2002, 2008, 2011, 2014, 2017, and 2018. The emissions rates for an ABY emissions inventory are developed using MOVES2010a. The model input file is set up to turn off all 1990 FCAA effects, and the model evaluation year is set to the RFP base or milestone year. The model is run to determine emission factors for each base or milestone year with only pre-1990 FCAA controls. The emission factors for all years are then multiplied by the 2002 base year VMT. Since all of the resulting emissions inventories use the base year VMT, they are referred to as RFP ABY emissions inventories. Details of the development of the HGB RFP ABY emissions inventories are included in Section 7.2 of this document and in Appendix D.

Step four of the RFP target calculation process, calculating the non-creditable fleet turnover correction, is accomplished by subtracting the RFP ABY emissions inventory for each milestone year from the ABY emissions inventory for the previous RFP milestone year. Since the ABY emissions inventories estimate the effects of the non-creditable pre-1990 FCAA controls, the difference between RFP ABY emissions inventories represent an estimate of the non-creditable RFP emissions reductions, also referred to as the fleet turnover correction. Table 7-18: *Summary of Non-Creditable NO_X Fleet Turnover Reduction (tons per day)* and Table 7-19: *Summary of Non-Creditable VOC Fleet Turnover Reduction (tons per day)* provide a summary of the fleet turnover corrections for all RFP milestone years. Refer to Chapter 3 of the 2010 HGB RFP SIP Revision for the equations for calculating the fleet turnover correction between two milestone years.

[6] References for guidance documents used for emissions inventory development in this RFP SIP revision are listed in the *References for Guidance Documents* section at the end of this chapter.

Table 7-18: Summary of Non-Creditable NO_X Fleet Turnover Reduction (tons per day)

RFP Analysis Year	On-road Mobile ABY NO_X	Non-creditable NO_X Fleet Turnover Reduction	Non-creditable Pre-1990 FCAA Fleet Turnover Reduction Years
2002	552.30	N/A	N/A
2008	578.29	-25.99	2002 through 2008
2011	601.92	-23.63	2008 through 2011
2014	600.98	0.94	2011 through 2014
2017	599.24	1.74	2014 through 2017
2018	598.95	0.29	2017 through 2018

Table 7-19: Summary of Non-Creditable VOC Fleet Turnover Reduction (tons per day)

RFP Analysis Year	On-road Mobile ABY VOC	Non-creditable VOC Fleet Turnover Reduction	Non-creditable Pre-1990 FCAA Fleet Turnover Reduction Years
2002	205.76	N/A	N/A
2008	205.89	-0.13	2002 through 2008
2011	214.76	-8.87	2008 through 2011
2014	210.66	4.10	2011 through 2014
2017	208.69	1.97	2014 through 2017
2018	208.33	0.36	2017 through 2018

Step five of the RFP target calculation process, calculating the required 3% per year emissions reduction amount, is accomplished by multiplying the RFP milestone year ABY emissions inventory values by the percent reduction needed to meet RFP requirements. For the HGB nonattainment area, the first requirement is to reduce emissions by 18% from 2002 through 2008, and the post-2008 requirement is to reduce emissions by 3% per year from 2008 through the attainment year. Phase II of the EPA's implementation rule for the 1997 eight-hour ozone standard allows ozone nonattainment areas to substitute NO_X reductions for VOC reductions, but use of NO_X emissions reductions must meet the criteria in §182(c)(2)(C) in the FCAA (70 FR 71612). The total of the percent NO_X and VOC reductions must equal the total emissions reductions requirements for each milestone year. The 2008 reduction requirement is met for the eight nonattainment counties through a 17% NO_X reduction and a 1% VOC reduction. For the milestone years after 2008, the reduction requirement for this RFP SIP revision is satisfied by taking 0.5% per year reduction from VOC emissions and 2.5% from NO_X emissions. Refer to Chapter 3 of the 2010 HGB RFP SIP Revision for a full description of the method used to calculate the percentage of NO_X emissions substituted for VOC emissions.

Emissions reductions percentages are multiplied by their corresponding NO_X and VOC milestone year ABY emissions inventories to calculate the required NO_X and VOC emissions reductions for each milestone year. Table 7-20: *Calculation of Required 18% and 3% per Year NO_X and VOC Reductions for the HGB RFP* provides a summary of the NO_X and VOC reductions needed to satisfy the 3% per year requirement for all RFP milestone years. Refer to Chapter 3 of the 2010 HGB RFP SIP Revision for the equations for calculating the 3% required reductions for NO_X and VOC.

Table 7-20: Calculation of Required 18% and 3% per Year NO_X and VOC Reductions for the HGB RFP

RFP Analysis Year	Total Percent Reduction Requirement	Percent NO_X	Percent VOC	ABY Emissions Inventory NO_X (tpd)	ABY Emissions Inventory VOC (tpd)	Required Reductions NO_X (tpd)	Required Reductions VOC (tpd)
2008	18.0	17.0	1.0	983.26	933.15	167.15	9.33
2011	9.0	8.5	0.5	1006.89	942.02	85.59	4.71
2014	9.0	8.5	0.5	1005.95	937.92	85.51	4.69
2017	9.0	8.5	0.5	1004.21	935.95	85.36	4.68
2018	3.0	2.5	0.5	1003.92	935.59	25.10	4.68

Step six of the RFP target calculation process, calculating RFP emissions target levels, is accomplished by subtracting the required emissions reductions (step five) and the fleet turnover correction factor (step four) from the 2002 base year emissions inventory. Refer to Chapter 3 of the 2010 HGB RFP SIP Revision for a full discussion regarding the method used for calculating the target levels of emissions for the HGB RFP milestone years.

Appendix C: *Revisions to Appendix 1, HGB Reasonable Further Progress Demonstration Calculations Spreadsheet, Adopted March 10, 2010* documents the calculation of the target values for all RFP milestone years. Table 7-17 provides a step-by-step summary of the calculation of the 2008 target levels for the HGB nonattainment area. Table 7-21 and Table 7-22 summarize the calculation of the target levels of VOC and NO_X for all RFP milestone years and provide the FMVCP non-creditable emissions reductions. Section 7.3.5: *RFP Demonstration* and Section 7.4 describe how the target levels are integrated into the RFP demonstration.

Table 7-21: Post-2002 RFP Target Level of NO_X Emissions (tons per day)

RFP Milestone Year	Previous Target	FMVCP Non-Creditable Reduction	Post-2002 Percent Reduction Requirement NO_X	NO_X Target
2002 Base Year	N/A	N/A	N/A	[1]957.27
2008	957.27	[2]-25.99	167.15	816.10
2011	816.10	[2]-23.63	85.59	754.15
2014	754.15	0.94	85.51	667.70
2017	667.70	1.74	85.36	580.60
2018	580.60	0.29	25.10	555.22

[1] This number is the base year emissions inventory, which is the starting point for calculating target values.

[2] Calculations, based on EPA guidance and on the MOVES model, produced a negative number due to the decreasing influence of Tier 0 FMVCP on emission factors.

Table 7-22: Post-2002 RFP Target Level of VOC Emissions (tons per day)

RFP Milestone Year	Previous Target	FMVCP Non-Creditable Reduction	Post-2002 Percent Reduction Requirement VOC	VOC Target
2002 Base Year	N/A	N/A	N/A	[1]933.02
2008	933.02	[2]-0.13	9.33	923.82
2011	923.82	[2]-8.87	4.71	927.98
2014	927.98	4.10	4.69	919.19
2017	919.19	1.97	4.68	912.54
2018	912.54	0.36	4.68	907.50

[1] This number is the base year emissions inventory, which is the starting point for calculating target values.

[2] Calculations, based on EPA guidance and on the MOVES model, produced a negative number due to the decreasing influence of Tier 0 FMVCP on emission factors.

7.3.4 Growth

The HGB RFP SIP revision must account for any growth in emissions between 2002 and each RFP milestone year (2008, 2011, 2014, 2017, and 2018). The NO_X and VOC uncontrolled projected milestone year emissions inventories are derived by applying the appropriate projection methodologies to the 2002 base year emissions inventory, emission factor development, and/or to activity level estimates. The method for accounting for growth is based on EPA guidance for performing RFP calculations.[7] The development of the uncontrolled projected emissions inventory is documented in Section 7.2. The development of the projected control reductions is documented in Section 7.4.

7.3.5 RFP Demonstration

RFP demonstration calculations using the MOVES2010a-based on-road mobile source emissions inventories were completed for the 2008, 2011, 2014, 2017, and 2018 milestone years. The demonstration of the RFP SIP revision for each milestone year is summarized in:

- Table 7-23: *Summary of the 2008 HGB RFP Demonstration (tons per day)*;
- Table 7-24: *Summary of the 2011 HGB RFP Demonstration (tons per day)*;
- Table 7-25: *Summary of the 2014 HGB RFP Demonstration (tons per day)*;
- Table 7-26: *Summary of the 2017 HGB RFP Demonstration (tons per day)*; and
- Table 7-27: *Summary of the 2018 HGB RFP Demonstration (tons per day)*.

All RFP calculations, including the required reductions, the fleet turnover correction factor, and the target emissions levels, are shown in Appendix C. Details of the controls used to calculate the creditable RFP emissions reductions for each milestone year are documented in Section 7.4 and summarized in:

[7] EPA, "Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard; Final Rule," *Federal Register* (70 FR 71631), November 29, 2005.

- Table 7-28: *Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2002 through 2008 (tons per day)*;
- Table 7-29: *Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2008 through 2011 (tons per day)*;
- Table 7-30: *Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2011 through 2014 (tons per day)*;
- Table 7-31: *Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2014 through 2017 (tons per day)*; and
- Table 7-32: *Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2017 through 2018 (tons per day)*.

This SIP revision demonstrates reasonable further progress toward attainment of the 1997 eight-hour ozone standard for all the milestone years, 2008, 2011, 2014, 2017, and 2018. This SIP revision also demonstrates the required contingency emissions reductions are available for the 2008, 2011, 2014, and 2017 milestone years as well as the 2018 attainment year.

Table 7-23: Summary of the 2008 HGB RFP Demonstration (tons per day)

Line #	Description	NO_X	VOC
Line 1	Uncontrolled Emissions Forecast With Growth	1321.24	1052.58
Line 2	Creditable RFP Control Reductions for 2008	678.69	169.45
Line 3	Controlled RFP Emissions Forecast (Line 1 minus Line 2)	642.55	883.13
Line 4	RFP Target Level of Emissions	816.10	923.82
Line 5	Excess (+) / Shortfall (-) (Line 4 minus Line 3)	+173.55	+40.69
Line 6	**Is post-control RFP emissions inventory less than target level of emissions?**	**Yes**	**Yes**

Table 7-24: Summary of the 2011 HGB RFP Demonstration (tons per day)

Line #	Description	NO_X	VOC
Line 1	Uncontrolled Emissions Forecast With Growth	1432.28	1108.01
Line 2	Creditable RFP Control Reductions for 2008	678.69	169.45
Line 3	Creditable RFP Control Reductions 2008 to 2011	142.49	67.51
Line 4	Controlled RFP Emissions Forecast (Line 1 minus Line 2 minus Line 3)	611.10	871.05
Line 5	Amount of Creditable Reductions Reserved for 2009 to 2018 Contingency	24.58	4.67
Line 6	Controlled RFP Forecast Without Reductions Reserved for Contingency (Line 4 plus Line 5)	635.68	875.72
Line 7	RFP Target Level of Emissions	754.15	927.98
Line 8	Excess (+) / Shortfall (-) (Line 7 minus Line 6)	+118.47	+52.26
Line 9	**Is post-control RFP emissions inventory less than target level of emissions?**	**Yes**	**Yes**

Table 7-25: Summary of the 2014 HGB RFP Demonstration (tons per day)

Line #	Description	NO_X	VOC
Line 1	Uncontrolled Emissions Forecast With Growth	1511.38	1146.34

Line #	Description	NO_X	VOC
Line 2	Creditable RFP Control Reductions for 2008, 2011	821.18	217.14
Line 3	Creditable RFP Control Reductions 2011 to 2014	142.90	47.70
Line 4	Controlled RFP Emissions Forecast (Line 1 minus Line 2 minus Line 3)	547.29	881.50
Line 5	Amount of Creditable Reductions Reserved for 2009 to 2018 Contingency	24.58	4.67
Line 6	Controlled RFP Forecast Without Reductions Reserved for Contingency (Line 4 plus Line 5)	571.88	886.17
Line 7	RFP Target Level of Emissions	667.70	919.19
Line 8	Excess (+) / Shortfall (-) (Line 7 minus Line 6)	+95.83	+33.02
Line 9	**Is post-control RFP emissions inventory less than target level of emissions?**	**Yes**	**Yes**

Table 7-26: Summary of the 2017 HGB RFP Demonstration (tons per day)

Line #	Description	NO_X	VOC
Line 1	Uncontrolled Emissions Forecast With Growth	1601.38	1194.21
Line 2	Creditable RFP Control Reductions for 2008, 2011, 2014	964.08	264.84
Line 3	Creditable RFP Control Reductions 2014 to 2017	133.51	37.63
Line 4	Controlled RFP Emissions Forecast (Line 1 minus Line 2 minus Line 3)	503.79	891.74
Line 5	Amount of Creditable Reductions Reserved for 2009 to 2018 Contingency	24.58	4.67
Line 6	Controlled RFP Forecast Without Reductions Reserved for Contingency (Line 4 plus Line 5)	528.37	896.41
Line 7	RFP Target Level of Emissions	580.60	912.54
Line 8	Excess (+) / Shortfall (-) (Line 7 minus Line 6)	+52.23	+16.13
Line 9	**Is post-control RFP emissions inventory less than target level of emissions?**	**Yes**	**Yes**

Table 7-27: Summary of the 2018 HGB RFP Demonstration (tons per day)

Line #	Description	NO_X	VOC
Line 1	Uncontrolled Emissions Forecast With Growth	1636.21	1210.28
Line 2	Creditable RFP Control Reductions for 2008, 2011, 2014, 2017	1097.60	302.46
Line 3	Creditable RFP Control Reductions 2017 to 2018	41.03	10.86
Line 4	Controlled RFP Emissions Forecast (Line 1 minus Line 2 minus Line 3)	497.59	896.95
Line 5	Amount of Creditable Reductions Reserved for 2009 to 2018 Contingency	24.58	4.67
Line 6	Controlled RFP Forecast Without Reductions Reserved for Contingency (Line 4 plus Line 5)	522.17	901.62
Line 7	RFP Target Level of Emissions	555.22	907.50
Line 8	Excess (+) / Shortfall (-) (Line 7 minus Line 6)	+33.04	+5.88

Line #	Description	NO_X	VOC
Line 9	**Is post-control RFP emissions inventory less than target level of emissions?**	**Yes**	**Yes**

7.4 CONTROL MEASURES TO ACHIEVE TARGET LEVELS

7.4.1 Overview

This section describes the methods used to achieve the emissions reductions in NO_X and VOC required to demonstrate RFP for the HGB nonattainment area. The projected emissions reductions reflect identified federal and state emissions controls. All state control measures are codified in regulations for the State of Texas. Control measures used for RFP do not include all emission reduction programs for the HGB area. Only the controls used to meet the HGB RFP requirements for 2008, 2011, 2014, 2017, and 2018 milestone years are presented in Table 7-28, Table 7-29, Table 7-30, Table 7-31, and Table 7-32. Individual and total values shown in the summary tables have been extracted from the spreadsheet in Appendix C. All values represent the numbers rounded to two significant figures. Since the totals in the tables are taken directly from the spreadsheet and rounded rather than summed from the rounded values in the table, there may be rounding discrepancies for the total values. Since the 2010 HGB RFP SIP Revision, only the on-road mobile source controls have been updated. Changes to the tables only reflect updated incremental emissions reductions for on-road mobile sources and the corresponding updated total reductions. Control reduction values for area, point, and non-road sources are unchanged from the 2010 HGB RFP SIP Revision.

Table 7-28: Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2002 through 2008 (tons per day)

Control Strategy Description	NO_X Reductions	VOC Reductions
Chapter 117 NO_X point source controls	35.93	0.00
Mass Emissions Cap and Trade Program (MECT)	219.83	0.00
Tank Landing Loss Rule	0.00	0.00
Portable Fuel Containers	0.00	0.00
RFG	150.64	22.03
FMVCP	241.17	109.17
I/M	17.35	9.56
On-road TxLED	6.03	0.00
Tier I and II Locomotive NO_X Standards	11.74	0.27
Small Non-Road Spark Ignition (SI) Phase I	[1]-0.30	1.77
Heavy Duty Non-road Engines	5.76	4.73
Tier 2 and 3 Non-road Diesel Engines	8.13	0.95
Small Non-road SI Engines (Phase II)	1.25	16.70
Large Non-road SI & Recreational Marine	12.27	4.14
Non-road TxLED	2.87	0.00
Non-road RFG	0.00	0.04
Tier 4 Diesel Rule	0.00	0.00
Federal Marine Diesel Tier 2	1.96	0.08

Control Strategy Description	NO_X Reductions	VOC Reductions
Sum of incremental reductions from projected uncontrolled emissions	**678.69**	**169.45**

[1] The negative NO_X emissions reductions number from Small Non-Road SI Phase I Engines is attributed to fleet growth in light of more stringent standards.

Table 7-29: Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2008 through 2011 (tons per day)

Control Strategy Description	NO_X Reductions	VOC Reductions
MECT	7.82	0.00
Tank Landing Loss Rule	0.00	11.50
Portable Fuel Containers	0.00	3.68
RFG	38.90	0.76
FMVCP	78.55	39.66
I/M	[2]-0.73	0.21
On-road TxLED	[2]-0.95	0.00
Tier I and II Locomotive NO_X Standards	1.01	0.07
Small Non-Road SI Phase I	[1]-0.09	0.73
Heavy Duty Non-road Engines	2.15	2.09
Tier 2 and 3 Non-road Diesel Engines	5.88	0.73
Small Non-road SI Engines (Phase II)	0.41	4.11
Large Non-road SI & Recreational Marine	8.03	3.82
Non-road TxLED	[2]-0.29	0.00
Non-road RFG	0.00	0.09
Tier 4 Diesel Rule	0.52	0.03
Federal Marine Diesel Tier 2	1.27	0.04
Sum of incremental reductions from projected uncontrolled emissions	**142.49**	**67.51**

[1] The negative NO_X emissions reduction number from Small Non-Road SI Phase I Engines is attributed to fleet growth in light of more stringent standards.

[2] Individual control reductions are calculated by sequentially turning on each control in a model that calculates emissions/emission rates. Since controls are sometimes based upon percentage reductions, the first controls turned on will have a relatively higher reduction value when compared to the controls turned on last. In some cases, the reduction for the controls that are turned on first are large enough that the subsequent controls will have a reduction that is positive but less than it was in a previous year. When a control has a positive value, but a value less than a previous year, the incremental reduction for that control will show as a negative value.

Table 7-30: Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2011 through 2014 (tons per day)

Control Strategy Description	NO_X Reductions	VOC Reductions
MECT	16.23	0.00

Control Strategy Description	NO_X Reductions	VOC Reductions
Tank Landing Loss Rule	0.00	0.00
Portable Fuel Containers	0.00	5.97
RFG	23.90	[2]-5.52
FMVCP	89.33	40.15
I/M	[2]-4.82	[2]-1.78
On-road TxLED	[2]-1.56	0.00
Tier I and II Locomotive NO_X Standards	1.34	0.09
Small Non-Road SI Phase I	[1]-0.08	0.72
Heavy Duty Non-road Engines	1.73	1.72
Tier 2 and 3 Non-road Diesel Engines	4.75	0.64
Small Non-road SI Engines (Phase II)	0.20	1.92
Large Non-road SI & Recreational Marine	6.71	3.41
Non-road TxLED	[2]-0.45	0.00
Non-road RFG	0.00	0.08
Tier 4 Diesel Rule	4.14	0.23
Federal Marine Diesel Tier 2	1.49	0.06
Sum of incremental reductions from projected uncontrolled emissions	**142.90**	**47.70**

[1] The negative NO_X emissions reductions number from Small Non-Road SI Phase I Engines is attributed to fleet growth in light of more stringent standards.

[2] Individual control reductions are calculated by sequentially turning on each control in a model that calculates emissions/emission rates. Since controls are sometimes based upon percentage reductions, the first controls turned on will have a relatively higher reduction value when compared to the controls turned on last. In some cases, the reduction for the controls that are turned on first are large enough that the subsequent controls will have a reduction that is positive but less than it was in a previous year. When a control has a positive value, but a value less than a previous year, the incremental reduction for that control will show as a negative value.

Table 7-31: Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2014 through 2017 (tons per day)

Control Strategy Description	NO_X Reductions	VOC Reductions
MECT	19.36	0.00
Tank Landing Loss Rule	0.00	0.00
Portable Fuel Containers	0.00	.45
RFG	21.56	[2]-3.15
FMVCP	77.79	33.91
I/M	[2]-3.77	[2]-1.13
On-road TxLED	[2]-.97	0.00
Tier I and II Locomotive NO_X Standards	1.15	.10
Small Non-Road SI Phase I	[1]-0.08	0.72
Heavy Duty Non-road Engines	2.39	1.63

Control Strategy Description	NO_X Reductions	VOC Reductions
Tier 2 and 3 Non-road Diesel Engines	4.50	.63
Small Non-road SI Engines (Phase II)	.14	1.41
Large Non-road SI & Recreational Marine	4.09	2.66
Non-road TxLED	[2]-.41	0.00
Non-road RFG	0.00	0.08
Tier 4 Diesel Rule	6.29	.26
Federal Marine Diesel Tier 2	1.48	0.06
Sum of incremental reductions from projected uncontrolled emissions	**133.51**	**37.63**

[1] The negative NO_X emissions reductions number from Small Non-Road SI Phase I Engines is attributed to fleet growth in light of more stringent standards.

[2] Individual control reductions are calculated by sequentially turning on each control in a model that calculates emissions/emission rates. Since controls are sometimes based upon percentage reductions, the first controls turned on will have a relatively higher reduction value when compared to the controls turned on last. In some cases, the reduction for the controls that are turned on first are large enough that the subsequent controls will have a reduction that is positive but less than it was in a previous year. When a control has a positive value, but a value less than a previous year, the incremental reduction for that control will show as a negative value.

Table 7-32: Summary of HGB NO_X and VOC Incremental Emissions Reductions from Control Strategies for 2017 through 2018 (tons per day)

Control Strategy Description	NO_X Reductions	VOC Reductions
MECT	6.71	0.00
Tank Landing Loss Rule	0.00	0.00
Portable Fuel Containers	0.00	0.15
RFG	6.29	[2]-0.64
FMVCP	23.31	9.55
I/M	[2]-0.93	[2]-0.35
On-road TxLED	[2]-0.19	0.00
Tier I and II Locomotive NO_X Standards	0.80	0.06
Small Non-Road SI Phase I	[1]-0.03	0.24
Heavy Duty Non-road Engines	0.54	0.41
Tier 2 and 3 Non-road Diesel Engines	1.03	0.15
Small Non-road SI Engines (Phase II)	0.04	0.44
Large Non-road SI & Recreational Marine	1.02	0.73
Non-road TxLED	[2]-0.13	0.00
Non-road RFG	0.00	0.03
Tier 4 Diesel Rule	1.86	0.07
Federal Marine Diesel Tier 2	0.70	0.02
Sum of incremental reductions from projected uncontrolled emissions	**41.03**	**10.86**

[1] The negative NO_X emissions reductions number from Small Non-Road SI Phase I Engines is attributed to fleet growth in light of more stringent standards.

[2] Individual control reductions are calculated by sequentially turning on each control in a model that calculates emissions/emission rates. Since controls are sometimes based upon percentage reductions, the first controls turned on will have a relatively higher reduction value when compared to the controls turned on last. In some cases, the reduction for the controls that are turned on first are large enough that the subsequent controls will have a reduction that is positive but less than it was in a previous year. When a control has a positive value, but a value less than a previous year, the incremental reduction for that control will show as a negative value.

7.4.2 Point Source Controls

Updates have not occurred to the point source emissions inventory since the 2010 HGB RFP SIP Revision.

7.4.3 Area Source Controls

Updates have occurred to the area source emissions inventory since the 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB RFP SIP Revision.

7.4.4 Non-Road Mobile Source Controls

Updates have occurred to the non-road mobile source emissions inventory since the 2010 HGB RFP SIP Revision; however, these updates would not change the overall conclusion of the 2010 HGB RFP SIP Revision.

7.4.5 On-Road Mobile Source Controls

On-road mobile source emissions reductions estimates are provided in this section. In the previous SIP revision, MOBILE6.2 was used to develop the on-road inventories and estimate on-road mobile control reductions. In March 2010, the EPA replaced the MOBILE model with MOVES as the official mobile source emissions estimation model for developing on-road mobile source category emissions inventories. The updated on-road mobile source emissions reductions based on MOVES2010a are provided in this section.

The on-road mobile source emissions inventories documented in Appendix D include quantification of emissions reductions for all federal and state on-road mobile source control rules for each RFP milestone year for the HGB nonattainment area. A summary of the on-road mobile source controls included in the 2008, 2011, 2014, 2017, and 2018 RFP emissions inventories is presented in Table 7-33: *On-Road Mobile Control Programs Modeled for 2008, 2011, 2014, 2017, 2018, and 2019 RFP Control Scenarios*. The RFP reductions due to the control strategies for 2008, 2011, 2014, 2017, and 2018 are summarized in Table 7-28, Table 7-29, Table 7-30, Table 7-31, and Table 7-32. The summary of 2008, 2011, 2014, 2017, and 2018 uncontrolled and post-control emissions for on-road mobile sources in the HGB nonattainment area may be found in:

- Table 7-34: *HGB RFP 2008 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)*;
- Table 7-35: *HGB RFP 2011 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)*;
- Table 7-36: *HGB RFP 2014 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)*;
- Table 7-37: *HGB RFP 2017 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)*; and
- Table 7-38: *HGB RFP 2018 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)*.

Table 7-33: On-Road Mobile Control Programs Modeled for 2008, 2011, 2014, 2017, 2018, and 2019 RFP Control Scenarios

Control Program Description	Strategy Notes	Year Control Program Started	Creditable for RFP
Pre-1990 FMVCP	Pre-1990 Control	Pre-1990	No
1992 Federal Controls on Gasoline Volatility	Pre-1990 Control. Maximum Reid Vapor Pressure of 7.8 pounds per square inch	1992	No
Anti-Tampering Program	No Strategy Note	1986	Yes
I/M Program	No Strategy Note	1997	Yes
Tier 1 FMVCP	Modeled as part of post-1990 FMVCP	1994	Yes
RFG	No Strategy Note	1995 for Phase One, 2000 for Phase Two	Yes

Control Program Description	Strategy Notes	Year Control Program Started	Creditable for RFP
National Low Emission Vehicle (NLEV) Program	Modeled as part of Post-1990 FMVCP	2001	Yes
Tier 2 FMVCP	Modeled as part of Post-1990 FMVCP, Phase in 2004 to 2009	2004	Yes
TxLED	Low aromatic hydrocarbon and high cetane number to control NO_X	2006	Yes
Federal Low-Sulfur Highway Diesel	15 parts per million maximum sulfur content	2006	Yes
2007 Heavy Duty FMVCP	Modeled as part of Post-1990 FMVCP, Phase in 2007 to 2010	2007	Yes

Table 7-34: HGB RFP 2008 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)

Emissions	NO_X	VOC
Uncontrolled Emissions	653.33	233.94
RFG	150.64	22.30
FMVCP	241.17	109.17
I/M	17.35	9.56
TxLED	6.03	0.00
RFP Post-Control Emissions	238.13	92.91

Table 7-35: HGB RFP 2011 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)

Emissions	NO_X	VOC
Uncontrolled Emissions	744.52	266.44
RFG	189.54	22.79
FMVCP	319.72	148.83
I/M	16.62	9.77
TxLED	5.08	0.00
RFP Post-Control Emissions	213.57	85.05

Table 7-36: HGB RFP 2014 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)

Emissions	NO_X	VOC
Uncontrolled Emissions	793.84	279.29
RFG	213.44	17.27
FMVCP	409.05	188.98

Emissions	NO_X	VOC
I/M	11.80	7.99
TxLED	3.52	0.00
RFP Post-Control Emissions	156.03	65.04

Table 7-37: HGB RFP 2017 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)

Emissions	NO_X	VOC
Uncontrolled Emissions	850.60	298.20
RFG	235.00	14.12
FMVCP	486.84	222.89
I/M	8.03	6.86
TxLED	2.55	0.00
RFP Post-Control Emissions	118.17	54.34

Table 7-38: HGB RFP 2018 On-Road Mobile Source Emissions and Reductions Summary for NO_X and VOC (tons per day)

Emissions	NO_X	VOC
Uncontrolled Emissions	870.89	304.27
RFG	241.29	13.48
FMVCP	510.15	232.44
I/M	7.10	6.51
TxLED	2.36	0.00
RFP Post-Control Emissions	109.98	51.84

7.4.6 Vehicle Miles Traveled, On-Road Emissions, and Transportation Control Measures

This section is an update to Section 4.6: *VMT, On-Road Emissions, and Transportation Control Measures* of the 2010 HGB RFP SIP Revision. Since the 2010 HGB RFP SIP Revision, a January 27, 2012, United States (U.S.) Ninth Circuit Court of Appeals decision addressed transportation control measures (TCM) requirements in SIP revisions. This decision is discussed in Section 7.4.6.1: *U.S. Ninth Circuit Court of Appeals Decision*.

For nonattainment areas classified as serious and above under the 1997 eight-hour ozone standard, FCAA, §7511a(d)(1)(A) requires TCMs "to offset any growth in emissions from growth in vehicle miles traveled or numbers of vehicles trips in such area and to attain reduction in motor vehicle emissions as necessary, in combination with other emission reduction requirements of this subpart. . .." The TCMs are, therefore, part of the overall control strategy for the HGB nonattainment area; however, TCMs are not used as line item control strategies. The values presented in this section reflect the most recent on-road mobile source emissions inventory developed using the most recent planning assumptions and the EPA's mobile source emissions estimation model, MOVES2010a, and are documented in a contractor report found in Appendix D.

There is projected growth in VMT for the HGB area for the years between the 2002 RFP base year and the 2018 attainment year, as illustrated in Figure 7-1: *RFP VMT Trends*. However, the growth in VMT for the area is offset by control measures that reduce the per mile emissions rates, resulting in a decrease in both NO_X and VOC emissions for the same time period as shown in Figure 7-2: *RFP Post-Control On-Road NO_X and VOC Emissions Trends*. The increase in VMT and decrease in vehicle emissions for the RFP demonstration time period are summarized in Table 7-39: *HGB RFP On-Road Mobile Post-Control NO_X Emissions, Post-Control VOC Emissions, and Vehicle Miles Traveled*. The control measures used to achieve the on-road mobile source RFP emissions reductions and to demonstrate RFP requirements do not include TCMs for this SIP revision.

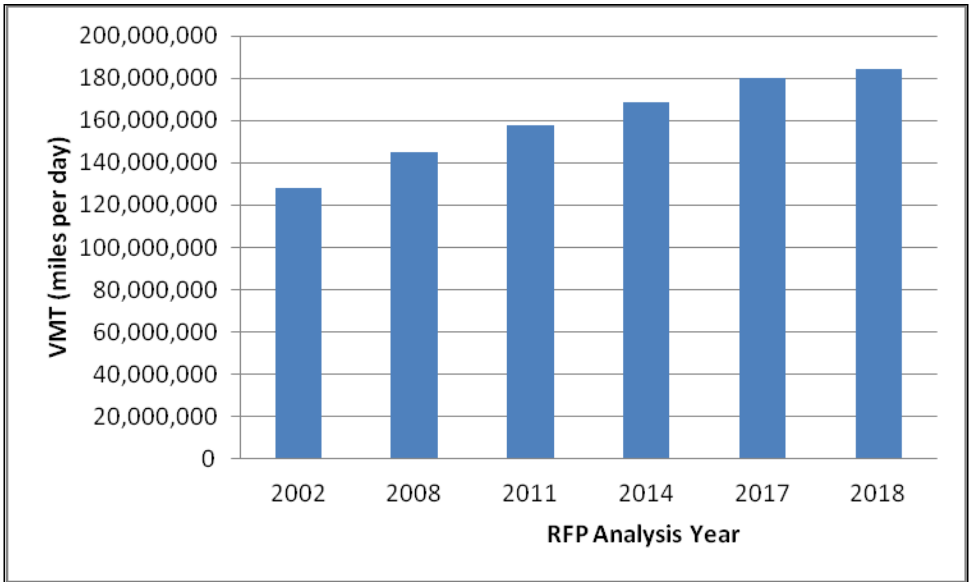

Figure 7-1: RFP VMT Trends

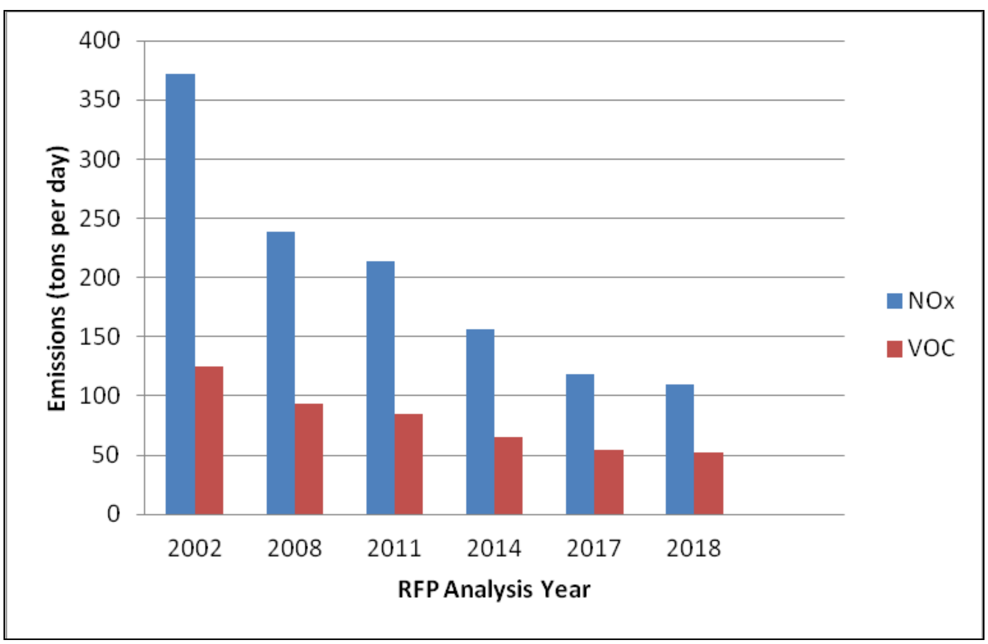

Figure 7-2: RFP Post-Control On-Road NO_X and VOC Emissions Trends

Table 7-39: HGB RFP On-Road Mobile Post-Control NO_X Emissions, Post-Control VOC Emissions, and Vehicle Miles Traveled

RFP Milestone Year	NO_X (tons per day)	VOC (tons per day)	VMT (miles per day)
2002	371.89	124.47	128,145,285
2008	238.13	92.91	145,079,180
2011	213.57	85.05	157,480,120
2014	156.03	65.04	168,350,216
2017	118.17	54.34	179,999,154
2018	109.98	51.84	184,065,162

7.4.6.1 U.S. Ninth Circuit Court of Appeals Decision

A recent U.S. Ninth Circuit Court of Appeals decision [Association of Irritated Residents, et. al. v. United States Environmental Protection Agency, 2012 WL 251912 (C.A.9)] addressed the requirements for TCMs in SIPs for severe nonattainment areas. The court stated ". . .we cannot ignore the possibility that with advances in clean car technology, one day VMT could increase without a corresponding increase in emissions. If that happens, under the statute, EPA would not need to impose TCMs even though VMT increased."

According to both the MOBILE6.2 and MOVES2010a EPA models, total on-road emissions for NO_X, VOC, and carbon monoxide (CO) have been steadily decreasing while VMT has steadily increased. This decrease in emissions is due primarily to the introduction of more stringent vehicle emission standards beginning in the 1960s. Examples of more recent federal standards for light-duty vehicles and trucks include Tier 1, which began with the 1994 model year; NLEV, which began with the 2001 model year; and Tier 2, which began with the 2004 model year.

An on-road trends study using the MOBILE6.2 model for all 254 Texas counties was completed by TTI in August 2008 for all years from 1990 through 2040. Figure 7-3: *Eight-County HGB Area On-Road Emission Trend Estimates from 1990 through 2040 Using MOBILE6.2* summarizes the results of this study for the eight-county HGB area. As shown, the maximum on-road emissions were estimated to have occurred in 1990, with the minimum levels expected to occur between 2020 and 2030. The complete MOBILE6.2 on-road Texas trends study and associated electronic files (ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Trends/m62/) are available online.

In light of the recent U.S. Ninth Circuit Court of Appeals decision, the EPA has determined that additional analysis is needed to demonstrate that the VMT increase does not trigger additional TCMs for the HGB area. On August 30, 2012, the EPA released guidance on how to address this requirement and sent the TCEQ a revised model (MOVES2010bROP) to conduct the necessary analysis. The TCEQ did not receive the guidance and model in time to incorporate the demonstration into this proposed SIP revision; however, the TCEQ is now evaluating the guidance and model, and the commission will consider providing the analysis at adoption of this revision in order to submit to the EPA for consideration.

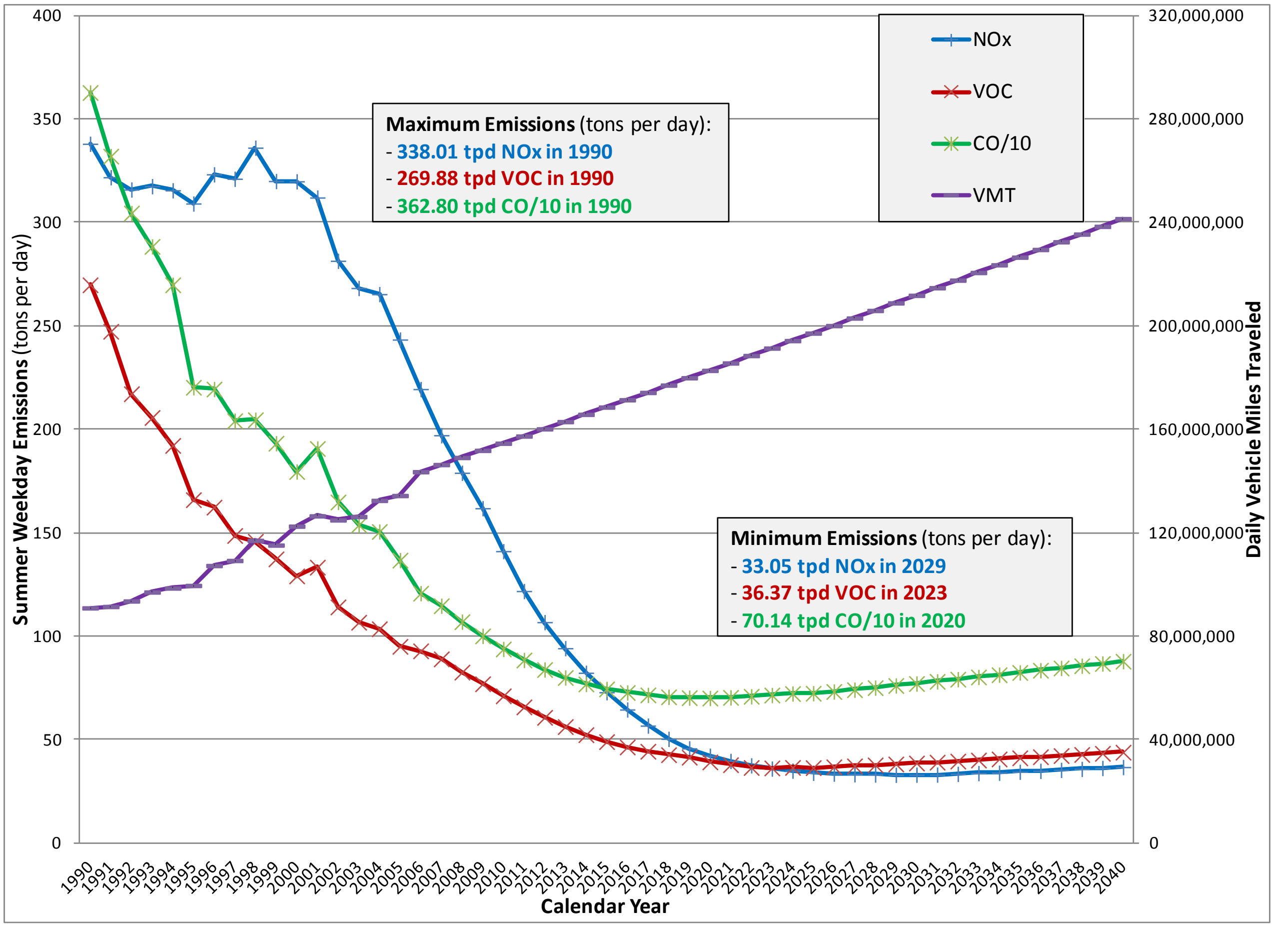

Figure 7-3: Eight-County HGB Area On-Road Emission Trend Estimates from 1990 through 2040 Using MOBILE6.2

In July 2011, an on-road trends study was completed by TTI for all 254 Texas counties using the EPA's more recent on-road emissions model, MOVES2010a. Other than 1990, MOVES2010a cannot be used to estimate emissions for 1998 and earlier years. Figure 7-4: *Eight-County HGB Area On-Road Emission Trend Estimates from 1999 through 2030 Using MOVES2010a* summarizes the results of this study for the eight-county HGB area from 1999 through 2030. As shown, the maximum on-road emissions were estimated to have occurred in 1999, with the minimum levels expected to occur between 2020 and 2030. The complete MOVES2010a on-road Texas trends study and associated electronic files (ftp://amdaftp.tceq.texas.gov/pub/Mobile_EI/Trends/mvs/) are available online.

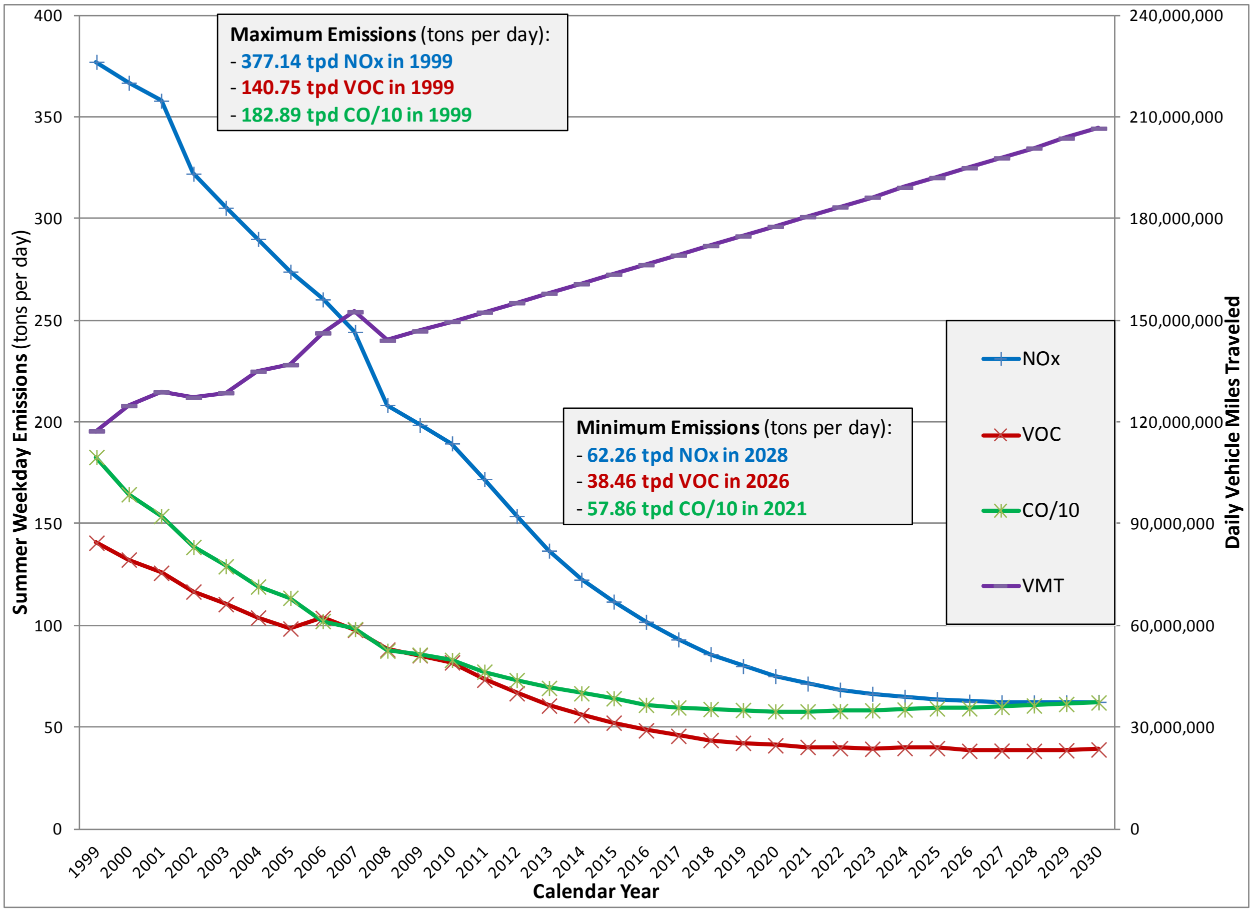

Figure 7-4: Eight-County HGB Area On-Road Emission Trend Estimates from 1999 through 2030 Using MOVES2010a

Out of necessity, trends analyses such as the ones shown in Figure 7-3 and Figure 7-4 must rely on an aggregated macro-scale approach when estimating VMT and emission rates. The 2006 and 2018 HGB on-road emission inventories used for this SIP revision rely on a finer scale approach that utilizes hourly emissions rate and VMT estimates for thousands of individual roadway segments. Table 7-40: *2006 and 2018 Summer Weekday On-Road Emission Estimates for the Eight-County HGB Area* provides a summary of the 2006 and 2018 link-based on-road emission inventory totals included in Chapter 3: *Photochemical Modeling* to show that even with a 26% projected increase in VMT, NO_X, VOC, and CO emissions are expected to decline by roughly 62%, 52%, and 36%, respectively.

Table 7-40: 2006 and 2018 Summer Weekday On-Road Emission Estimates for the Eight-County HGB Area

Calendar Year Scenario	Daily VMT	Summer Weekday NO_X Emissions (tons per day)	Summer Weekday VOC Emissions (tons per day)	Summer Weekday CO Emissions (tons per day)
2006 Base Case	143,408,584	270.00	104.74	1,024.03
2018 Future Case	180,955,402	103.34	50.13	656.24
Difference	37,546,818	-166.66	-54.61	-367.79
Relative Change	26.2%	-61.7%	-52.1%	-35.9%

As the analyses presented in Figure 7-3, Figure 7-4, and Table 7-40 show, NO_X, VOC, and CO on-road emissions are estimated to steadily decrease between 2004 and 2019, even as VMT has either increased or is expected to steadily increase for most of these years. This decrease in emissions is true whether emission rates are obtained from the older MOBILE6.2 model or the newer MOVES2010a model. These results demonstrate the scenario described in the U.S. Ninth Circuit Court of Appeals opinion where "VMT could increase without a corresponding increase in emissions." The opinion clearly stated that "if that happens, under the statute, EPA would not need to impose TCMs even though VMT increased." Therefore, even though the eight-county HGB nonattainment area for the 1997 eight-hour ozone standard is classified as severe with a June 15, 2019, attainment date, inclusion of TCMs to offset VMT increases may not be required.

7.4.7 Contingency Measures

As contingency, in the event of a milestone year failure, control measures are required that would reduce emissions by an additional 3%. Contingency is required for each milestone year and the attainment year. As with the 3% per year reduction required to demonstrate RFP, the 3% contingency requirement is based on the ABY and may be met using VOC and/or NO_X reductions. This SIP revision contains a milestone year RFP contingency demonstration and an attainment year RFP contingency demonstration. Table 7-40: *HGB RFP Contingency Demonstration for the 2008 through 2017 Milestone Years (tons per day)* shows the milestone year 2008 contingency, for which the 3% contingency demonstration is based on a 2.5% reduction in NO_X and 0.5% reduction in VOC to be achieved between 2008 and 2009. Since the ABY inventory decreases over time, the 2008 to 2009 contingency is great enough to cover contingency requirements for milestone years 2011, 2014, and 2017. The same contingency reduction is used for all four milestone years. Reductions needed for milestone year contingency were reserved from the 2008, 2011, 2014, and 2017 milestone year target reductions. The milestone year contingency reductions are subtracted from creditable control reductions for milestone years 2008, 2011, 2014, and 2017 to account for the contingency requirements for each milestone year. Documentation of the calculation of the milestone year contingency value and integration of the requirement into the RFP demonstration for each milestone year are documented in Appendix C.

Table 7-41: HGB RFP Contingency Demonstration for the 2008 through 2017 Milestone Years (tons per day)

Contingency Demonstration Description	NO_X	VOC
2008 ABY emissions inventory	983.26	933.15
Percent for milestone year 2011 contingency calculation (total of 3%)	2.50	0.50
2008 to 2009 required contingency reductions (ABY emissions inventory x (contingency percent))	24.58	4.67
Reserved surplus reductions from 2008 RFP demonstration	24.58	4.67
Are enough contingency reductions available to meet required contingency reduction?	**Yes**	**Yes**

The 3% attainment year RFP contingency demonstration is based on a 2.5% reduction in NO_X and a 0.5% reduction in VOC to be achieved between 2018 and 2019. This SIP revision provides for a 10% NO_X MVEB safety margin, the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for RFP, using some of the surplus emissions reductions from the 2018 RFP demonstration. Those emissions are subtracted from the amount available to demonstrate RFP contingency for the 2018 attainment year. A summary of the 2018 attainment year RFP contingency demonstration is provided in Table 7-41*: HGB RFP Contingency Demonstration for the 2018 Attainment Year (tons per day)*. The demonstration shows that attainment year RFP contingency reductions exceed the 3% requirement; therefore, the RFP contingency requirement is fulfilled for the HGB nonattainment area for the 1997 eight-hour ozone standard. Documentation of the calculation of the milestone year contingency value and integration of the requirement into the RFP demonstration for each milestone year are documented in Appendix C.

Table 7-42: HGB RFP Contingency Demonstration for the 2018 Attainment Year (tons per day)

Contingency Element Description	NO_X	VOC
2018 ABY emissions inventory	1003.92	935.59
Percent for contingency calculation (total of 3%)	2.50	0.50
2012 to 2013 required contingency reductions (ABY emissions inventory x contingency percent)	25.10	4.68
Control reductions to meet contingency requirements		
Surplus reductions from 2018 RFP demonstration	33.04	5.88
Subtract 2018 RFP demonstration motor vehicle emissions budget safety margin from surplus reductions from 2012 RFP demonstration	-11.00	-5.18
RFG	6.80	-0.25
FMVCP	22.28	9.50
I/M	-0.67	-0.26
On-road TxLED	-0.20	0.00
Tier I and II Locomotive NOX Standards	0.68	0.01
Small Non-Road SI Phase I	-0.03	0.24
Heavy Duty Non-road Engines	0.30	0.32
Tier 2 and 3 Non-road Diesel Engines	0.72	0.11
Small Non-road SI Engines (Phase II)	0.04	0.43
Large Non-road SI & Recreational Marine	0.95	0.62
Non-road TxLED	0.00	0.00
Non-road RFG	0.00	0.03
Tier 4 Diesel Rule	1.58	0.06
Federal Marine Diesel Tier 2	0.55	0.02
Total RFP demonstration contingency reductions	55.04	11.53
Contingency Surplus (+) or Shortfall (-)	**+29.95**	**+6.85**

7.5 MOTOR VEHICLE EMISSIONS BUDGETS

7.5.1 Introduction

This SIP revision establishes MOVES2010a-based MVEBs, setting the allowable on-road mobile emissions that an area can produce while continuing to demonstrate RFP. Local transportation planning organizations are required to demonstrate that projected emissions from transportation plans, programs, and projects do not surpass the NO_X and VOC emissions limits set by MVEBs in the SIP, as required by the federal transportation conformity rule.

7.5.2 Overview of Methodologies and Assumptions

The TCEQ developed updated on-road mobile source emissions inventories and control strategies reductions estimates using the latest planning assumptions and the EPA's mobile source emissions estimation model, MOVES. On-road mobile emissions inventory updates include development of:

- a 2002 base year emissions inventory;
- an ABY emissions inventories for 2008, 2011, 2014, 2017, and 2018;
- an uncontrolled milestone year emissions inventories for 2008, 2011, 2014, 2017, and 2018;
- a post-control milestone year emissions inventories for 2008, 2011, 2014, 2017, and 2018; and
- a control strategy reduction estimate for 2008, 2011, 2014, 2017, and 2018.

The TCEQ contracted with TTI to develop the RFP emissions inventories and control strategies reductions used for this SIP revision. Detailed documentation of the on-road mobile emissions inventory development is provided in the TTI contractor report in Appendix D.

7.5.3 Motor Vehicle Emissions Budgets for RFP Milestone Years

The RFP MVEBs reflect the on-road mobile source emissions inventories for RFP milestone years, the on-road mobile source reductions strategies used to demonstrate RFP, and a transportation conformity safety margin, where one is used. Summaries for MVEB calculations for each RFP milestone year are presented in:

- Table 7-42: *2008 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)*;
- Table 7-43: *2011 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)*;
- Table 7-44: *2014 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)*;
- Table 7-45: *2017 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)*; and
- Table 7-46: *2018 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)*.

Details for MVEB calculations are documented in Appendix C.

The controls used for RFP demonstration produce more than the required emissions reductions for each milestone year. Excess emissions reductions for each milestone year are used to provide a safety margin for each milestone year. This safety margin is less than the total emissions reductions needed for the RFP demonstration; therefore, even if this safety margin is used, the HGB area will still demonstrate RFP for each milestone year.

Table 7-43: 2008 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)

Control Strategy Description	NO_X	VOC
2008 on-road emissions projection without post-1990 FCAA controls	653.33	233.94
2008 On-Road Mobile RFP Controls	NO_X	VOC
Tier 1 FMVCP; RFG; I/M Program; Tier 2 FMVCP; 2007 heavy duty diesel FMVCP; On-road TxLED	415.19	140.76
2008 on-road emissions projection with post-1990 FCAA controls (uncontrolled emissions inventory minus control reductions)	238.14	93.18
Add transportation conformity safety margin[1]	23.81	9.32
2008 RFP MVEBs	**261.95**	**102.50**

[1] The 2008 RFP reductions exceed the required NO_X and VOC emissions reductions; therefore, 10% of surplus NO_X and VOC emissions are used to provide a safety margin for milestone year 2008.

Table 7-44: 2011 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)

Control Strategy Description	NO_X	VOC
2011 on-road emissions projection without post-1990 FCAA controls	744.52	266.44
2011 On-Road Mobile RFP Controls	NO_X	VOC
Tier 1 FMVCP; RFG; I/M Program; Tier 2 FMVCP; 2007 heavy duty diesel FMVCP; On-road TxLED	530.96	181.39
2011 on-road emissions projection with post-1990 FCAA controls (uncontrolled inventory minus control reductions)	213.56	85.05
Add transportation conformity safety margin[1]	21.36	8.51
2011 RFP MVEBs	**234.92**	**93.56**

[1] The 2011 RFP reductions exceed the required NO_X and VOC emissions reductions; therefore, 10% of surplus NO_X and VOC emissions are used to provide a safety margin for milestone year 2011.

Table 7-45: 2014 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)

Control Strategy Description	NO_X	VOC
2014 on-road emissions projection without post-1990 FCAA controls	793.84	279.29
2014 On-Road Mobile RFP Controls	NO_X	VOC
Tier 1 FMVCP; RFG; I/M Program; Tier 2 FMVCP; 2007 heavy duty diesel FMVCP; On-road TxLED	637.81	214.24
2014 on-road emissions projection with post-1990 FCAA controls (uncontrolled inventory minus control reductions)	156.03	65.05
Add transportation conformity safety margin[1]	15.60	6.51
2014 RFP MVEBs	**171.63**	**71.56**

[1] The 2014 RFP reductions exceed the required NO_X and VOC emissions reductions; therefore, 10% of surplus NO_X and VOC emissions are used to provide a safety margin for milestone year 2014.

Table 7-46: 2017 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)

Control Strategy Description	NO_X	VOC
2017 on-road emissions projection without post-1990 FCAA controls	850.60	298.20
2017 On-Road Mobile RFP Controls	NO_X	VOC
Tier 1 FMVCP; RFG; I/M Program; Tier 2 FMVCP; 2007 heavy duty diesel FMVCP; On-road TxLED	732.42	243.87
2017 on-road emissions projection with post-1990 FCAA controls (uncontrolled inventory minus control reductions)	118.18	54.33
Add transportation conformity safety margin[1]	11.82	5.43
2017 RFP MVEBs	**130.00**	**59.76**

[1] The 2017 RFP reductions exceed the required NO_X and VOC emissions reductions; therefore, 10% of surplus NO_X and VOC emissions are used to provide a safety margin for milestone year 2017.

Table 7-47: 2018 RFP Motor Vehicle Emissions Budgets for the HGB Ozone Nonattainment Area (tons per day)

Control Strategy Description	NO_X	VOC
2018 on-road emissions projection without post-1990 FCAA controls	870.89	304.27
2018 On-Road Mobile RFP Controls	NO_X	VOC
Tier 1 FMVCP; RFG; I/M Program; Tier 2 FMVCP; 2007 heavy duty diesel FMVCP; On-road TxLED	760.90	252.43
2018 on-road emissions projection with post-1990 FCAA controls (uncontrolled inventory minus control reductions)	109.99	51.84
Add transportation conformity safety margin[1]	11.00	5.18
2018 RFP MVEBs	**120.99**	**57.02**

[1] The 2018 RFP reductions exceed the required NO_X and VOC emissions reductions; therefore, 10% of surplus NO_X and VOC emissions are used to provide a safety margin for attainment year 2018.

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Appendices Available Upon Request

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