AGENDA REQUEST: Proposed State Implementation Plan Revision

AGENDA REQUESTED: March 7, 2018

DATE OF REQUEST: February 16, 2018

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

CAPTION: Docket No. 2017-1762-SIP. Consideration for publication of, and hearing on, the proposed Federal Clean Air Act (FCAA), Section 110(a)(1) and 110(a)(2)(D) Transport State Implementation Plan (SIP) Revision for the 2015 ozone National Ambient Air Quality Standards (NAAQS).

The proposed SIP revision would outline the requirements of FCAA, Section 110(a)(2)(D)(i) and (ii) and the Texas provisions supporting the requirements for the 2015 ozone NAAQS. This proposed revision would also include a technical demonstration to support the determination that Texas meets the interstate transport requirements of Section 110(a)(2)(D)(i)(I). The infrastructure requirements of FCAA, Section 110(a)(2)(A) through (C) and (E) through (M) would be addressed in a separate SIP revision (Non-Rule Project No. 2017-040-SIP-NR). (Kristin Patton, Amy Browning) (Non-Rule Project No. 2017-039-SIP-NR)

Steve Hagle, P.E.
Deputy Director

David Brymer
Division Director

Joyce Nelson
Agenda Coordinator

Copy to CCC Secretary? NO   X   YES
Texas Commission on Environmental Quality
Interoffice Memorandum

To: Commissioner

Date: February 16, 2018

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

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

Docket No.: 2017-1762-SIP

Subject: Commission Approval for Proposed Federal Clean Air Act (FCAA), §110(a)(1) and §110(a)(2)(D) Transport State Implementation Plan (SIP) Revision for the 2015 Ozone National Ambient Air Quality Standards (NAAQS)

       2015 Ozone NAAQS Transport SIP Revision
       Project No. 2017-039-SIP-NR

Background and reason(s) for the SIP revision:
On October 1, 2015, the United States Environmental Protection Agency (EPA) revised the primary and secondary NAAQS for ozone to an eight-hour standard of 0.070 parts per million. Within three years of the promulgation of any new or revised NAAQS, FCAA, §110(a)(1) requires states to submit a SIP revision to provide for the implementation, maintenance, and enforcement of the NAAQS. Section 110(a)(2)(A) through (M), lists the elements that the SIP submissions must contain. This SIP revision would specifically address transport requirements under FCAA, §110(a)(2)(D). The remaining infrastructure requirements of FCAA, §110(a)(2)(A) through (M) would be addressed in a separate SIP revision (Project No. 2017-040-SIP-NR). Infrastructure and transport SIP revisions to address the 2015 ozone NAAQS are due to the EPA by October 1, 2018.

Scope of the SIP revision:

A.) Summary of what the SIP revision will do:
The proposed SIP revision would document how the transport elements listed in FCAA, §110(a)(2)(D) are currently addressed in the Texas SIP. This SIP revision would provide a detailed technical demonstration and other supporting information to meet the interstate transport requirements of FCAA, §110(a)(2)(D)(i) and (ii).

B.) Scope required by federal regulations or state statutes:
Pursuant to FCAA, §110(a)(2)(D)(i), this SIP revision must contain several elements that provide supporting information demonstrating that Texas is:

- not contributing significantly to nonattainment of the 2015 ozone NAAQS for areas in other states;
- not interfering with the maintenance of the 2015 ozone NAAQS in any other state;
- not interfering with measures required to meet an implementation plan for any other state related to prevention of significant deterioration (PSD); and
- not interfering with measures required to meet the implementation plan for any other state related to regional haze and visibility.
In addition, pursuant to FCAA, §110(a)(2)(D)(ii), the SIP revision must provide information demonstrating compliance with the applicable requirements of FCAA, §126 and §115 relating to interstate and international pollution abatement.

Guidance on development and submission of infrastructure SIPs issued by the EPA on September 13, 2013¹ did not address §110(a)(2)(D)(i)(I), which specifically concerns interstate pollution transport affecting attainment and maintenance of the NAAQS. The EPA’s August 15, 2006, §110(a)(2)(D)(i) guidance for the 1997 eight-hour ozone NAAQS² did not provide specific guidance on how states should develop a transport analysis but indicated that a transport demonstration might include information concerning emissions in the state, meteorological conditions in the state, the distance to the nearest nonattainment area in another state, reliance on EPA modeling, or such other information as the state considers probative on the issue of significant contribution and interference with maintenance. This SIP revision would include an analysis of required transport elements consistent with statutory requirements.

C.) Additional staff recommendations that are not required by federal rule or state statute:
None

Statutory authority:
The EPA published the final rule establishing the revised NAAQS for ozone in the Federal Register on October 26, 2015 (80 FR 65292). The authority to propose and adopt the SIP revision is derived from FCAA, §110, which requires states to submit SIP revisions that contain enforceable measures to achieve the 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:
No effects on the regulated community are anticipated. However, if the EPA were to issue a federal implementation plan (FIP) because the state failed to submit a SIP revision there could ultimately be significant effects on the regulated community.

B.) Public:
None

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

Stakeholder meetings:
If approved by the commission, the proposed SIP revision would go through a public review and comment period including a public hearing.

Potential controversial concerns and legislative interest:
Section 110(a)(2)(D) of the FCAA requires transport SIPs to contain adequate provisions to prevent emissions from interfering with visibility in another state. As part of the EPA’s October 17, 2017 FIP to address best available retrofit technology (BART) requirements for Texas electric generating units, the EPA disapproved portions of the Texas SIP with regard to interstate visibility transport for the 1997 eight-hour ozone, 1997 PM$_{2.5}$ (annual and 24-hour), 2006 PM$_{2.5}$ (24-hour), 2008 eight-hour ozone, 2010 one-hour nitrogen dioxide, and 2010 one-hour sulfur dioxide NAAQS (82 FR 48324). The EPA also made a finding that the BART alternatives adopted as the FIP meet the interstate visibility transport requirements for these NAAQS under FCAA, §110(a)(2)(D)(II). Based on the finding that Texas meets the visibility transport provision for these other NAAQS under the BART FIP, along with the modeling analysis in the proposed SIP revision demonstrating that Texas does not significantly contribute to nonattainment or maintenance in another state for the 2015 ozone NAAQS, the fact that the EPA has not established a separate visibility standard for ozone, and because Texas is included in the Cross-State Air Pollution Rule (CSAPR) Update ozone season nitrogen oxides (NOx) trading program, it is concluded that Texas meets the visibility transport provision for the 2015 ozone NAAQS as well.

Texas is included in the EPA’s CSAPR Update Rule for ozone season NOx, due to the EPA’s disapproval of the portion of Texas’ 2008 ozone infrastructure and transport SIP revision pertaining to the §110(a)(2)(D)(ii)(I) interstate transport requirements and the EPA’s determination that Texas significantly contributes to nonattainment or interferes with maintenance of the 2008 eight-hour ozone NAAQS in other states. While the CSAPR Update Rule does not specifically cover the 2015 ozone NAAQS, litigation over the rule is still ongoing and could potentially affect interstate transport requirements in the future.

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 SIP revision?
Transport SIP revisions are required by §110(a) of the FCAA to be submitted within three years of the EPA promulgating the revised standard. The commission could choose to not comply with requirements to develop and submit a transport SIP revision to the EPA. However, if the required SIP revision is not submitted to the EPA by the October 1, 2018
deadline, the EPA has the authority to issue a finding of failure to submit requiring that
the TCEQ submit the SIP revision within a specified time period and potentially imposing
sanctions on the state. The EPA would be required to promulgate a FIP if the TCEQ failed
to make the submission within two years, or by October 1, 2020.

The commission could choose to wait to submit this SIP revision based on the possibility
that the 2015 ozone NAAQS may be reconsidered in the future based on pending
litigation or other EPA action. However, reconsideration of the standard would have to be
completed, or an action to repeal the rule would have to be finalized by the EPA prior to
the October 1, 2018, due date in order to avoid the potential of a finding of failure to
submit.

**Key points in the proposal SIP revision schedule:**

- **Anticipated proposal date:** March 7, 2018
- **Anticipated public hearing date (if any):** April 2018
- **Anticipated public comment period:** March – April 2018
- **Anticipated adoption date:** September 2018

**Agency contacts:**
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cc: Chief Clerk, 2 copies
    Executive Director’s Office
    Erin Chancellor
    Stephen Tatum
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    Office of General Counsel
    Kristin Patton
    Joyce Spencer-Nelson
REVISIONS TO THE STATE OF TEXAS AIR QUALITY IMPLEMENTATION PLAN CONCERNING FEDERAL CLEAN AIR ACT SECTIONS 110(a)(1) AND (2) INFRASTRUCTURE

TRANSPORT DEMONSTRATION FOR OZONE

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

FEDERAL CLEAN AIR ACT, SECTIONS 110(A)(1) AND (2) TRANSPORT STATE IMPLEMENTATION PLAN REVISION FOR THE 2015 OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS

PROJECT NUMBER 2017-039-SIP-NR

Proposal
March 7, 2018
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EXECUTIVE SUMMARY

This proposed revision to the state implementation plan (SIP) is intended to meet the infrastructure and transport requirements of the Federal Clean Air Act (FCAA), §110(a). States are required by FCAA, §110(a)(1) to submit SIP revisions providing for the implementation, maintenance, and enforcement of a new or revised National Ambient Air Quality Standard (NAAQS) within three years after promulgation. On October 1, 2015, the United States Environmental Protection Agency (EPA) revised the primary and secondary NAAQS for ozone to an eight-hour standard of 0.070 parts per million. Infrastructure and transport SIP revisions to address the 2015 Ozone NAAQS are due to the EPA by October 1, 2018.

FCAA, §110(a)(2)(A) through (M), lists the elements that infrastructure and transport SIP submissions must contain. This proposed SIP revision specifically addresses transport requirements under FCAA, §110(a)(2)(D) for the 2015 ozone NAAQS. The remaining infrastructure requirements of FCAA, §110(a)(2)(A) through (M) are addressed in a separate SIP revision (Project No. 2017-040-SIP-NR). This proposed SIP revision documents how the transport elements listed in FCAA, §110(a)(2)(D) are currently addressed in the Texas SIP and provides a detailed technical demonstration and other supporting information to meet the interstate transport requirements of FCAA, §110(a)(2)(D)(i) and (ii).

Pursuant to FCAA, §110(a)(2)(D)(i), this proposed SIP revision must contain several elements that provide supporting information demonstrating that Texas is:

- not contributing significantly to nonattainment of the 2015 ozone NAAQS for areas in other states;
- not interfering with the maintenance of the 2015 ozone NAAQS in any other state;
- not interfering with measures required to meet an implementation plan for any other state related to prevention of significant deterioration (PSD); and
- not interfering with measures required to meet the implementation plan for any other state related to regional haze and visibility.

In addition, pursuant to FCAA, §110(a)(2)(D)(ii), this proposed SIP revision must provide information demonstrating compliance with the applicable requirements of FCAA, §126 and §115 relating to interstate and international pollution abatement.

To meet the requirements of FCAA, §110(a)(2)(D)(i)(I), this proposed SIP revision includes an analysis of ozone design value and emissions trends in Texas, a modeling analysis of the impacts of Texas’ emissions on other states, and a discussion of existing ozone control strategies to demonstrate that emissions from Texas do not contribute significantly to nonattainment or interfere with maintenance of the 2015 ozone NAAQS in another state. Information regarding how Texas meets the requirements of FCAA, §110(a)(2)(D)(i)(II) is provided in Chapter 4: Prevention of Significant Deterioration and Visibility Transport [FCAA, §110(a)(2)(D)(i)(II)]. Statements
regarding compliance with FCAA, §110(a)(2)(D)(ii) are provided in Chapter 5: *Interstate Pollution Abatement and International Air Pollution [FCAA, §110(a)(2)(D)(ii)].*
SECTION V-A: LEGAL AUTHORITY

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


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

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

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

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

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

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

TEXAS HEALTH & SAFETY CODE, Chapter 382 September 1, 2017
TEXAS WATER CODE September 1, 2017

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, §§39.201; 39.401; 39.403(a) and (b)(8)-(10);
   39.405(f)(1) and (g); 39.409; 39.411 (a), (b)(1)-(6), and (8)-(10) and (c)(1)-
   (6) and (d); 39.413(9), (11), (12), and (14); 39.418(a) and (b)(3) and (4);
   39.419(a), (b), (d), and (e); 39.420(a), (b) and (c)(3) and (4); 39.423 (a)
   and (b); 39.601-39.605
   December 29, 2016

Chapter 55: Requests for Reconsideration and Contested Case
   Hearings; Public Comment, §§55.1; 55.21(a) - (d), (e)(2), (3), and (12), (f)
   and (g); 55.101(a), (b), and (c)(6) - (8); 55.103; 55.150; 55.152(a)(1), (2),
   and (6) and (b); 55.154; 55.156; 55.200; 55.201(a) - (h); 55.203; 55.205;
   55.209, and 55.211
   December 31, 2015

Chapter 101: General Air Quality Rules
   October 12, 2017

Chapter 106: Permits by Rule, Subchapter A
   April 17, 2014

Chapter 111: Control of Air Pollution from Visible Emissions and
   Particulate Matter
   August 3, 2017

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
   December 29, 2016

Chapter 115: Control of Air Pollution from Volatile Organic
   Compounds
   June 25, 2015

Chapter 116: Permits for New Construction or Modification
   November 24, 2016

Chapter 117: Control of Air Pollution from Nitrogen Compounds
   June 25, 2015

Chapter 118: Control of Air Pollution Episodes
   March 5, 2000

Chapter 122: §122.122: Potential to Emit
   February 23, 2017
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

A. Introduction (No change)
B. Ozone (No change)
C. Particulate Matter (No change)
D. Carbon Monoxide (No change)
E. Lead (No change)
F. Oxides of Nitrogen (No change)
G. Sulfur Dioxide (No change)
H. Conformity with the National Ambient Air Quality Standards (No change)
I. Site Specific (No change)
J. Mobile Sources Strategies (No change)
K. Clean Air Interstate Rule (No change)
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<th>Acronym</th>
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<tbody>
<tr>
<td>3-D</td>
<td>three-dimensional</td>
</tr>
<tr>
<td>AD</td>
<td>attainment demonstration</td>
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<td>APCA</td>
<td>Anthropogenic Culpability Precursor Analysis</td>
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<td>AQS</td>
<td>Air Quality System</td>
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<td>BART</td>
<td>best available retrofit technology</td>
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<td>BEIS</td>
<td>Biogenic Emissions Inventory Systems</td>
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<td>BPA</td>
<td>Beaumont-Port Arthur</td>
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<td>CAIR</td>
<td>Clean Air Interstate Rule</td>
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<td>CAMx</td>
<td>Comprehensive Air Quality Model with Extensions</td>
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<td>CEMS</td>
<td>continuous emissions monitoring system</td>
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<td>Cross-State Air Pollution Rule</td>
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<td>Central Standard Time</td>
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<td>Chemical Transport Model</td>
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<td>Direct Decoupled Method</td>
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<td>EGF</td>
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<td>FIP</td>
<td>federal implementation plan</td>
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<tr>
<td>FR</td>
<td><em>Federal Register</em></td>
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<td>FY</td>
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<td>g/hp-hr</td>
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PM$_{2.5}$ particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers

ppb parts per billion

ppm parts per million

PSD prevention of significant deterioration

PUCT Public Utility Commission of Texas

RACT reasonably available control technology

RE renewable energy

RFP reasonable further progress

RMSE root mean square error

RRF relative response factor

SB Senate Bill

SECO State Energy Conservation Office

SIP state implementation plan

SMOKE Sparse Matrix Operation Kernel Emissions (System)

SO$_2$ sulfur dioxide

TAC Texas Administrative Code

TACB Texas Air Control Board

TCAA Texas Clean Air Act

TCEQ Texas Commission on Environmental Quality (commission)

TCFP Texas Clean Fleet Program

TERP Texas Emissions Reduction Plan

THSC Texas Health and Safety Code

TNGVGP Texas Natural Gas Vehicle Grant Program

TNRCCE Texas Natural Resource Conservation Commission

tpd tons per day

tpy tons per year

TUC Texas Utilities Code

TX$_{ovf}$ Texas contribution to a monitor’s future year design value

VOC volatile organic compounds

WRF Weather Research and Forecasting Model
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CHAPTER 1: GENERAL

1.1 BACKGROUND
Information on the Texas state implementation plan (SIP) and a list of SIP revisions and other air quality plans adopted by the commission can be found on the Texas State Implementation Plan webpage (http://www.tceq.texas.gov/airquality/sip) on the Texas Commission on Environmental Quality's (TCEQ) website (http://www.tceq.texas.gov/).

1.2 INTRODUCTION
On October 1, 2015, the United States Environmental Protection Agency (EPA) revised the primary and secondary NAAQS for ozone to an eight-hour standard of 0.070 parts per million (ppm) or 70 parts per billion (ppb) (80 Federal Register (FR) 65291, October 26, 2015). Within three years of the promulgation of any new or revised NAAQS, FCAA, §110(a)(1) requires states to submit a SIP revision to provide for the implementation, maintenance, and enforcement of the NAAQS. Section 110(a)(2)(A) through (M), lists the elements that the SIP submissions must contain. This proposed SIP revision would specifically address transport requirements under FCAA, §110(a)(2)(D). The TCEQ is addressing the infrastructure requirements of FCAA, §110(a)(2)(A) through (C) and (E) through (M) in a separate concurrent SIP revision (Project No. 2017-040-SIP-NR). Submittal of this SIP revision and the infrastructure SIP revision covering FCAA, §110(a)(2)(A) through (C) and (E) through (M) will fulfill the FCAA, §110(a)(1) requirement. Infrastructure and transport SIP revisions to address the 2015 Ozone NAAQS are due to the EPA by October 1, 2018.

Pursuant to FCAA, §110(a)(2)(D)(i), this proposed transport SIP revision must contain adequate provisions that prohibit any source or other type of emissions activity within the state from emitting any NAAQS pollutants in amounts that will:

- contribute significantly to nonattainment of the 2015 ozone NAAQS for areas in other states;
- interfere with the maintenance of the 2015 ozone NAAQS in any other state;
- interfere with measures required to meet an implementation plan for any other state related to prevention of significant deterioration (PSD); and
- interfere with measures required to meet the implementation plan for any other state related to regional haze and visibility.

In addition, pursuant to FCAA, §110(a)(2)(D)(ii), this proposed SIP revision must provide information demonstrating compliance with the applicable requirements of FCAA, §126 and §115 relating to interstate and international pollution abatement.

The EPA has historically failed to issue timely guidance to address transport requirements for previous NAAQS and has not issued formal guidance for states to use in developing transport SIP revisions for the 2015 ozone NAAQS. In order to meet statutory deadlines, states do not have the option of waiting for the EPA to provide guidance before proceeding with SIP development, review, and submittal and must proceed without the EPA’s formal guidance to develop submittals based on information available at the time.
This proposed SIP revision includes an analysis of required transport elements in FCAA, §110(a)(2)(D)(i) and (ii) consistent with statutory requirements and includes a technical demonstration and various Texas provisions that support the conclusion that Texas meets the requirements of each section. The TCEQ acknowledges that proposed changes to federal regulations may have future impacts on how the TCEQ meets the requirements of FCAA, §110(a)(2)(D); however, this proposed SIP revision reflects the methods and means by which Texas meets these requirements at the time this SIP revision was developed. Should future federal rule changes necessitate state rule changes, the TCEQ will act appropriately at that time.

1.3 HEALTH EFFECTS

On October 1, 2015, the EPA revised the primary and secondary eight-hour ozone NAAQS to 70 ppb (80 FR 65291). To support the 2015 ozone NAAQS, the EPA provided information that suggested that health effects may potentially occur at levels lower than the 2008 standard of 75 ppb. Breathing relatively high levels of ground-level ozone can cause acute respiratory problems like cough and decreases in lung function and can aggravate the symptoms of asthma. Repeated exposures to high levels of ozone can potentially make people more susceptible to allergic responses and lung inflammation.

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

1.4 PUBLIC HEARING AND COMMENT INFORMATION

The commission will hold a public hearing for this proposed SIP revision at the following time and location:

Table 1-1: Public Hearing Information

<table>
<thead>
<tr>
<th>City</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>Austin, TX</td>
<td>April 10, 2018</td>
<td>2:00 p.m.</td>
<td>Texas Commission on Environmental Quality, 12100 Park 35 Circle, Building E, Room 201S</td>
</tr>
</tbody>
</table>

The public comment period will open on March 9, 2018, and close on April 10, 2018. Written comments will be accepted via mail, fax, or through the eComments (http://www1.tceq.texas.gov/rules/ecomments/index.cfm) system. All comments should reference the “2015 Ozone NAAQS Transport SIP Revision” and should reference Project Number 2017-039-SIP-NR. Comments may be submitted to Kristin Patton, MC 206, State Implementation Plan Team, Air Quality Division, 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 system. File size restrictions may apply to
comments being submitted via the eComments system. Comments must be received by April 10, 2018.

An electronic version of the 2015 Ozone NAAQS Transport SIP Revision and appendices can be found on the TCEQ's Air Pollution from Ozone webpage (https://www.tceq.texas.gov/airquality/sip/criteria-pollutants/sip-ozone).

1.5 SOCIAL AND ECONOMIC CONSIDERATIONS
Because rulemaking is not a part of this SIP revision, there are no changes that would impact society or the economy.

1.6 FISCAL AND MANPOWER RESOURCES
The TCEQ has determined that its fiscal and manpower resources are adequate and will not be adversely affected through the implementation of this plan.
CHAPTER 2: OZONE DATA

2.1 INTRODUCTION

Ozone (O₃) is a secondary pollutant that is created through a photochemical reaction between oxygen (O₂), nitrogen oxides (NOₓ), and volatile organic compounds (VOC). NOₓ refers to the combination of nitrogen oxide (NO) and nitrogen dioxide (NO₂). The following reactions show how NOₓ, VOC, and O₂ react in the presence of sunlight (hv) to form O₃:

\[
O₂ + NO₂ \xleftrightarrow{hv} O₃ + NO
\]

\[
NO + VOC \rightarrow NO₂
\]

The amount of ozone formed depends on several factors. Meteorological conditions, such as wind direction and speed, temperature, mixing height, solar radiation, and other parameters, affect the rates at which ozone formation occurs. The types and the concentration of precursors present can affect net reactivity of precursor compounds found in a plume of emissions.

Precursor compounds, NOₓ and VOC, also exist under natural conditions. Ozone is created and destroyed on a natural cycle according to atmospheric conditions and chemical concentrations, even in the absence of additional anthropogenic precursor sources. This natural ozone formation is known as “natural background” ozone and is the starting point for measuring the contribution of ozone and precursors attributable to human activity. Within an urban area, not all ozone formation is necessarily caused by emissions produced locally because anthropogenic precursors, along with ozone formed by them, are often transported over long distances. Because the amount of ozone formed depends on so many other variables, it can be difficult to quantify the exact contribution from specific sources.

The United States Environmental Protection Agency (EPA) revised the eight-hour ozone National Ambient Air Quality Standard (NAAQS) to 0.070 parts per million (ppm) in 2015. On November 16, 2017, the EPA designated the majority of Texas as attainment/unclassifiable for the 2015 eight-hour ozone NAAQS (82 Federal Register 54232). On December 22, 2017, the EPA sent 120-day letters responding to state recommendations for remaining area designations.¹ The EPA is proposing nonattainment designations for Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties in the Dallas-Fort Worth (DFW) area and Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties in the Houston-Galveston-Brazoria (HGB) area. The EPA also intends to designate all other counties listed in the proposal as attainment/unclassifiable. This chapter will discuss trends in ozone and ozone precursor emissions in Texas to demonstrate the progress the state has made towards achieving the NAAQS.

2.2 OZONE DESIGN VALUE TRENDS IN TEXAS

A design value is a statistic that is used to compare air quality data to the NAAQS. For eight-hour ozone, a design value is the three-year average of the fourth-highest daily-maximum eight-hour averaged ozone. The latest year in the three-year average is used to represent the design value for that three-year period. Design values are calculated at each ozone monitor and the monitor with the highest design value will set the design value for that area. Although the eight-hour ozone NAAQS is reported in ppm, design values in this chapter will be displayed in parts per billion (ppb) for ease of reading.

In 2016, Texas had 76 ozone monitoring sites in 34 counties that reported valid data to the EPA. Eight-hour ozone design values for 2016 are displayed in Figure 2-1: 2016 Eight-Hour Ozone Design Values by County in Texas and listed in Table 2-1: 2016 Eight-Hour Ozone Design Values by County in Texas. Figure 2-1 and Table 2-1 show that most Texas counties have 2016 design values below the 2015 ozone NAAQS of 70 ppb. Three areas of Texas: DFW, HGB, and San Antonio, have eight-hour ozone design values above 70 ppb.

![Figure 2-1: 2016 Eight-Hour Ozone Design Values by County in Texas](image-url)

2016 Eight-Hour Ozone Design Values (ppb)
- ≤ 70
- 71 - 75
- > 75
- No Data

Figure 2-1: 2016 Eight-Hour Ozone Design Values by County in Texas
Table 2-1: 2016 Eight-Hour Ozone Design Values by County in Texas

<table>
<thead>
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<th>CSA/CBSA</th>
<th>County</th>
<th>2016 Eight-Hour Ozone Design Values (ppb)</th>
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<td>Houston—The Woodlands</td>
<td>Harris</td>
<td>79</td>
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<td>Laredo</td>
<td>Webb</td>
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Design value trends can be used to determine if various areas in Texas are making progress towards attainment of the ozone NAAQS. Eight-hour ozone design value trends by Texas area are displayed in Figure 2-2: Eight-Hour Ozone Design Values and Population by Area in Texas. Figure 2-2 shows that all areas of Texas have shown decreases in design values over the past 25 years. No area has seen an increase in eight-hour ozone design values. As mentioned above, in 2016 only three areas in Texas are measuring above the 2015 ozone NAAQS of 70 ppb. The largest ozone decreases
from 1991 through 2016 were observed in the HGB area, which had a 34% decrease in eight-hour ozone design values, and the Beaumont-Port Arthur (BPA) area, which had a 33% decrease in eight-hour ozone design values.

Figure 2-2: Eight-Hour Ozone Design Values and Population by Area in Texas

2.3 OZONE EMISSIONS TRENDS IN TEXAS

2.3.1 General
The Texas Commission on Environmental Quality (TCEQ) maintains an inventory of current information for sources of ozone precursor emissions (NOx and VOC) that identifies the types of emissions sources present in an area, the amount of each pollutant emitted, and the types of processes and control devices employed at each plant or source category. The total anthropogenic inventory of NOx and VOC emissions for an area is derived from estimates developed for three general categories of emissions sources: point, area, and mobile (both non-road and on-road). The emissions inventory also provides data for a variety of air quality planning tasks, including establishing baseline emissions levels, calculating reduction targets, developing control strategies to achieve emissions reductions, developing emissions inputs for air quality models, and tracking actual emissions reductions against established emissions growth and control budgets.

The most current emissions inventory (EI) data were analyzed as part of this ozone transport SIP revision. At the time of preparation of this SIP revision, the TCEQ was
planning the development of the 2017 periodic EI in accordance with the EPA’s Air Emissions Reporting Requirements (40 Code of Federal Regulations Part 51, Subpart A). The calendar year 2014 periodic inventory was the most recent periodic inventory available to develop this SIP revision’s EI.

Additionally, 10 years of anthropogenic emissions data (2005 through 2014) were analyzed to develop historical trend data. During this time, the EI for Texas and its two current ozone nonattainment areas (DFW and HGB) showed a significant decrease in ozone precursor emissions from all source categories; reductions range from 15 to 46%, as detailed in Section 2.3.2: Historical Emissions Inventory Trends. These reductions contributed to the attainment of both the one-hour and the 1997 eight-hour ozone NAAQS. These reductions were accomplished through a variety of federal, state, and local regulations and programs as detailed below.

2.3.2 Historical Emissions Inventory Trends
For the 10-year historical period up to and including 2014 (2005 through 2014), overall anthropogenic ozone precursor emissions in Texas as well as the DFW and HGB ozone nonattainment areas declined substantially. As demonstrated in Figure 2-3: Statewide Historical NO\textsubscript{X} Emissions Trends in Tons per Year and Figure 2-4: Statewide Historical VOC Emissions Trends in Tons per Year, anthropogenic NO\textsubscript{X} emissions decreased 35% and anthropogenic VOC emissions decreased 17% from 2005 through 2014. These emissions reductions were the result of regulations implemented at the federal, state, and local levels and innovative programs implemented by the TCEQ.

Both 30 Texas Administrative Code (TAC) Chapter 115: Control of Air Pollution from Volatile Organic Compounds and 30 TAC Chapter 117: Control of Air Pollution from Nitrogen Compounds regulations have significantly reduced overall ozone precursor emissions at both major and minor (point and area) industrial, commercial, and institutional sources in the DFW and HGB ozone nonattainment areas as well as other portions of the state (e.g., East Texas Combustion Rule).

The implementation of statewide or regional emissions banking and trading programs have also assisted in reducing ozone precursor emissions. For example, the Emissions Banking and Trading of Allowances program has implemented annual NO\textsubscript{X} emissions caps for grandfathered and electing electric generating facilities. Similarly, the Highly Reactive Volatile Organic Compound (HRVOC) Emissions Cap and Trade Program and the Mass Emissions Cap and Trade Program have specifically reduced HRVOC and NO\textsubscript{X} emissions, respectively, from point sources in the HGB area.

Innovative emissions reduction programs such as the Texas Emissions Reduction Plan and 30 TAC Chapter 114: Control of Air Pollution from Motor Vehicles, which includes programs such as the AirCheckTexas Drive a Clean Machine program and vehicle emissions testing, have also reduced mobile source emissions, the primary source of NO\textsubscript{X} emissions in the state.

The following graphs illustrate these trends statewide as well as in the DFW and HGB ozone nonattainment areas.
Figure 2-3: Statewide Historical NO\textsubscript{x} Emissions Trends in Tons per Year

Figure 2-4: Statewide Historical VOC Emissions Trends in Tons per Year
Similarly, Figure 2-5: DFW 10-County Nonattainment Area Historical NO$_x$ Emissions Trends in Tons per Year and Figure 2-6: DFW 10-County Nonattainment Area Historical VOC Emissions Trends in Tons per Year demonstrate a marked 46% decrease in anthropogenic NO$_x$ emissions and a 15% decrease in anthropogenic VOC emissions from 2005 through 2014.

Figure 2-5: DFW 10-County Nonattainment Area Historical NO$_x$ Emissions Trends in Tons per Year
Finally, the HGB area shows significant overall progress in reducing anthropogenic emissions. As shown in Figure 2-7: *HGB Eight-County Nonattainment Area Historical NO\textsubscript{X} Emissions Trends in Tons per Year* and Figure 2-8: *HGB Eight-County Nonattainment Area Historical VOC Emissions Trends in Tons per Year*, a 43% decrease in anthropogenic NO\textsubscript{X} emissions and a 37% decrease in anthropogenic VOC emissions has occurred from 2005 through 2014.
Figure 2-7: HGB Eight-County Nonattainment Area Historical NO\textsubscript{X} Emissions Trends in Tons per Year

Figure 2-8: HGB Eight-County Nonattainment Area Historical VOC Emissions Trends in Tons per Year

2-9
2.4 OZONE DATA SUMMARY

Ozone data in Texas show that there are three areas that have eight-hour ozone design values above 70 ppb: DFW, HGB, and San Antonio. Over the past 25 years, all areas in Texas have observed some decrease in eight-hour ozone design values. The largest eight-hour ozone design value decreases from 1991 through 2016 were observed in the HGB and the BPA areas with decreases of 34% and 33%, respectively.

Statewide trend analysis using the 2005 through 2014 emissions shows a similar reduction in ozone precursor emissions: a 17% reduction in VOC emissions and a 35% reduction in NO\textsubscript{x} emissions. These reductions have assisted the state in attaining both the one-hour and 1997 eight-hour ozone NAAQS and are expected to help the state in attaining the 2008 and 2015 NAAQS in the future.
3.1 INTRODUCTION
The Federal Clean Air Act (FCAA), §110(a)(2)(D)(i)(I) requires states to submit a state implementation plan (SIP) revision that contains adequate provisions to prohibit any source or other type of emissions activity within the state from emitting any air pollutants in amounts that will contribute significantly to nonattainment of the National Ambient Air Quality Standards (NAAQS) for areas in other states or interfere with maintenance of the NAAQS in any other state. The purpose of FCAA’s §110(a)(2)(D)(i)(I), also known as the “good neighbor” provision, is to ensure that emissions in one state that contribute significantly to nonattainment or interfere with maintenance in another state are addressed appropriately.

For this SIP revision, the key aspect of fulfilling this obligation is to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance of the 2015 eight-hour ozone NAAQS in another state. The following sections utilize photochemical modeling and data analysis to demonstrate that emissions from Texas do not contribute significantly to nonattainment or interfere with maintenance of the 2015 eight-hour ozone NAAQS in another state.

The approach used by the Texas Commission on Environmental Quality (TCEQ) to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance at downwind monitors in another state is based partly on the United States Environmental Protection Agency’s (EPA) Notice of Data Availability of Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone NAAQS (2015 Transport NODA) published in the January 6, 2017 Federal Register (82 FR 1733), with several key improvements. The TCEQ used a three-step approach, detailed below, to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance at downwind monitors in another state.

**Step 1:** Identify monitors projected to be in nonattainment or have maintenance issues in a future year.

**Step 2:** Identify projected nonattainment and/or maintenance monitors in other states that might be impacted by emissions from Texas, tagging them for further review.

**Step 3:** Determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance at the monitors tagged for review in Step 2.

The EPA used a four-step framework, referred to as the Cross-State Air Pollution Rule (CSAPR) framework, to address the requirements of the “good neighbor” provision in the 2015 Transport NODA. From the 2015 Transport NODA, the four steps in the CSAPR framework are as follows (82 FR 1735):

“[1] Identifying downwind receptors that are expected to have problems attaining or maintaining clean air standards (i.e., NAAQS);
[2] determining which states contribute to these problems in amounts sufficient to “link: them to the downwind air quality problems;

[3] for states linked to downwind air quality problems, identifying upwind emissions that significantly contribute to nonattainment or interfere with maintenance of the NAAQS by quantifying upwind reductions in ozone precursor emissions and apportioning emissions reduction responsibility among upwind states; and

[4] for states that are found to have emissions that significantly contributes to nonattainment or interfere with maintenance of the NAAQS downwind, adopting SIPs or FIPs that eliminate such emissions."

The TCEQ’s three-step process covers steps [1] and [2] of the four-step framework. Step 1 of the TCEQ’s three-step process is the same as step [1] of the EPA’s four-step framework. Steps 2 and 3 of the TCEQ’s process together are equivalent to step [2] of the EPA’s framework. Steps [3] and [4] of EPA’s framework are relevant only if emissions from Texas contribute significantly to nonattainment or interfere with maintenance at downwind monitors in another state and are therefore not addressed in this SIP revision.

In the 2015 Transport NODA, upwind states with contributions greater than or equal to 0.7 ppb to a monitor’s future year design value are linked to the downwind monitor. Once the linkages have been established, the portion of emissions from linked states that were determined by the EPA to have contributed significantly to nonattainment or interfere with maintenance are identified (Steps 2 and 3, respectively, of the EPA’s four-step framework). The EPA’s framework establishes the 1% of NAAQS threshold as the default definition of significant contribution to nonattainment or interference with maintenance. The TCEQ has maintained and noted in comments to EPA on its transport modeling, that an arbitrary threshold of 1% of the NAAQS for significant contribution to nonattainment or interference with maintenance is inappropriate and incomplete.2,3 In the 2015 Transport NODA, the EPA acknowledges that a contribution of 1% of the NAAQS from an upwind state alone does not determine whether the upwind state significantly contributes to nonattainment or interferes with maintenance of a NAAQS to a downwind state (FR 82 1740). The TCEQ believes that it is critical to determine if emissions from an upwind state contribute significantly to nonattainment or interfere with maintenance prior to the identification (and subsequent reduction) of such emissions.

2 “Comments by the Texas Commission on Environmental Quality Regarding the Notice of Availability of the Environmental Protection Agency’s Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone National Ambient Air Quality Standard”, available at https://www.tceq.texas.gov/assets/public/agency/nc/air/TCEQ-Summary-on-EPA%28%93HO%28%80%93OAR%28%80%932016%28%80%930751.pdf

In this SIP revision, the TCEQ is partially addressing its concern with the use of the 1% of NAAQS threshold as the definition of significant contribution to nonattainment by adding a step that uses a more comprehensive analysis to determine if emissions from an upwind state contribute significantly to nonattainment or interfere with maintenance.

For Step 1, the TCEQ used regional photochemical modeling to identify monitors projected to be in nonattainment or have maintenance issues in the future year. In Step 2, if the Texas contribution to a monitor's future year design value was greater than or equal to 1% of the NAAQS (i.e., 0.7 ppb) the monitor was tagged for further review. In Step 3, a comprehensive review of modeling and analysis of monitoring data was used to determine if emissions from Texas contributed significantly to nonattainment or interfered with maintenance for monitors tagged in Step 2.

3.2 STEP 1: IDENTIFICATION OF PROJECTED NONATTAINMENT AND MAINTENANCE MONITORS

The TCEQ used photochemical modeling, in accordance with the EPA’s 2014 Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM$_{2.5}$, and Regional Haze (EPA Modeling Guidance), to identify monitors projected to be in nonattainment in a future year. Photochemical modeling for ozone consists of using a regional Chemical Transport Model (CTM) with appropriate meteorological and emissions inputs, to simulate the formation and transport of ozone.

To assess the future attainment status of monitors, the EPA’s Modeling Guidance uses modeling results in a relative sense. This relative approach is based on how the model responds to the change in emissions between a base year and a future year while holding meteorological inputs constant. For this SIP revision, the TCEQ used a 2012 base year and a 2023 future year to identify monitors projected to be in nonattainment or have maintenance issues in the future. The future year of 2023 was chosen based on the assumed attainment date for moderate nonattainment areas as detailed in EPA’s 2015 Transport NODA.

The photochemical modeling process began with episode, base year, and domain selection. Base case and future year modeling was conducted, and results were interpreted to determine future year (2023) design values (DV$_i$) at monitoring sites in the modeling domain.

3.2.1 Modeling Domain

The geographic extent of the modeling domain used for the 2015 ozone NAAQS Transport SIP revision is shown in Figure 3-1: Map of 2015 Ozone NAAQS Transport SIP Revision CTM Modeling Domain. The domain includes the 48 contiguous states of the United States (U.S.), with parts of southern Canada and northern Mexico.

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The CTM used for this SIP revision is the Comprehensive Air Quality Model with Extensions (CAMx), version 6.40. CAMx is a three-dimensional grid-based Eulerian model designed to simulate the formation and transport of ozone and ozone precursor concentrations over regional and urban spatial scales. The modeling domain, referred to as the rpo_12km domain, has a horizontal grid resolution of 12 kilometers (km) by 12 km and 29 vertical layers. The domain definitions are provided in Table 3-1: 2015 Ozone NAAQS Transport SIP Revision CAMx Modeling Domain Definitions.

Table 3-2: 2015 Ozone NAAQS Transport SIP Revision CAMx Modeling Domain Vertical Structure provides details of the modeling domain vertical layers such as the top and center height in meters Above Ground Level (m AGL) and thickness in meters (m).
Table 3-1: 2015 Ozone NAAQS Transport SIP Revision CAMx Modeling Domain Definitions

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<th>Domain</th>
<th>Easting Range (km)</th>
<th>Northing Range (km)</th>
<th>Number of Cells (Easting)</th>
<th>Number of Cells (Northing)</th>
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Table 3-2: 2015 Ozone NAAQS Transport SIP Revision CAMx Modeling Domain Vertical Structure

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3.2.2 Modeling Episode
The modeling episode used for this SIP revision was the May 1 through September 30, 2012 period (May through September 2012). A robust modeling platform had been developed for May through September 2012 as part of the Houston-Galveston Brazoria Attainment Demonstration SIP revision for the 2008 Eight-hour Ozone NAAQS (HGB...
AD SIP) that was adopted on December 15, 2016 by the commission and submitted to the EPA on December 29, 2016. The May through September 2012 episode was selected in accordance with the episode selection criteria specified in the EPA Modeling Guidance, details of which are documented in the section 3.4: Episode Selection of the HGB AD SIP. The EPA, in its 2015 Transport NODA, used May 1 through September 30, 2011 period (May through September 2011) for its transport modeling. However, 2011 was a meteorologically anomalous year for Texas and surrounding states as it was the hottest year on record and the single-worst drought year recorded in Texas since 1895 (Hoerling et al., 2012). Figure 3-2: U.S. Drought Monitor Map of Texas for July 26, 2011 shows the extent of the drought across the state.

![U.S. Drought Monitor Map of Texas for July 26, 2011](image)

Figure 3-2: U.S. Drought Monitor Map of Texas for July 26, 2011

The TCEQ has submitted comments on the unsuitability of the May through September 2011 episode for Texas ozone modeling in response to several EPA actions such as the

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6 Revisions to the State of Texas Air Quality Implementation Plan for the Control of Ozone Air Pollution, Houston-Galveston Brazoria Attainment Demonstration SIP revision for the 2008 Eight-hour Ozone Standard Nonattainment Area (pages 3-4 to 3-17) [https://www.tceq.texas.gov/assets/public/implementation/air/sip/hgb/HGB_2016_AD_RFP/AD_Adoption_16016SIP_HGB08AD_ado.pdf](https://www.tceq.texas.gov/assets/public/implementation/air/sip/hgb/HGB_2016_AD_RFP/AD_Adoption_16016SIP_HGB08AD_ado.pdf)

3.2.2.1 Meteorology of 2012
Meteorology for the May through September 2012 period was analyzed for the rest of the contiguous U.S. The year 2012 had above average temperatures across most of the U.S., except in some states in the southeast. New Hampshire had their highest May through October average temperatures on record. The National Oceanic and Atmospheric Administration’s (NOAA) National Climatic Data Center (NCDC) temperature rankings for the May through October average temperature of 2012 relative to the years 1895 through 2012 are shown in Figure 3-3: May through October 2012 Statewide NCDC Temperature Ranks. The numbers in each state represent the numerical rank for that state for 2012. Among the NCDC climatic regions, the Northeast had its warmest year on record for the years 1895 through 2012.

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9 TCEQ comments on EPA’s Notice of Data Availability of the Updated Ozone Transport Modeling Data for the 2008 Ozone NAAQS. Submitted 10/15/15 and available at https://www.tceq.texas.gov/agency/nc/Air_Issues.html/#101515
11 Explanation of Climatological Rankings available at https://www.ncdc.noaa.gov/monitoring-references/dyk/ranking-definition
12 NCDC US Climatic Region definitions are available at https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php
Figure 3-3: May through October 2012 Statewide NCDC Temperature Ranks

Figure 3-4: May through October 2012 Statewide NCDC Precipitation Ranks shows the NCDC precipitation rankings for the May through October months of 2012 relative to the years 1895 through 2012. May through October 2012 had below normal or much below normal precipitation in most of the South and Northern Rockies and Plains and parts of the Upper Midwest and Ohio River Valley climate regions with a record driest year for Nebraska and Wyoming. However, the Northeast and parts of the Southeast had above normal or much above normal precipitation.
The entire central portion of the U.S. was in some state of drought. However, the drought reported in Texas by July 2011 had diminished in severity by July 2012. Figure 3-5: Change in Texas Drought Conditions from July 2011 to July 2012 shows the change in drought class from July 26, 2011 to July 24, 2012 with approximately 60 to 70% of Texas showing improvement by three to five drought classes statewide.
3.2.2.2 Ozone Production in 2012

The TCEQ analyzed, similarly to the EPA’s analysis for its transport modeling, the meteorologically adjusted ozone trends for the NCDC climate regions for May through September 2012. Figure 3-6: Meteorologically-Adjusted Ozone Trends for NCDC Climate Regions for 2000 through 2016 shows the meteorologically-adjusted ozone trends from 2000 through 2016. The 2010 through 2016 time period shows variation in ozone conducive conditions across years and climate regions. The year 2012 was more conducive (relative to 2010 through 2016) for ozone formation in the Northeast, Upper Midwest, Northwest, Northern Rockies and Plains, and West regions while for the Ohio River Valley, South, Southeast, and Southwest climate regions 2011 was more conducive to ozone production. In the past the EPA has acknowledged that no single year will be representative of “typical” meteorological conditions for ozone for all regions of the U.S. (EPA, August 2016). Based on this analysis, the TCEQ concluded that the well-tested 2012 modeling platform is appropriate for use in this SIP revision.


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14 Data for this analysis shown in Figure 3-6 was obtained from the EPA's Air-Trends webpage (https://www.epa.gov/air-trends/trends-ozone-adjusted-weather-conditions)
Figure 3-6: Meteorologically-Adjusted Ozone Trends for NCDC Climate Regions for 2000 through 2016
3.2.3 Base Case Modeling

Base case modeling was used to evaluate the CTM’s ability to replicate measured ozone and precursor concentrations. The adequacy of the model in replicating observations was assessed statistically and graphically. Satisfactory model performance in base case modeling provided a degree of confidence in the use of the model to predict future ozone concentrations and to evaluate transport impacts.

Base case modeling included the generation of initial and boundary conditions, emissions inputs and meteorological inputs for the May through September 2012 period needed by CAMx. Results of base case modeling included modeled ozone and precursor concentrations for every grid cell of the rpo_12km domain for every hour of May through September 2012. The base case modeling results were evaluated by comparisons with observed measurements at monitoring sites across the modeling domain. The model performance evaluation was iterative. Feedback from successive evaluations was incorporated to ensure that the model was adequately replicating observations throughout the modeling domain and episode. Details of the inputs generated for base case modeling are provided below.

3.2.3.1 Meteorological Modeling

The TCEQ used the Weather Research and Forecasting Model (WRF) version 3.8.1 to create the May through September 2012 meteorological inputs for CAMx. The WRF domain was chosen to accommodate the CAMx domain shown in Figure 3-1. Figure 3-7: Map of 2015 Ozone NAAQS Transport SIP Revision Meteorological Modeling Domain shows the geographical extent of the WRF modeling domain, along with the CAMx domain for reference.
For the meteorological model, a single domain was used, referred to as na_12km, with horizontal grid resolution of 12 km x 12 km and 44 vertical layers. The WRF model domain definitions are provided in Table 3-3: 2015 Transport SIP Revision WRF Modeling Domain Definitions. Table 3-4: 2015 Transport SIP Revision WRF Modeling Domain Vertical Structure provides details of the WRF model domain vertical layers, such as heights and thickness. Figure 3-8: Matching of WRF and CAMx Vertical Layers shows how the vertical layers of WRF shown in Table 3-4 are matched to the vertical layers of CAMx shown in Table 3-2.

Table 3-3: 2015 Transport SIP Revision WRF Modeling Domain Definitions

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Table 3-4: 2015 Transport SIP Revision WRF Modeling Domain Vertical Structure

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</tbody>
</table>

**Note**

AGL - Above Ground Level.

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**Figure 3-8: Matching of WRF and CAMx Vertical Layers**
The initial and boundary conditions for WRF modeling were obtained from the GCIP (GEWEX (Global Energy and Water EXperiment) Continental-Scale International Project) NCEP (National Centers for Environmental Prediction) Eta data archive. Where data were missing from the GCIP NCEP Eta archive, data extracted from the NCEP North American Mesoscale model were used. More details regarding how missing data were handled is presented in Appendix A: *Meteorological Modeling for the Transport State Implementation Plan Revision for the 2015 Eight-Hour Ozone National Ambient Air Quality Standard*. To optimize performance, two types of nudging were utilized. The first type was analysis nudging, both three-dimensional (3-D) and surface. The 3-D analysis nudging was used to nudge the wind, temperature and moisture, while the surface analysis nudging was only used to nudge wind and temperature. The second type of nudging used was observational nudging, which used the radar profiler data for nudging aloft winds towards observed vertical profiles.

The selection of the final meteorological modeling configuration for May through September 2012 resulted from numerous sensitivity tests and model performance evaluation. The final WRF parameterization schemes and options selected are shown in Table 3-5: *WRF Model Configuration Parameters*. Details of the meteorological sensitivity tests are provided in Appendix A.

**Table 3-5: WRF Model Configuration Parameters**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Nudging Type</th>
<th>PBL</th>
<th>Cumulus</th>
<th>Radiation</th>
<th>Land-Surface</th>
<th>Microphysics</th>
</tr>
</thead>
<tbody>
<tr>
<td>na_12km</td>
<td>3-D, Surface Analysis, PX Soil Nudging, NPN and CAP Radar Profiler Observations</td>
<td>YSU</td>
<td>Multiscale Kain-Fritsch</td>
<td>RRTM / Dudhia</td>
<td>Pleim-Xiu</td>
<td>WSM5</td>
</tr>
</tbody>
</table>

WRF output was post-processed using the WRF2CAMx version 4.6 utility with the Community Multi-Scale Air Quality (CMAQ) modeling system vertical diffusivity (Kv) option to convert the WRF meteorological fields to the appropriate CAMx grid and input format. The 100 m Kv Patch program developed by Ramboll Environ\(^1\) was used to modify the vertical diffusivity coefficients based on a land-use basis to maintain vertical mixing within the first 100 meters of the model over urban areas. Sub grid stratiform cloud diagnostics were applied to better simulate ultraviolet-attenuation in CAMx.

WRF model performance was evaluated for wind speed and direction, temperature, and humidity. Figure 3-9: *Wind Speed Mean Bias for May through September 2012*, Figure 3-10: *Two Meter Temperature Mean Bias for May through September 2012*, and Figure 3-11: *Humidity Mean Bias for May through September 2012* show the mean bias for wind speed, temperature, and humidity, respectively for May through September 2012 for each monitoring station across the na_12km domain.

Figure 3-9: Wind Speed Mean Bias for May through September 2012

Figure 3-10: Two Meter Temperature Mean Bias for May through September 2012
Figure 3-11: Humidity Mean Bias for May through September 2012

Figure 3-9 shows that wind speed had a negative bias along the East Coast, Southeast, and western continental U.S., while eastern Texas, the Ohio River Valley, and the Great Lakes region had a positive bias. Mean bias for temperature in Figure 3-10 does not show strong geographical trends, although slightly more monitors in the western U.S. show a positive bias. Figure 3-11 shows that there was a positive bias for humidity at most monitoring stations in the domain, although a negative bias is seen over much of Oklahoma through eastern Kansas and into southern Nebraska, and also in parts of southern California.

Figure 3-12: Wind Speed Mean Absolute Error for May through September 2012, Figure 3-13: Two Meter Temperature Mean Absolute Error for May through September 2012, and Figure 3-14: Humidity Mean Absolute Error for May through September 2012 show the mean absolute error for wind speed, temperature, and humidity, respectively for May through September 2012 at monitoring stations across the na_12km domain.
Figure 3-12: Wind Speed Mean Absolute Error for May through September 2012

Figure 3-13: Two Meter Temperature Mean Absolute Error for May through September 2012
Figure 3-14: Humidity Mean Absolute Error for May through September 2012

Figure 3-12 and Figure 3-13 show that the mean absolute error for wind speed and temperature, respectively, were lower in the eastern U.S. than western U.S. Figure 3-14 shows a more north/south regional difference for humidity, with monitors in the northern U.S. having less mean absolute error than monitors in the southern U.S.

Figure 3-15: Wind Speed RMSE for May through September 2012, Figure 3-16: Two Meter Temperature RMSE for May through September 2012, and Figure 3-17: Humidity RMSE for May through September 2012 show the Root Mean Square Error (RMSE) for wind speed, temperature, and humidity, respectively, for May through September 2012 at monitoring stations across the na_12km domain.
Figure 3-15: Wind Speed RMSE for May through September 2012

Figure 3-16: Two Meter Temperature RMSE for May through September 2012
Similar to the Mean Absolute Error in Figures 3-12 through 3-14, Figure 3-15 and Figure 3-16 show an east/west regional trend with monitors in the east having lower RMSE than monitors in the west for wind speed and temperature, respectively, while Figure 3-17 shows that RMSE for humidity in the southern and central monitors are greater than RMSE for northern monitors.

Overall, WRF model performance for May through September 2012 was acceptable for the CTM input. More details regarding WRF model performance, including daily, monthly, and regional performance statistics, are presented in Appendix A.

3.2.3.2 Emissions Modeling

Emissions modeling is the process of creating CAMx-ready emissions inputs. For base case modeling, precursor emissions inputs are chemically speciated into the Carbon Bond 6 (CB6) chemical mechanism species used in CAMx, temporally allocated, and spatially distributed to 12 km grid cells for May through September 2012. The main ozone precursors are nitrogen oxides (NOx) and volatile organic compounds (VOC) while carbon monoxide (CO) plays a minor role in ozone formation. Though CO has very low reactivity and does not play a major role in controlling ozone formation, in this subsection details of CO modeling emissions inventories are presented as CO is a chemical species in the model.

Version 3.22 of the Emissions Processor System (EPS3) was used to prepare the gridded emissions inputs. Table 3-6: Emissions Processing Modules summarizes many of the steps taken to prepare the required emission files needed by CAMx and the software modules in EPS3 that were used for each step.
### Table 3-6: Emissions Processing Modules

<table>
<thead>
<tr>
<th>EPS3 Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREAM</td>
<td>Prepare area and non-link based area and mobile source emissions for further processing</td>
</tr>
<tr>
<td>LBASE</td>
<td>Spatially allocate link-based mobile source emissions among grid cells</td>
</tr>
<tr>
<td>PREPNT</td>
<td>Group point source emissions into elevated and low-level categories for further processing</td>
</tr>
<tr>
<td>CNTLEM</td>
<td>Apply controls to model strategies, apply adjustments, make projections, etc.</td>
</tr>
<tr>
<td>TMPRL</td>
<td>Apply temporal profiles to allocate emissions by day type and hour</td>
</tr>
<tr>
<td>SPCEMS</td>
<td>Chemically speciate emissions into nitrogen oxide (NO), nitrogen dioxide (NO₂), and various CB6 VOC species</td>
</tr>
<tr>
<td>GRDEM</td>
<td>Spatially distribute emissions by grid cell using source category surrogates</td>
</tr>
<tr>
<td>MRGUAM</td>
<td>Merge and adjust multiple gridded files for model-ready input</td>
</tr>
<tr>
<td>PIGEMS</td>
<td>Assign Plume-in-Grid (PiG) emissions and merge elevated point source files</td>
</tr>
</tbody>
</table>

Figure 3-18: **Base Case Representative Day Total Anthropogenic Precursor Emissions by Geographic Regions** shows the total anthropogenic precursor emissions in the rpo_12km domain by major geographic region (Texas, Non-Texas U.S., southern Canada, northern Mexico, and Oceanic) on a sample 2012 summer weekday in tons per day.

![2012 Summer Weekday Anthropogenic Precursor Emissions by Geographic Region](image)

**Figure 3-18: Base Case Representative Day Total Anthropogenic Precursor Emissions by Geographic Regions**

Emissions modeling includes preparing emissions inventories for anthropogenic emissions source categories such as stationary point sources (power plants, refineries,
etc.), area sources (dry cleaners, gas stations, etc.), on-road mobile sources (cars, trucks, etc.), non-road mobile sources (construction vehicles, lawn mowing equipment, etc.), off-road mobile sources (locomotives, commercial marine, aircraft, etc.), and oceanic (off-shore oil rigs and ocean-going vessels). Figure 3-19: Base Case Representative Day Total Anthropogenic Precursor Emissions by Source Category shows the total anthropogenic precursor emissions in the rpo_12km domain by source category for a sample 2012 summer weekday in tons per day.

![2012 Summer Weekday Anthropogenic Precursor Emissions by Source Category](image)

**Figure 3-19: Base Case Representative Day Total Anthropogenic Precursor Emissions by Source Category**

Emissions inventories for natural emissions source categories, i.e., biogenic sources and fires, were also developed. Version 3.61 of the Biogenic Emissions Inventory System (BEIS) (Bash et al., 2016) within the Sparse Matrix Operation Kernel Emissions (SMOKE) System version 3.7\(^6\) was used to create the biogenic emissions inventory. Figure 3-20: Biogenic VOC Emissions in RPO_12km Domain on July 18, 2012 shows a sample of biogenic VOC emissions in the rpo_12km domain.

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\(^6\) Available at [https://www.cmascenter.org/smoke/](https://www.cmascenter.org/smoke/)
Wildfire emissions were estimated from the daily Fire Inventory from the National Center for Atmospheric Research (NCAR) (FINN) version 1.5 product for 2012 (Wiedinmyer, 2011). The FINN fire estimates were projected to the model grid and grouped together if fires were within 5 km of each other. Each fire was treated as a point source and processed using the EPS3 PREFIR, CHMSPL, TMPRL, and PSTFIR.
modules following the methodology developed in a TCEQ project.\textsuperscript{17} The fire emissions were temporally allocated according to the temperate North American diurnal cycle of fires from Mu et al. (2011).

Since the purpose of base case modeling is to evaluate the ability of the model to recreate a past episode, measured and reported emissions data from 2012 with the highest resolution available were relied upon to determine the spatial and temporal allocation of emissions in the modeling domain for each hour of the modeling episode. Details of the development and processing of emissions inventories for base case modeling are provided in Appendix B: \textit{Emissions Modeling for the Transport State Implementation Plan Revision for the 2015 Eight-Hour Ozone National Ambient Air Quality Standard}.

3.2.3.3 Initial and Boundary Conditions

In addition to emissions and meteorological inputs, CAMx requires initial and boundary conditions. Initial conditions refer to the state of the atmosphere in the rpo\_12km domain at the start of the modeling episode. Boundary conditions refer to the state of the atmosphere at the five edges (North, South, East, West, and Top) of the rpo\_12km domain.

The initial and boundary conditions were derived from the output of a three-dimensional global CTM, GEOS-Chem. The GEOS-Chem model simulates atmospheric chemical and physical processes driven by assimilated meteorological observations from the NASA's Goddard Earth Observing System (GEOS).\textsuperscript{18} The TCEQ used a modified version of the standard GEOS-Chem version 10-01. The modifications were implemented by Ramboll Environ as part of TCEQ projects\textsuperscript{19, 20} that updated the lightning NO\textsubscript{x} module (Travis et al., 2016; Zhang et al., 2014) and halogen chemistry (Sherwen et al., 2016; Yarwood et al., 2016), and fixed several model errors.

For the base case simulation, GEOS-Chem was run for 2012 with a grid resolution of 2.0 degrees latitude x 2.5 degrees longitude, using meteorology from the GEOS Model Version 5 (GEOS-5) and global anthropogenic emissions inventory for non-U.S. regions from the Hemispheric Transport of Air Pollution (HTAP) version 2. For U.S. emissions, the U.S. National Emission Inventory 2011 (2011 National Emissions Inventory) was used. GEOS-Chem results were used to provide one-way dynamic boundary concentrations at three-hour intervals and an initial concentration field for the CAMx simulations. Figure 3-21: \textit{Initial Concentration on April 16, 2012 in the RPO\_12km} shows a map of the initial ozone concentration field on 12 a.m., April 16, 2012 at the surface layer in the rpo\_12km domain. April 16, 2012 is the start date of the CAMx simulations.


\textsuperscript{18} GEOS-Chem Model, \url{http://acmg.seas.harvard.edu/geos/}


simulation with a ramp up period of April 16 through April 30 for the base case modeling.

Figure 3-21: Initial Concentration on April 16, 2012 in the RPO_12km

Figure 3-22: 2012 East Boundary Condition Cross-Section for July 18, 2012 Episode Day, Figure 3-23: 2012 West Boundary Condition Cross-Section for July 18, 2012 Episode Day, Figure 3-24: 2012 North Boundary Condition Cross-Section for July 18, 2012 Episode Day, and Figure 3-25: 2012 South Boundary Condition Cross-Section for July 18, 2012 Episode Day show a samples of the 2012 east, west, north, and south, respectively, boundary conditions for the July 18, 2012 episode day for the three-hour window of 12 p.m. to 3 p.m.
Figure 3-22: 2012 East Boundary Condition Cross-Section for July 18, 2012 Episode Day

Figure 3-23: 2012 West Boundary Condition Cross-Section for July 18, 2012 Episode Day

Figure 3-24: 2012 North Boundary Condition Cross-Section for July 18, 2012 Episode Day
3.2.3.4 Photochemical Modeling

The TCEQ used CAMx version 6.40,21 with the following options:

- New gas-phase chemistry mechanism CB6 “revision 4,” with condensed halogen chemistry and inline sea salt emissions (CB6r4h); and
- Wesely dry deposition scheme.

In addition to the meteorological, emissions, and initial and boundary condition inputs, CAMx needs spatially resolved surface characteristic parameters, albedo/haze/ozone (i.e., opacity), photolysis rates and a file with chemistry parameters.

Surface characteristic parameters, including topographic elevation, Leaf Area Index (LAI), vegetative distribution, and water/land boundaries are input to CAMx via a land-use file. The land-use file provides the fractional contribution of 26 land-use categories per grid cell, as defined by Zhang et al (2003). The land use file was developed using version 3 of the Biogenic Emissions Land Use Database for areas outside the U.S. and the 2006 National Land Cover Dataset for the U.S. For Texas and surrounding states, updated land-use files developed by Texas A&M University (Popescu et al., 2012) were used. The land use file, in addition to the land-use categories, has LAI ratios. LAI is the ratio of total upper leaf surface of vegetation divided by the surface area of the land on which the vegetation grows. LAI is a dimensionless value, typically ranging from zero for bare ground to over seven for a dense forest. Monthly averaged LAI was created from the eight-day 1 km resolution MODIS MCD15A2 product.

Spatially resolved opacity and photolysis rates that are specific to the chemistry parameters for the CB6 mechanism are input to CAMx via a photolysis rates file and an opacity file. The chemistry parameters for the CB6 mechanism are provided in the

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chemistry parameters file. Episode-specific satellite data from the Total Ozone Mapping Spectrometer were used to prepare the clear-sky photolysis rates and opacity files. Photolysis rates are internally adjusted by CAMx according to cloud and aerosol properties using the inline Tropospheric Ultraviolet Visible model.

The CAMx model configuration was applied to the 2012 base case using the episode-specific meteorological inputs, biogenic and anthropogenic emission inputs, and initial and boundary conditions described above. The CAMx modeling results were compared to the measured ozone and ozone precursor concentrations at all regulatory monitoring sites in the rpo_12km domain, which resulted in several modeling iterations to implement improvements to the meteorological modeling, emissions modeling, and subsequent CAMx modeling. Various configuration changes such as the choice of biogenic emission models, land-use model used in WRF modeling, impact of cloud assimilation, etc., were evaluated along with updates to various anthropogenic emissions categories.

Statistical metrics such as Mean Bias (MB), Mean Error (ME), Normalized Mean Bias (NMB), Normalized Mean Error (NME), and RMSE were calculated by comparing monitored (measured) and bi-linearly interpolated modeled ozone concentrations for all episode days and monitors. These statistical metrics were used to evaluate the different configurations and arrive at the final configuration used for the 2015 Ozone NAAQS Transport SIP revision.

Episode-wide model performance statistics and graphics for the final modeling configuration are presented below. Figure 3-26: Mean Bias for the May through September 2012 Episode at AQS Monitoring Sites shows the mean bias for all the EPA Air Quality System (AQS) monitoring sites for the May through September 2012 episode for days with observed Maximum Daily Average Eight-Hour (MDA8) ozone concentration greater than or equal to 60 ppb. Figure 3-26 shows that the mean biases for days with MDA8 greater than 60 ppb differ by region, with monitors along the East Coast showing positive bias while monitors on the West Coast show negative biases. Most monitors have a mean bias in the range of ± 5 ppb on high ozone days, which is acceptable model performance (Simon et al., 2012). Figure 3-27: RMSE for May through September 2012 Episode at AQS Monitoring Sites shows the RMSE for each of the AQS monitoring sites on days with observed MDA8 greater than 60 ppb. The RMSE at most monitors in the modeling domain were in the range of 6 to 12 ppb. However, monitors along the northeast and the southwest coast had higher deviations with RMSE in the 16 to 20 ppb range. Table 3-7: Statistical Model Performance Evaluation Metrics for TCEQ’s 2015 Ozone NAAQS Transport SIP Revision Configuration provides the statistical metrics for the May through September 2012 episode on days with observed MDA8 greater than 60 ppb for each of the NCDC Climate Regions.

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22 https://www.epa.gov/aqs
Figure 3-26: Mean Bias for the May through September 2012 Episode at AQS Monitoring Sites
Figure 3-27: RMSE for May through September 2012 Episode at AQS Monitoring Sites

Table 3-7: Statistical Model Performance Evaluation Metrics for TCEQ’s 2015 Ozone NAAQS Transport SIP Revision Configuration

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<th>No. of Obs</th>
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<th>NMB (%)</th>
<th>NME (%)</th>
<th>RMSE (ppb)</th>
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</tbody>
</table>

Overall, the base case modeling showed reasonable model performance and is comparable with the EPA’s modeling documented in the 2015 Transport NODA. Although the EPA had better performance in the Northeast climate region, in the South
climate region, which includes Texas and surrounding states, the TCEQ’s modeling performed better than the EPA’s. Detailed performance evaluation for the 2012 base case modeling episode is included in Appendix C: Photochemical Model Performance Evaluation for the Transport State Implementation Plan Revision for the 2015 Eight-Hour Ozone National Ambient Air Quality Standard.

3.2.4 Future Year Modeling

Future year modeling is used to predict ozone concentrations and calculate a DV, at each AQS monitor in the modeling domain in the future year, 2023. In future year modeling, the same modeling episode (May through September 2012) is used, but with projected future anthropogenic emissions. Future year modeling predicts the change in ozone concentrations due to changes in anthropogenic emissions in a future year while keeping the meteorological and natural emissions (biogenic and wildfires) inputs constant. Future year modeling answers the question: what would the ozone concentrations be in the future if the same meteorological conditions (that resulted in a high ozone episode in the past) were to repeat?

The meteorological inputs generated for May through September 2012 using the WRF model and described in section 3.2.3.1: Meteorological Modeling were used as inputs to the CTM in the future year modeling.

3.2.4.1 Emissions Modeling

For future year modeling, emissions inventories were developed for the anthropogenic emissions source categories by applying growth and control factors to base year emissions. Growth and control factors are developed based on the projected growth in the demand for goods and services, along with the reduction in emissions expected from state, local, and federal control programs. Figure 3-28: Future Year Representative Day Total Anthropogenic Precursor Emissions by Geographic Region shows the total projected anthropogenic precursor emissions in the rpo_12km domain by major geographic region on a representative 2023 summer weekday in tons per day. Figure 3-29: Future Year Representative Day Total Anthropogenic Precursor Emissions by Source Category shows the total projected anthropogenic precursor emissions in the rpo_12km domain by source category for a sample 2023 summer weekday in tons per day.
Figure 3-28: Future Year Representative Day Total Anthropogenic Precursor Emissions by Geographic Region

Figure 3-29: Future Year Representative Day Total Anthropogenic Precursor Emissions by Source Category

Since biogenic emissions are dependent upon the meteorological conditions on a given day, the same episode-specific emissions that were used in the base case modeling
were also used in the 2023 future year modeling. Since future year wildfires cannot be predicted, the wildfire emissions inventory developed for the base case modeling was also used in the 2023 future year modeling. Details regarding the development of the 2023 emissions inventory, including projection tools, projection growth factors and federal/state/local rules and programs incorporated are provided in Appendix B.

3.2.4.2 Initial and Boundary Conditions
For future year modeling, updated 2023 initial and boundary conditions were developed by running GEOS-Chem again. The 2023 initial and boundary conditions were developed by using projected 2023 anthropogenic emissions inventories with the same GEOS-Chem meteorological and CTM configurations as the 2012 base case. The 2023 anthropogenic emissions were updated from the base year using projected growth factors. Emissions in North America (specifically, the continental U.S., southern Canada, and northern Mexico) were projected using the same methods used by the TCEQ to project anthropogenic emissions in the rpo_12km domain as explained in Appendix B. In all other areas of the GEOS-Chem domain, emissions projection factors from the Representative Concentration Pathway (RCP85) Database23 were used to develop the 2023 anthropogenic emissions. Since the RCP85 data are only available at 5 or 10 year intervals (e.g., 2000, 2005, 2010, 2020, etc.), emission projections factors for 2023 were linearly interpolated from changes between the two nearest projection years. Details of the emissions projections methodology are available in the TCEQ Project FY2016-16 report Updated Boundary Conditions for CAMx Modeling.24

Figure 3-30: 2023 East Boundary Condition Cross-Section for July 18, 2012 Episode Day, Figure 3-31: 2023 West Boundary Condition Cross-Section for July 18, 2012 Episode Day, Figure 3-32: 2023 North Boundary Condition Cross-Section for July 18, 2012 Episode Day, and Figure 3-33: 2023 South Boundary Condition Cross-Section for July 18, 2012 Episode Day show samples of the 2023 east, west, north and south boundary conditions for July 18, 2012 episode day for the three-hour window of 12 p.m. to 3 p.m.

23 https://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=welcome
Figure 3-30: 2023 East Boundary Condition Cross-Section for July 18, 2012 Episode Day

Figure 3-31: 2023 West Boundary Condition Cross-Section for July 18, 2012 Episode Day

Figure 3-32: 2023 North Boundary Condition Cross-Section for July 18, 2012 Episode Day
For future year modeling, the 2023 anthropogenic emissions inventories were input along with the 2012 meteorological, biogenic, and wildfire emissions to the CAMx model configuration detailed in the section 3.2.3: Base Case Modeling. The output of the future year modeling, ozone concentrations for each grid cell in the rpo_12km domain, was post-processed to obtain the 2023 DV$_F$ at each AQS monitor in the rpo_12km domain.

**Projected Nonattainment Monitors**

The methodology described in EPA Modeling Guidance was used to determine the 2023 DV$_F$ at each monitor in the rpo_12km domain. A monitor’s DV$_F$ is calculated by multiplying the Relative Response Factor (RRF) by a baseline year design value (DV$_B$) as shown in *Equation 3-1: Future Year Design Value Calculation for a Monitor*.

$$DV_F = RRF \times DV_B$$

**Equation 3-1: Future Year Design Value Calculation for a Monitor**

The RRF is the ratio of the average future year modeled MDA8 ozone concentrations to the average base year modeled MDA8 ozone concentrations on the top 10 modeled MDA8 base year days. In accordance with EPA Modeling Guidance, the maximum concentration of the three-by-three grid cell array surrounding each monitor on the top 10 base year days with modeled MDA8 above 60 ppb was used to calculate the RRF for each monitor. The DV$_B$ is the average of the regulatory design values for the three consecutive years containing the base year, as shown in Figure 3-34: Baseline Design Value (DV$_B$) for the 2015 Ozone NAAQS Transport SIP.
Figure 3-34: Baseline Design Value (DV$_b$) for the 2015 Ozone NAAQS Transport SIP Revision

Figure 3-35: 2023 Future Design Value (DV$_f$) for the AQS Monitors in the RPO$_{12km}$ Domain shows a map of the rpo$_{12km}$ domain with the 2023 DV$_f$ for each AQS monitor.
Projected Maintenance Monitors

In Step 1, in addition to identifying the monitors projected to be in nonattainment in 2023 as described above, monitors projected to have maintenance issues were also identified. To identify monitors that could have maintenance issues in 2023, the TCEQ calculated Maintenance Future Year Design Values (MDV_f). The 2023 MDV_f is calculated using the same equation presented in Equation 3-1, except that the DV_b is the most recent, instead of the average, of the three regulatory design values containing the base year. Therefore, since 2012 is the base year, the 2014 design value that is the latest regulatory design value that contains the base year of 2012 is used as DV_b. For monitors with no regulatory 2014 design value, the 2013 or 2012 design values were used as applicable. The regulatory design values after 2014, namely 2015 and 2016, are not used since these design values do not include monitored data from the modeling base year of 2012.

The TCEQ's approach for identifying maintenance monitors differs from the approach used by the EPA in the 2015 Transport NODA. The EPA used the maximum of the three consecutive regulatory design values containing the base year as the DV_b to identify maintenance monitors. However, as the TCEQ commented, this approach is not appropriate for monitors with design values that have been decreasing because of emissions reductions and not merely due to meteorological variability. The TCEQ's approach takes into consideration both meteorological variability (since the latest regulatory design value is itself an average of the fourth highest measured...
concentrations for three years) and any emissions reductions that might have occurred. It should be noted that it is possible that the latest regulatory design value might also be the maximum design value. Figure 3-36: 2023 Maintenance Future Year Design Value (MDVₘ) for the AQS Monitors in the RPO_12km Domain shows the MDVₘ for all the AQS monitors in the rpo_12km domain.

![Figure 3-36: 2023 Maintenance Future Year Design Value (MDVₘ) for the AQS Monitors in the RPO_12km Domain](image)

### 3.3 STEP 2: SOURCE APPORTIONMENT AND IDENTIFICATION OF DOWNWIND MONITORS TAGGED FOR FURTHER REVIEW

Section 3.2 detailed how photochemical modeling was used in the relative sense to identify monitors projected to be in nonattainment or have maintenance issues in 2023. In this section, details on Step 2 and the identification of the subset of monitors that might be impacted by Texas emissions from the approximately 1200 AQS monitors in the rpo_12km domain are presented. The subset of monitors tagged in Step 2 were further reviewed in Step 3 to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance at that monitor.

The Anthropogenic Culpability Precursor Analysis (APCA) tool was used to identify and tag the subset of downwind monitors that might be impacted by Texas emissions (and will be further reviewed in Step 3). APCA is a probing tool in CAMx that is used to apportion the modeled ozone concentration at each grid cell at each simulation hour to specific user-defined geographic regions and/or source categories. APCA does this by keeping track of the origin of the NOₓ and VOC precursors creating the ozone in each grid cell for each time step during the model run.
The APCA contribution categories chosen were to facilitate better understanding of interstate problems at the monitors within the rpo_12km domain. Since Step 2 is to identify monitors that might be impacted by Texas emissions, the TCEQ considered Texas anthropogenic emissions as a contribution category for this SIP revision. Anthropogenic emissions from other states in the continental U.S. were grouped together as one contribution category. Other contribution categories were chosen to separate out the impacts of emissions that are not directly related to interstate problems such as biogenics, fires, ocean, etc. The following are source contribution categories that were used in the APCA model run:

- Texas Anthro – NO\textsubscript{x} and VOC emissions from Texas anthropogenic sources;
- Non-Texas U.S. Anthro – NO\textsubscript{x} and VOC emissions from anthropogenic sources in the 47 other states of the continental U.S.;
- Non-U.S. Anthro – NO\textsubscript{x} and VOC emissions from southern Canadian and northern Mexican anthropogenic sources included in the rpo_12km domain;
- Ocean Anthro – NO\textsubscript{x} and VOC emissions from ocean-going vessels and off-shore oil and gas platforms;
- Biogenic Emissions;
- Fires; and
- Initial and boundary conditions.

Figure 3-37: APCA Geographic Regions for the 2015 Ozone NAAQS Transport SIP shows a map of the APCA contribution categories with Texas in red, Non-Texas U.S. in pink, Non-U.S. in lavender, and Ocean in blue.
The outputs of an APCA model run are the total modeled hourly concentration and the breakdown of the total concentration by each user-specified contribution category for each grid cell of the domain for each hour of the episode. For example, as part of the 2023 APCA simulation, for cell index [242, 78], which contains the Manvel Croix monitor, the hourly modeled ozone concentration is 72.21 ppb on episode day July 14 at 12:00 p.m. Central Standard Time (CST). The total ozone concentration of 72.21 ppb in the cell is apportioned to the specified contribution categories as shown in Table 3-8: Apportion of Total Ozone Concentration for cell index [242, 78] on episode day July 14 at 12:00 p.m. CST to Contribution Categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas anthropogenic emissions</td>
<td>48.41</td>
</tr>
<tr>
<td>Non-Texas US anthropogenic emissions</td>
<td>0.72</td>
</tr>
<tr>
<td>Non-US anthropogenic emissions</td>
<td>0.25</td>
</tr>
<tr>
<td>Ocean anthropogenic emissions</td>
<td>7.71</td>
</tr>
<tr>
<td>Fire emissions</td>
<td>0.32</td>
</tr>
<tr>
<td>Biogenic emissions</td>
<td>4.91</td>
</tr>
<tr>
<td>Boundary conditions</td>
<td>9.90</td>
</tr>
</tbody>
</table>
In an APCA model run, the sum concentrations apportioned to each contribution category will always equal the total modeled concentration for each grid cell for each hour. APCA apportions ozone formed due to the interaction of biogenic and anthropogenic precursor emissions by recognizing that biogenic emissions as a non-controllable category. Therefore, APCA apportions/attributes ozone formed from such interactions to the anthropogenic precursor emissions. Details of how APCA results were used to tag downwind nonattainment and maintenance monitors for further review are presented in this section.

To identify nonattainment and maintenance monitors for further review, Texas contribution to the monitor’s 2023 DVₐ (2023 TXᵥᵥ) was evaluated. The following methodology was used to determine the 2023 TXᵥᵥ:

1. Calculate the 2023 MDA8 total concentration for each grid cell for each episode day.

2. Calculate the 2023 MDA8 Texas contribution using the hourly apportioned concentration for Texas for each grid cell for each episode day, using contributions from the hours that comprised the MDA8 concentration for that day.

3. For each monitor, calculate the ratio of the average of the 2023 MDA8 Texas contribution to the average of the 2023 MDA8 total concentration from the same days and grid cells used in the 2023 DVₐ calculation for that monitor.

4. Calculate the 2023 TXᵥᵥ for each monitor by multiplying the 2023 DVₐ for that monitor by the ratio calculated in the previous step for that monitor.
In addition to determining TXDVF, the contribution of each APCA category to the 2023 DVF for each AQS monitor in the rpo_12km domain was also calculated using the steps outlined above.

### 3.3.1 Identification of Nonattainment Monitors for Further Review

Two criteria were used to tag downwind nonattainment monitors for further review - a monitor's 2023 DVF is greater than or equal to 71 ppb and the monitor's 2023 TXDVF is greater than or equal to 0.7 ppb. Table 3-9: Downwind Nonattainment Monitors Tagged for Further Review, sorted by state, provides details such as AQS ID, site name, state and county, 2023 DVF, and 2023 TXDVF of the downwind nonattainment monitors tagged for further review in Step 3.

**Table 3-9: Downwind Nonattainment Monitors Tagged for Further Review**

<table>
<thead>
<tr>
<th>AQS ID</th>
<th>Site Name</th>
<th>State</th>
<th>County</th>
<th>2023 DVF (ppb)</th>
<th>2023 TXDVF (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80350004</td>
<td>Highland Reservoir</td>
<td>Colorado</td>
<td>Douglas</td>
<td>73</td>
<td>1.42</td>
</tr>
<tr>
<td>80590006</td>
<td>Chatfield State Park</td>
<td>Colorado</td>
<td>Jefferson</td>
<td>72</td>
<td>1.26</td>
</tr>
<tr>
<td>80590011</td>
<td>Rocky Flats</td>
<td>Colorado</td>
<td>Jefferson</td>
<td>71</td>
<td>1.26</td>
</tr>
<tr>
<td>80690011</td>
<td>National Renewable Energy</td>
<td>Colorado</td>
<td>Larimer</td>
<td>72</td>
<td>1.22</td>
</tr>
<tr>
<td>40038001</td>
<td>Chiricahua National Monument</td>
<td>Arizona</td>
<td>Cochise</td>
<td>71</td>
<td>1.06</td>
</tr>
<tr>
<td>60371201</td>
<td>Reseda</td>
<td>California</td>
<td>Los Angeles</td>
<td>80</td>
<td>0.76</td>
</tr>
<tr>
<td>60371701</td>
<td>Pomona</td>
<td>California</td>
<td>Los Angeles</td>
<td>80</td>
<td>0.72</td>
</tr>
<tr>
<td>60376012</td>
<td>Santa Clarita</td>
<td>California</td>
<td>Los Angeles</td>
<td>87</td>
<td>0.9</td>
</tr>
<tr>
<td>60658001</td>
<td>Rubidoux</td>
<td>California</td>
<td>Riverside</td>
<td>88</td>
<td>0.73</td>
</tr>
<tr>
<td>60658005</td>
<td>Mira Loma (Van Buren)</td>
<td>California</td>
<td>Riverside</td>
<td>84</td>
<td>0.71</td>
</tr>
<tr>
<td>60710001</td>
<td>Barstow</td>
<td>California</td>
<td>San Bernardino</td>
<td>71</td>
<td>0.84</td>
</tr>
<tr>
<td>60710306</td>
<td>Victorville-Park Avenue</td>
<td>California</td>
<td>San Bernardino</td>
<td>76</td>
<td>0.81</td>
</tr>
<tr>
<td>60711004</td>
<td>Upland</td>
<td>California</td>
<td>San Bernardino</td>
<td>91</td>
<td>0.88</td>
</tr>
<tr>
<td>60714001</td>
<td>Hesperia-Olive Street</td>
<td>California</td>
<td>San Bernardino</td>
<td>82</td>
<td>0.86</td>
</tr>
<tr>
<td>60714003</td>
<td>Redlands</td>
<td>California</td>
<td>San Bernardino</td>
<td>94</td>
<td>0.74</td>
</tr>
</tbody>
</table>

### 3.3.2 Identification of Maintenance Monitors for Further Review

Two criteria were used to tag downwind maintenance monitors for further review - a monitor's 2023 MDVF is greater than or equal to 71 ppb and the monitor's 2023 TXDVF is greater than or equal to 0.7 ppb. Table 3-10: Downwind Maintenance Monitors Tagged for Further Review, sorted by state, provides details such as AQS ID, site name, state
and county, 2023 MDV$_r$ and 2023 TX$_{uvf}$ of the downwind maintenance monitors tagged for further review in Step 3.

Table 3-10: Downwind Maintenance Monitors Tagged for Further Review

<table>
<thead>
<tr>
<th>AQS ID</th>
<th>Site Name</th>
<th>State</th>
<th>County</th>
<th>2023 MDV$_r$ (ppb)</th>
<th>2023 TX$_{uvf}$ (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80350004</td>
<td>Highland Reservoir</td>
<td>Colorado</td>
<td>Douglas</td>
<td>72</td>
<td>1.42</td>
</tr>
<tr>
<td>80590006</td>
<td>Chatfield State Park</td>
<td>Colorado</td>
<td>Jefferson</td>
<td>73</td>
<td>1.26</td>
</tr>
<tr>
<td>80590011</td>
<td>Rocky Flats</td>
<td>Colorado</td>
<td>Jefferson</td>
<td>71</td>
<td>1.26</td>
</tr>
<tr>
<td>80690011</td>
<td>National Renewable Energy Labs-NREL</td>
<td>Colorado</td>
<td>Larimer</td>
<td>71</td>
<td>1.22</td>
</tr>
<tr>
<td>80050002</td>
<td>Highland Reservoir</td>
<td>Colorado</td>
<td>Arapahoe</td>
<td>71</td>
<td>1.15</td>
</tr>
<tr>
<td>60371201</td>
<td>Reseda</td>
<td>California</td>
<td>Los Angeles</td>
<td>78</td>
<td>0.76</td>
</tr>
<tr>
<td>60371701</td>
<td>Pomona</td>
<td>California</td>
<td>Los Angeles</td>
<td>82</td>
<td>0.72</td>
</tr>
<tr>
<td>60376012</td>
<td>Santa Clarita</td>
<td>California</td>
<td>Los Angeles</td>
<td>86</td>
<td>0.9</td>
</tr>
<tr>
<td>60658001</td>
<td>Rubidoux</td>
<td>California</td>
<td>Riverside</td>
<td>85</td>
<td>0.73</td>
</tr>
<tr>
<td>60658005</td>
<td>Mira Loma (Van Buren)</td>
<td>California</td>
<td>Riverside</td>
<td>83</td>
<td>0.71</td>
</tr>
<tr>
<td>60710001</td>
<td>Barstow</td>
<td>California</td>
<td>San Bernardino</td>
<td>72</td>
<td>0.84</td>
</tr>
<tr>
<td>60710306</td>
<td>Victorville-Park Avenue</td>
<td>California</td>
<td>San Bernardino</td>
<td>77</td>
<td>0.81</td>
</tr>
<tr>
<td>60711004</td>
<td>Upland</td>
<td>California</td>
<td>San Bernardino</td>
<td>90</td>
<td>0.88</td>
</tr>
<tr>
<td>60714001</td>
<td>Hesperia-Olive Street</td>
<td>California</td>
<td>San Bernardino</td>
<td>79</td>
<td>0.86</td>
</tr>
<tr>
<td>60714003</td>
<td>Redlands</td>
<td>California</td>
<td>San Bernardino</td>
<td>91</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Except for the Highland Reservoir (AQS ID: 80050002) monitor in Arapahoe County, Colorado, all the maintenance monitors are also nonattainment monitors.

In the 2015 Transport NODA, the EPA’s modeling linked Texas to six monitors based solely because modeled contributions to a monitor’s future year design value were greater than or equal to 0.7 ppb. Table 3 11: Monitors Linked to Texas by EPA Modeling in the 2015 Transport NODA shows the six monitors, the 2023 DV$_r$ and modeled Texas contributions to DV$_r$ from the EPA’s modeling and the corresponding values determined using the TCEQ’s modeling.
Table 3-11: Monitors Linked to Texas by EPA Modeling in the 2015 Transport NODA

<table>
<thead>
<tr>
<th>AQS ID</th>
<th>State</th>
<th>County</th>
<th>2023 DV&lt;sub&gt;f&lt;/sub&gt; in EPA Modeling (ppb)</th>
<th>2023 TX&lt;sub&gt;DVF&lt;/sub&gt; in EPA Modeling (ppb)</th>
<th>2023 DV&lt;sub&gt;f&lt;/sub&gt; TCEQ Modeling (ppb)</th>
<th>2023 TX&lt;sub&gt;DVF&lt;/sub&gt; in TCEQ Modeling (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>260050003</td>
<td>Michigan</td>
<td>Allegan</td>
<td>68.8</td>
<td>2.49</td>
<td>71</td>
<td>0.59</td>
</tr>
<tr>
<td>551170006</td>
<td>Wisconsin</td>
<td>Sheboygan</td>
<td>71.0</td>
<td>1.92</td>
<td>70</td>
<td>0.73</td>
</tr>
<tr>
<td>240251001</td>
<td>Maryland</td>
<td>Harford</td>
<td>71.3</td>
<td>0.91</td>
<td>65</td>
<td>0.69</td>
</tr>
<tr>
<td>360850067</td>
<td>New York</td>
<td>Richmond</td>
<td>71.2</td>
<td>0.77</td>
<td>62</td>
<td>0.67</td>
</tr>
<tr>
<td>361030002</td>
<td>New York</td>
<td>Suffolk</td>
<td>71.3</td>
<td>0.71</td>
<td>67</td>
<td>0.63</td>
</tr>
<tr>
<td>80590011</td>
<td>Colorado</td>
<td>Jefferson</td>
<td>69.7</td>
<td>1.03</td>
<td>71</td>
<td>1.26</td>
</tr>
</tbody>
</table>

In the EPA’s modeling, five of the six monitors linked to Texas were located in eastern states, whereas all the monitors tagged for further review by the TCEQ’s modeling are located in western states. This difference is due to key changes made by the TCEQ to address several critical concerns with the EPA’s methodology in the 2015 Transport NODA; therefore, the TCEQ focused only on the monitors tagged for further review by TCEQ modeling and shown in Table 3-9 and Table 3-10 to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance.

The downwind nonattainment and maintenance monitors tagged for further review are in three states: Arizona, California, and Colorado. To aid further review and analysis of the tagged monitors, APCA runs were conducted with additional contribution categories: California Anthro, Colorado Anthro, New Mexico Anthro, Kansas Anthro, Nebraska Anthro, Wyoming Anthro, Utah Anthro, California Anthro, Arizona Anthro, Nevada Anthro and Oregon Anthro. Figure 3-39: Map of Additional APCA Geographic Regions Based on Location of Tagged Monitors shows all the geographic contribution regions used in the APCA runs for this 2015 Ozone NAAQS Transport SIP revision.

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25 Per the EPA, Eastern states include all states from Texas northward to North Dakota and eastward to the East Coast while the Western states include the 11 western contiguous states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming (FR 82, 1737).
3.4 STEP 3: ANALYSIS TO DETERMINE IF TEXAS EMISSIONS CONTRIBUTE SIGNIFICANTLY TO NONATTAINMENT OR INTERFERE WITH MAINTENANCE AT TAGGED MONITORS

This section describes the analysis used to determine whether Texas emissions significantly contribute to nonattainment or interfere with maintenance at the sixteen downwind monitors that were tagged for further review in Step 2. To make this determination, a weight-of-evidence approach was used. Interstate transport is a complex problem and a nuanced approach that takes into consideration the factors relevant to the ozone conditions at the tagged monitors is required. Examples of factors considered include the current attainment status of the monitors, design value trends, the meteorological conditions that lead to high ozone formation at the monitor, and the number of days with elevated ozone (observed and modeled).

Since there could be considerable variation in the characteristics of the ozone problem at each monitor, not all factors were considered or analyzed for every monitor. In addition, the use of 1% of the NAAQS threshold for modeled contribution as the sole definition of significant contribution is inappropriate for the 2015 ozone NAAQS since the more stringent 0.7 ppb threshold is an order of magnitude smaller than the biases and errors typically documented for regional photochemical modeling (Simon et al., 2012). The Texas contribution should be deemed “significant” only if there is a persistent and consistent pattern of contribution on several days with elevated.

Figure 3-39: Map of Additional APCA Geographic Regions Based on Location of Tagged Monitors
ozone. Analysis is presented for each state with a tagged downwind monitor in the following sections.

3.4.1 Colorado Monitors
Modeling tagged four Colorado nonattainment monitors, as shown in Table 3-9, for further review. In addition to these monitors, modeling also tagged one Colorado maintenance monitor, the Highland Reservoir (AQS ID 080050002) monitor, as shown in Table 3-10 for further review.

Results of in-depth analysis leads to the conclusion that Texas emissions do not contribute to nonattainment or interfere with maintenance at the five Colorado monitors tagged for further review. The conclusion is based on design value trends, number of monitored elevated ozone days, back trajectory analysis on elevated ozone days, average modeled contributions from modeled future elevated ozone days, the collective interstate contribution to the future design values, and the responsiveness to Texas emissions at these monitors. Details of the analysis are presented in the following sections.

3.4.1.1 Eight-Hour Ozone Design Value Trends
Eight-hour ozone design value trends at the tagged monitors, along with the other monitors in the Denver-Aurora combined statistical area (CSA), are displayed in Figure 3-40: Eight-Hour Ozone Design Values for Monitors in the Denver-Aurora Area. The Colorado monitors tagged for further review are highlighted in color while the other monitors in the Denver-Aurora CSA are in gray. The four nonattainment monitors tagged for further review have the highest eight-hour ozone design values in the Denver-Aurora CSA, ranging from 80 ppb at National Renewable Energy Labs to 75 ppb at Fort Collins West. The tagged maintenance monitor does not have valid eight-hour ozone in 2016, but its last valid eight-hour ozone design value, 79 ppb in 2013, was one of the five highest eight-hour ozone design values for that year. All other monitors except one, the Welch monitor, in the Denver-Aurora area, have eight-hour ozone design values below the 2015 ozone NAAQS. Overall, eight-hour ozone design values in the Denver-Aurora area have been decreasing from 2007 through 2016. Decreases observed are modest ranging from a 2% to 10%. 
3.4.1.2 Monitored Elevated Ozone Days

To investigate the contribution of Texas emissions to ozone at the tagged Colorado monitors, days that had elevated ozone at each of the five tagged monitors were identified. Any day with a monitored daily maximum eight-hour average ozone concentration greater than 70 ppb was considered an elevated ozone day. From 2012 through 2016 the number of elevated ozone days at the Colorado monitors ranged from a high of 116 days at Rocky Flats to a low of 46 days at Highland Reservoir. In order to better characterize the ozone problem at the Colorado monitors and have more days with elevated ozone, the number of years evaluated was increased from five to ten. Using ten years of data more than doubled the number of elevated ozone days at some of the monitors, with a high of 237 days at Rocky Flats and a low of 78 days at Highland Reservoir. The number of elevated ozone days at each tagged monitor from the past 10 years is shown in Figure 3-41: Number of Elevated Eight-Hour Ozone Days at the Tagged Colorado Monitors for the years 2007 through 2016. Figure 3-41 shows that the five monitors seem to have similar trends with varying levels of severity. Trends in elevated ozone days overall appear to be decreasing, with a peak occurring in 2012. Over the past 10 years, all five tagged monitors in Colorado observed the highest number of elevated ozone days in 2012. The Rocky Flats monitor historically observed the most elevated ozone days until the most recent two years (2015 and 2016), when the National Renewable Energy Labs monitor observed the highest number of elevated ozone days.
3.4.1.3 Back Trajectory Analysis on Elevated Ozone Days

The elevated ozone days identified were used as a starting point to examine back trajectories from the tagged monitors. NOAA’s HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) back trajectory model was used to run 72-hour back trajectories for each elevated ozone day at each tagged monitor. A test run of back trajectories for the top 10 modeled high ozone days showed that some endpoints reached Texas only after 72 hours; therefore, it was determined that 72 hours was an appropriate length of time to determine whether air from Texas reaches Colorado on a given day. The time of daily maximum one-hour ozone on the elevated eight-hour ozone day was used as the starting hour for each trajectory. If the maximum one-hour ozone occurred over multiple hours, then multiple trajectories were run, using each different hour as the starting hour. Three starting heights were used, 500 m AGL, 1000 m AGL, and 1500 m AGL.

To look for probable cases where pollution from Texas was transported to Colorado, back trajectories were filtered for the following two conditions: back trajectories that did not hit the surface (zero m AGL) at any time during the 72-hour run, and back trajectories that started within the HYSPLIT calculated mixing layer in Colorado. The filtering criteria ensured that the back trajectories used were those that capture air that would affect the ground level monitor. The total number of HYSPLIT back trajectories and the number of trajectories that meet the filtering criteria are
summarized in Table 3-12: *Number of HYSPLIT Back Trajectories at Each Tagged Colorado Monitor.*

### Table 3-12: Number of HYSPLIT Back Trajectories at Each Tagged Colorado Monitor

<table>
<thead>
<tr>
<th>AQS ID</th>
<th>Site Name</th>
<th>Number of Back Trajectories</th>
<th>Number of Back Trajectories that Meet Filter Criteria</th>
<th>Percent of Back Trajectories that Meet Filter Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>80050002</td>
<td>Highland Reservoir</td>
<td>282</td>
<td>189</td>
<td>67%</td>
</tr>
<tr>
<td>80350004</td>
<td>Chatfield State Park</td>
<td>594</td>
<td>367</td>
<td>62%</td>
</tr>
<tr>
<td>80590006</td>
<td>Rocky Flats</td>
<td>846</td>
<td>578</td>
<td>68%</td>
</tr>
<tr>
<td>80590011</td>
<td>National Renewable Energy Labs-NREL</td>
<td>624</td>
<td>380</td>
<td>61%</td>
</tr>
<tr>
<td>80690011</td>
<td>Fort Collins-West</td>
<td>663</td>
<td>434</td>
<td>65%</td>
</tr>
</tbody>
</table>

The filtered back trajectories are displayed on the map in Figure 3-42: *HYSPLIT Back Trajectory Endpoints that Meet Filter Criteria from the Tagged Colorado Monitors.* For a trajectory (whether run forward or backward in time), the estimated location of the air parcel during each hour of the trajectory is referred to as an endpoint. The green endpoints represent an air parcel that is located above the mixing layer while the purple endpoints represent an air parcel that is located within the mixing layer. It is important to know which endpoints are located within the mixing layer because an endpoint in the mixing layer would demonstrate a clearer case of emissions at that location being transported to the starting location. Although it is difficult to see any detail for specific trajectories in the Colorado area, the map shows back trajectory end points that end in Texas. Out of the 1,948 back trajectories with 134,185 endpoints displayed in Figure 3-42, 116 back trajectories (6%) with a total of 2,019 endpoints (1.5%) reach Texas. Of those 2,019 endpoints, 912 are located within the mixing layer over Texas, meaning 0.68% of endpoints are located within the Texas mixing layer.
Although most back trajectories do not reach Texas on elevated ozone days in Colorado, further analysis was necessary to indicate whether the days where trajectories that reached Texas had a significant impact on ozone levels in Colorado. To investigate further, the number of trajectories to reach Texas from Colorado were calculated for each year from 2007 through 2016. The number of trajectories reaching Texas from each monitor were then compared to the number of elevated eight-hour ozone days for each year. The results are shown in Figure 3-43: *Number of Trajectories that Reach Texas and the Number of Elevated Eight-Hour Ozone Days at Each Tagged Colorado Monitor*. Figure 3-43 shows that the number of trajectories that reach Texas from Colorado varies by year. Most years from 2007 through 2016 show fewer than five, and some show zero trajectories that reach Texas. Of the trajectories that reach Texas from Colorado, 66% occurred during 2011 and 2012. This spike does not appear to be a pattern that repeats frequently. There were also many more elevated eight-hour ozone days observed in 2012 compared to other years. This may indicate that there were some unusual meteorological patterns that occurred that year that caused a more severe ozone season. There are years where few, if any, trajectories reach Texas and the number of elevated ozone days still remained high. For example, National Renewable Energy Labs had over 15 elevated eight-hour ozone days in 2007, 2008, 2015, and 2016, but only one trajectory reached Texas over those four years combined.
While the number of elevated ozone days can indicate the severity of an ozone season, the fourth-highest eight-hour ozone concentrations provide more information on how close the area is to attaining the standard. The fourth-highest eight-hour ozone values at the tagged Colorado monitors, along with the number of trajectories that reach Texas each year, are shown in Figure 3-44: Fourth-Highest Eight-Hour Ozone and the Number of Trajectories that Reach Texas. Overall, trends in the fourth-highest eight-hour ozone concentrations have only slightly decreased. The increase in trajectories that reach Texas in 2012 did not appear to increase the fourth-highest eight-hour ozone values at the tagged Colorado monitors much, if at all. The fourth-highest eight-
hour ozone values in 2015 and 2016 remained above 70 ppb, even though those years observed no trajectories that reached Texas.

In summary, trajectory analysis of transport from Texas to Colorado indicates that emissions from Texas are unlikely to affect ozone concentrations in the mixing layer over Colorado on elevated ozone days. Although trajectory analysis can have uncertainty (Stein et al. 2017), the large data set examined greatly reduces the uncertainty related to small sample sizes. Filtering the back trajectories by only looking at trajectories during elevated ozone episodes, that start within Colorado’s

Figure 3-44: Fourth-Highest Eight-Hour Ozone and the Number of Trajectories that Reach Texas
mixing layer, that do not hit the surface, and that have endpoints within Texas’ mixing layer is an attempt to find a clear case where emissions in Texas would affect the ozone in Colorado. Those filters showed that 6% of elevated ozone days in Colorado had trajectories that reached the mixing layer in Texas. Further analysis of the trajectories by year showed that 66% of days where trajectories reached the Texas mixing layer occurred in 2011 and 2012. There are many years where no trajectories reach Texas from Colorado. In the years where no trajectories reached Texas, the tagged monitors still observed a high number of elevated ozone days and fourth-highest eight-hour ozone concentrations above 70 ppb. Most importantly, the latest data (2015 and 2016) indicate that Texas was not upwind during any elevated ozone days at any of the five sites shown in Figure 3-44. Although air from Texas can reach Colorado, the air from Texas does not appear to significantly affect the ozone concentrations.

3.4.1.4 Texas Contributions on Projected Future Year Elevated Ozone Days
The previous sections showed that although there is possible transport of air parcels from Texas to the Colorado monitors on some historical monitored elevated ozone days, the probability of such transport is small. In addition to monitored elevated ozone days in the past, contributions from Texas on projected future year elevated ozone days were also evaluated. The subset of 2023 days with modeled MDA8 greater than 70 ppb was identified, and the average modeled Texas contributions for this subset of days were computed. Table 3-13: Modeled Elevated Ozone Days in the Future Year at the Tagged Colorado Monitors shows the number of days with modeled MDA8 greater than 70 ppb, the average eight-hour Texas ozone contribution, the average MDA8 for each of the tagged Colorado monitors, and the percentage of Texas contribution in the MDA8s.

Table 3-13: Modeled Elevated Ozone Days in the Future Year at the Tagged Colorado Monitors

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AQS ID</th>
<th>Number of Future Elevated Days</th>
<th>Average Texas Contribution on Future Elevated Ozone Days (ppb)</th>
<th>Average MDA8 on Future Elevated Ozone Days (ppb)</th>
<th>Percentage of Texas Contribution in MDA8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highland Reservoir</td>
<td>80350004</td>
<td>9</td>
<td>0.77</td>
<td>73.05</td>
<td>1.06%</td>
</tr>
<tr>
<td>Chatfield State Park</td>
<td>80590006</td>
<td>10</td>
<td>0.89</td>
<td>73.64</td>
<td>1.21%</td>
</tr>
<tr>
<td>Rocky Flats</td>
<td>80590011</td>
<td>11</td>
<td>0.86</td>
<td>74.09</td>
<td>1.16%</td>
</tr>
<tr>
<td>National Renewable Energy Labs</td>
<td>80690011</td>
<td>2</td>
<td>0.56</td>
<td>73.06</td>
<td>0.77%</td>
</tr>
<tr>
<td>Fort Collins-West</td>
<td>80050002</td>
<td>8</td>
<td>0.52</td>
<td>73.80</td>
<td>0.71%</td>
</tr>
</tbody>
</table>
Table 3-13 shows that for the Colorado monitors, the expected average Texas contribution on projected future elevated ozone days is a small percentage of the projected average MDA8 on these days. The expected impact is not significant, since the average contribution is less than one ppb on very few days, especially when considering the uncertainties associated with model predictions.

3.4.1.5 Collective Interstate Contribution to the Future Design Value
The EPA has maintained that the nature of the interstate transport problem varies between the western and eastern states. In the EPA’s 2015 Transport NODA, the EPA states “While the 1 percent screening threshold has been traditionally applied to evaluate upwind state linkages in eastern states where such collective contribution was identified, the EPA noted in the CSAPR Update Rule for the 2008 ozone NAAQS that, as to western states, there may be geographically specific factors to consider in determining whether the 1 percent screening threshold is appropriate. For certain receptors, where the collective contribution of emissions from one or more upwind states may not be a considerable portion of the ozone concentration at the downwind receptor, the EPA and states have considered, and could continue to consider, other factors to evaluate those states’ planning obligation pursuant to the Good Neighbor provision” (FR 82, 1740). Although the TCEQ does not believe that 1% of the NAAQS is an appropriate threshold for determining significant contribution, it agrees that the collective contribution of interstate transport is an important factor in the overall evaluation. The EPA defines collective contribution as “...the total upwind states' contribution to ozone concentration (from linked and unlinked states) based on modeling...”

The EPA has stated that the collective contribution metric is important to determine if interstate transport is a significant contributor to a monitor's nonattainment or maintenance problems. The collective interstate contribution to the 2023 DV for the tagged Colorado monitors was calculated. Table 3-14: Collective Interstate Contribution to Future Design Value at Tagged Colorado Monitors provides the percentage of interstate, intra-state, and background contributions to the future design values at the five tagged Colorado monitors.

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26 The EPA uses the term “linked” to refer to downwind monitors that have contributions to future design value greater than 1% of the NAAQS from an upwind state.
27 In approving Nevada's Inter-State Transport SIP the EPA states “One such factor that the EPA considers relevant to determining the nature of a projected receptor's interstate transport problem is the magnitude of ozone attributable to transport from all upwind states collectively contributing to the air quality problem” (81 FR 87859).
Table 3-14: Collective Interstate Contribution to Future Design Value at Tagged Colorado Monitors

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AQS ID</th>
<th>Percentage of 2023 DV(_f) from Background Contribution</th>
<th>Percentage of 2023 DV(_f) from Interstate Contribution</th>
<th>Percentage of 2023 DV(_f) from Intra-State Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highland Reservoir</td>
<td>80350004</td>
<td>62.12%</td>
<td>9.86%</td>
<td>25.44%</td>
</tr>
<tr>
<td>Chatfield State Park</td>
<td>80590006</td>
<td>60.57%</td>
<td>10.21%</td>
<td>26.88%</td>
</tr>
<tr>
<td>Rocky Flats</td>
<td>80590011</td>
<td>60.33%</td>
<td>10.27%</td>
<td>27.04%</td>
</tr>
<tr>
<td>National Renewable Energy Labs</td>
<td>80690011</td>
<td>67.42%</td>
<td>9.32%</td>
<td>20.88%</td>
</tr>
<tr>
<td>Fort Collins-West</td>
<td>80050002</td>
<td>62.47%</td>
<td>9.88%</td>
<td>25.28%</td>
</tr>
</tbody>
</table>

The total interstate contribution at tagged Colorado monitors ranges from 9.32% to 10.27%. The percentage of total interstate contribution is a small percentage and not as high as the total interstate percentages EPA calculated for Eastern States, which ranged from 17% to 67%.\(^{28}\) A significant portion of the tagged Colorado monitors’ 2023 DV\(_f\) is due to background emissions (sum of contributions from to biogenic, fires, and boundary conditions).

3.4.1.6 Direct Decoupled Method and Analysis of MDA8 Ozone Responsiveness to Texas Emissions

Direct Decoupled Method (DDM)\(^{29}\) is a probing tool available in CAMx that estimates the responsiveness of ozone formation to small changes in any input parameter. The DDM method calculates for each grid cell in the domain for each simulation hour the first-order differential for ozone formation due to changes in specific inputs. DDM results can explain the responsiveness of ozone formation due to marginal changes of any input parameter. DDM results should be interpreted with care, since the method only calculates the first-order differential which assumes a linear response. Ozone formation is highly non-linear and therefore DDM results are only useful for a limited range of input perturbations.

DDM was used to gauge the responsiveness of ozone formation to Texas NO\(_x\) emissions at the tagged Colorado monitors. For regional ozone problems and long-range transport, NO\(_x\) emissions play a major role. As part of the CSAPR final rule the EPA stated, “Authoritative assessments of ozone control approaches have concluded that, for reducing regional scale ozone transport, a NO\(_x\) control strategy is most effective, whereas VOC reductions are generally most effective locally, in more dense urbanized areas” (76 FR 48222). For these reasons, the TCEQ focused on Texas NO\(_x\)

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emissions while using DDM to evaluate the responsiveness of ozone formation at the tagged Colorado monitors.

Because it is resource intensive to use the DDM tool, it was run for a subset of the episode months, July and August, for the 2023 future year. July and August were chosen because they had the highest number of the top 10 days that went into the 2023 D\(V_e\) calculation. In addition to responsiveness to Texas NO\(_x\) emissions, responsiveness to Colorado NO\(_x\) emissions was also calculated at the tagged monitors. Since DDM calculates the responsiveness of ozone to NO\(_x\) emissions, the DDM values can be negative, indicating the destruction of ozone due to NO\(_x\) titration.

A series of figures showing the DDM results for each of the tagged Colorado monitors are presented below. In each figure, the hourly responsiveness of eight-hour average ozone at the tagged monitor to Texas NO\(_x\) emissions, Colorado NO\(_x\) emissions, and NO\(_x\) emissions from other sources excluding boundary conditions (“Other NO\(_x\)” emissions) are shown as a line graphs in blue, purple, and orange, respectively, with the ozone response in ppb is shown on the primary axis to the left. In addition to the responsiveness the figures also have the hourly eight-hour average ozone depicted in green line graph with markers, with the ozone concentration in ppb shown on the secondary axis to the right. The 2015 ozone NAAQS is shown as a black line.

Figure 3-45: **DDM Responsiveness of Ozone in July 2023 at Highland Reservoir** shows the responsiveness of ozone at the Highland Reservoir monitor (AQS ID: 80050002) to Texas NO\(_x\) emissions, Colorado NO\(_x\) emissions, and NO\(_x\) emissions from other sources (excluding boundary conditions) in the rpo_12km domain for the month of July.

![DDM Responsiveness of Ozone in July 2023 at Highland Reservoir](image)

**Figure 3-45: DDM Responsiveness of Ozone in July 2023 at Highland Reservoir**

In the month of July, Highland Reservoir (AQS ID: 80050002) had two elevated ozone days (July 11 and 12) and on both days, the modeled eight-hour ozone at the monitor is significantly more responsive to Colorado and “Other NO\(_x\)” emissions than to Texas NO\(_x\) emissions. This is a critical observation because the responsiveness of ozone at this monitor to Texas NO\(_x\) emissions remains flat throughout the month with no changes between days with and without elevated ozone.

Figure 3-46: **DDM Responsiveness of Ozone in August 2023 at Highland Reservoir** shows the responsiveness of ozone at the Highland Reservoir monitor (AQS ID: 80050002) to
Texas NO\textsubscript{x} emissions, Colorado NO\textsubscript{x} emissions, and NO\textsubscript{x} emissions from other sources in the rpo\_12km domain (excluding boundary conditions) for the month of August.

Figure 3-46: DDM Responsiveness of Ozone in August 2023 at Highland Reservoir

Similar to the July results, the responsiveness of eight-hour ozone to Texas NO\textsubscript{x} emissions at Highland Reservoir (AQS ID: 80050002) is near zero and stays flat in the month of August. Figure 3-45 and Figure 3-46 show that the modeled eight-hour ozone at Highland Reservoir (AQS ID: 80050002) is not responsive to Texas NO\textsubscript{x} emissions, during the period studied.

Figure 3-47: DDM Responsiveness of Ozone in July 2023 at Chatfield State Park shows the responsiveness of ozone at Chatfield State Park (AQS ID 80350004) to Texas NO\textsubscript{x} emissions, Colorado NO\textsubscript{x} emissions, and NO\textsubscript{x} emissions from other sources in the rpo\_12km domain (excluding boundary conditions) for the month of July while Figure 3-48: DDM Responsiveness of Ozone in August 2023 at Chatfield State Park does the same for the month of August. Chatfield State Park has fewer elevated ozone days than Highland Reservoir but shows a similar pattern of very limited responsiveness to Texas NO\textsubscript{x} emissions.

Figure 3-47: DDM Responsiveness of Ozone in July 2023 at Chatfield State Park

Figure 3-48: DDM Responsiveness of Ozone in August 2023 at Chatfield State Park
Figure 3-48: DDM Responsiveness of Ozone in August 2023 at Chatfield State Park

Figure 3-49: DDM Responsiveness of Ozone in July 2023 at Rocky Flats and Figure 3-50: DDM Responsiveness of Ozone in August 2023 at Rocky Flats show the responsiveness of ozone at Rocky Flat (AQS ID: 80590006) to Texas NOX emissions, Colorado NOX emissions, and NOX emissions from other sources in the rpo_12km domain (excluding boundary conditions) for the months of July and August, respectively.

Rocky Flats (AQS ID: 80590006) shows a small (approximately 2 ppb) responsiveness to Texas NOX emissions in mid to late July. However, when ozone at the monitor is responsive to Texas NOX emissions, elevated ozone was not observed except for a minor response on one day, July 23.
Figure 3-50: DDM Responsiveness of Ozone in August 2023 at Rocky Flats

Figure 3-51: DDM Responsiveness of Ozone in July 2023 at National Renewable Energy Labs-NREL and Figure 3-52: DDM Responsiveness of Ozone in August 2023 at National Renewable Energy Labs-NREL show the responsiveness of ozone at National Renewable Energy Labs – NREL (AQS ID: 80590011) to Texas NOX emissions, Colorado NOX emissions, and NOX emissions from other sources in the rpo_12km domain (excluding boundary conditions) for the months of July and August, respectively. In this case, there appears to be some minor responsiveness to Texas’ NOX emissions on two high ozone days in the third week of July, but similar to other Colorado monitors studied the degree of responsiveness is overwhelmed by the responsiveness to Colorado and “Other NOX” emissions.

Figure 3-51: DDM Responsiveness of Ozone in July 2023 at National Renewable Energy Labs-NREL
Figure 3-52: DDM Responsiveness of Ozone in August 2023 at National Renewable Energy Labs-NREL

Figure 3-53: DDM Responsiveness of Ozone in July 2023 at Fort Collins-West and Figure 3-54: DDM Responsiveness of Ozone in August 2023 at Fort Collins-West show the responsiveness of ozone at Fort Collins-West (AQS ID: 80690011) to Texas NO\textsubscript{x} emissions, Colorado NO\textsubscript{x} emissions, and NO\textsubscript{x} emissions from other sources in the rpo_12km domain (excluding boundary conditions) for the months of July and August, respectively. At Fort Collins-West the highest ozone days recorded in July or August were well below 71 ppb, so while ozone peak concentrations showed marginal responsiveness to Texas NO\textsubscript{x} emissions on a few days, clearly there was no significant contribution during this period.

Figure 3-53: DDM Responsiveness of Ozone in July 2023 at Fort Collins-West
Both at National Renewable Energy Labs-NREL (AQS ID: 80590011) and Fort Collins-West (AQS ID: 80690011), the same pattern of ozone responsiveness to Texas NOX emissions as the other three tagged Colorado monitors was observed.

In summary, though the DDM analysis may on occasion exhibit a limited responsiveness (two ppb or less) to Texas NOX emissions at the tagged Colorado monitors, the instances where this occurs are infrequent and rarely coincide with elevated ozone. Of the 62 days that DDM was estimated, the number of days that met the condition of having elevated ozone (MDA8 greater than 70 ppb) and appreciable responsiveness (greater than 1 ppb) ranged from three days at National Renewable Energy Labs-NREL (AQS ID: 80590011) and Rocky flats (AQS ID: 80590006) to zero days at Fort Collins-West (AQS ID: 80690011). In virtually all events, responsiveness to Texas NOX emissions is dwarfed by that of Colorado and “Other NOX” emissions.

Analysis of the design value trends, number of monitored elevated ozone days, back trajectory analysis on elevated ozone days, the modeled contributions on expected elevated ozone days, total interstate contribution, and the responsiveness of ozone formation at the tagged Colorado monitors to Texas NOX emissions leads to the conclusion that Texas emissions do not contribute significantly to nonattainment or interfere with maintenance of the 2015 ozone NAAQS at the tagged monitors in Colorado.

3.4.2 Arizona Monitor(s)
Modeling tagged the Chiricahua National Monument (AQS ID: 040038001) monitor in Cochise County, Arizona as a nonattainment monitor with a TX₅₇₈ of 1.06 ppb. A survey of the monitor’s recent design values shows that the monitor is currently attaining the 2015 eight-hour ozone NAAQS with a design value of 68 and 65 ppb in 2015 and 2016, respectively. In addition, the monitor has never been designated a nonattainment monitor and has been in attainment of both the 1997 and 2008 eight-hour ozone standards. Figure 3-55: Design Value Trends from 2007 through 2016 for Chiricahua National Monument (AQS ID: 040038001) shows the design value trends for the monitor.
Since the monitor is already in attainment of the 2015 Eight-Hour Ozone NAAQS, it can be concluded that emissions from Texas do not significantly contribute to nonattainment at this downwind monitor. As detailed in subsection 2.3.2, *Historical Emissions Inventory Trends*, anthropogenic ozone precursor emissions in Texas have decreased significantly due to several federal, state and local regulations. Since ozone precursor emissions in Texas, particularly NOx, are projected to stay capped or decrease and the design value at this monitor is currently significantly below the 2015 ozone NAAQS (65 ppb in 2016), emissions from Texas are not expected to interfere with maintenance of the 2015 ozone NAAQS.

### 3.4.3 California Monitors

Modeling tagged 10 monitors in California, as shown in Table 3-9 and Table 3-10, for further review to determine if emissions from Texas contribute significantly to nonattainment or interfere with maintenance of the 2015 ozone NAAQS at the monitors. The tagged monitors are in the Los Angeles-South Coast Air Basin (South Coast) and the Los Angeles–San Bernardino (Western Mojave Desert) nonattainment areas.

After extensive analysis, it was concluded that Texas emissions do not significantly contribute to nonattainment or interfere with maintenance at the 10 California monitors tagged in Step 2. Analysis included review of the conceptual model developed by the South Coast Air Basin for eight-hour ozone at these monitors, and considered design value trends, number of monitored elevated ozone days, back trajectory analysis on elevated ozone days, average modeled contributions from modeled future elevated ozone days, and the collective interstate contribution to the future design values at these monitors. Details of the analysis are presented in the following sections.
3.4.3.1 Conceptual Model of Eight-Hour Ozone Formation at Tagged California Monitors

Both the South Coast and the Western Mojave Desert nonattainment areas have had persistent nonattainment issues and have been designated nonattainment for every federal one-hour and eight-hour ozone NAAQS (1997 and 2008). The ozone problems in the Western Mojave Desert nonattainment area are largely due to transport from the South Coast and San Joaquin Valley. For the South Coast nonattainment area, the EPA, quoting the South Coast Air Quality Management District, described the meteorological conditions that would contribute to ozone formation as follows:

“The topography and climate of Southern California combine to make the Basin an area of high air pollution potential. During the summer months, a warm air mass frequently descends over the cool, moist marine layer produced by the interaction between the ocean’s surface and the lowest layer of the atmosphere. The warm upper layer forms a cap over the cool marine layer and inhibits the pollutants in the marine layer from dispersing upward. In addition, light winds during the summer further limit ventilation. Furthermore, sunlight triggers the photochemical reactions which produce ozone. The region experiences more days of sunlight than any other major urban area in the nation except Phoenix.”

“The Basin’s severe air pollution problem is a consequence of the combination of emissions from the nation’s second largest urban area and meteorological conditions that are adverse to the dispersion of those emissions. The average wind speed for Los Angeles is the lowest of the nation’s ten largest urban areas. In addition, the summertime maximum mixing height (an index of how well pollutants can be dispersed vertically in the atmosphere) in Southern California averages the lowest in the U.S. The Southern California area is also an area with abundant sunshine, which drives the photochemical reactions which form pollutants such as ozone. In the Basin, high concentrations of ozone are normally recorded during the spring and summer months.”

3.4.3.2 Eight-Hour Ozone Design Value Trends

Eight-hour ozone design value trends at the tagged California monitors along with the other monitors located in the Los Angeles CSA are displayed in Figure 3-56: Eight-Hour Ozone Design Values for Monitors in the Los Angeles Area. The tagged California monitors are highlighted in color while the other monitors in the Los Angeles CSA are in gray. The 10 monitors tagged in Step 2 had eight-hour ozone design values, ranging from 101 ppb to 80 ppb in 2016. The Los Angeles CSA had design values ranging from


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108 ppb to 63 ppb in 2016, and thus, none of the 10 tagged monitors recorded the highest eight-hour ozone design value for the CSA in 2016. Eight-hour ozone design values in the area have decreased overall for the past 10 years. The 10 monitors tagged for further review have observed eight-hour ozone design value decreases from 2007 through 2016 ranging from 13% at Reseda (AQS ID: 60371201) to 5% at Victorville-Park Avenue (AQS ID: 60710306).

Figure 3-56: Eight-Hour Ozone Design Values for Monitors in the Los Angeles Area

3.4.3.3 Monitored Elevated Ozone Days

To investigate the Texas contribution to ozone in California, days that had elevated ozone were identified at each of the 10 monitors tagged in Step 2. Any day with a monitored MDA8 ozone concentration greater than 70 ppb was considered an elevated ozone day. The number of elevated ozone days at each tagged monitor from the past five years is shown in Figure 3-57: Number of Elevated Eight-Hour Ozone Days at the Tagged California Monitors. As Figure 3-57 shows, the trends in the number of elevated ozone days at the 10 monitors vary. Trends in elevated ozone days overall appear to be flat. The Redlands (AQS ID: 60714003) monitor consistently observed the largest number of elevated ozone days, which ranged from a low of 76 days in 2015 to a high of 98 days in 2012. The Pomona (AQS ID: 60371701), Barstow (AQS ID: 60710001), and Reseda (AQS ID: 60371201) monitors observed the least number of elevated ozone days in the area, with Barstow (AQS ID: 60710011) observing only 18, the lowest number, of elevated ozone days in 2015.
3.4.3.4 Back Trajectory Analysis on Elevated Ozone Days

The elevated ozone days identified in the previous section were used as a starting point to examine back trajectories from the tagged monitors. NOAA’s HYSPLIT back trajectory model was used to run 72-hour back trajectories for each elevated ozone day at each tagged monitor. The time of daily maximum one-hour ozone on the elevated eight-hour ozone day was used as the starting hour for each trajectory. If the maximum one-hour ozone occurred over multiple hours, then multiple trajectories were run, using each different hour as the starting hour. Three starting heights were used, 500 m AGL, 1000 m AGL, and 1500 m AGL.

To look for probable cases where pollution from Texas was transported to California, back trajectories were filtered for the following two conditions: back trajectories that did not hit the surface (zero m AGL) at any time during the 72-hour run, and back trajectories that started within the HYSPLIT calculated mixing layer in California. The conceptual model of ozone formation outlined for these monitors discusses the significance of the mixing layer height. Per the conceptual model, the area has very low mixing heights and a low-level subsidence inversion that prevents air transported into the basin from mixing to the surface. The filtering criteria ensured that the back trajectories used are those that capture air that would affect the ground level monitor. Due to the geography and topography of the Los Angeles area, many back trajectories

Figure 3-57: Number of Elevated Eight-Hour Ozone Days at the Tagged California Monitors for the years 2012 through 2016
hit the ground after several hours back. In addition, on many days, the mixing layer at
the tagged monitors was below 1,000 m AGL, which eliminated the trajectories that
were run at higher altitudes. The total number of HYSPLIT back trajectories and the
number of trajectories that meet the filtering criteria are summarized in Table 3-15:
Table 3-15: Number of HYSPLIT Back Trajectories at Each Tagged California Monitor

<table>
<thead>
<tr>
<th>AQS ID</th>
<th>Site Name</th>
<th>Number of Back Trajectories</th>
<th>Number of Back Trajectories that Meet Filter Criteria</th>
<th>Percent of Back Trajectories that Meet Filter Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>60371201</td>
<td>Reseda</td>
<td>447</td>
<td>45</td>
<td>10%</td>
</tr>
<tr>
<td>60371701</td>
<td>Pomona</td>
<td>567</td>
<td>44</td>
<td>8%</td>
</tr>
<tr>
<td>60376012</td>
<td>Santa Clarita</td>
<td>1011</td>
<td>155</td>
<td>15%</td>
</tr>
<tr>
<td>60658001</td>
<td>Rubidoux</td>
<td>936</td>
<td>201</td>
<td>21%</td>
</tr>
<tr>
<td>60658005</td>
<td>Mira Loma (Van Buren)</td>
<td>894</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>60710001</td>
<td>Barstow</td>
<td>504</td>
<td>228</td>
<td>45%</td>
</tr>
<tr>
<td>60710306</td>
<td>Victorville-Park Avenue</td>
<td>750</td>
<td>259</td>
<td>35%</td>
</tr>
<tr>
<td>60711004</td>
<td>Upland</td>
<td>960</td>
<td>90</td>
<td>9%</td>
</tr>
<tr>
<td>60714001</td>
<td>Hesperia-Olive Street</td>
<td>939</td>
<td>244</td>
<td>26%</td>
</tr>
<tr>
<td>60714003</td>
<td>Redlands</td>
<td>1371</td>
<td>394</td>
<td>29%</td>
</tr>
</tbody>
</table>

A large number of back trajectories were run for each tagged monitor, as shown in
Table 3-15; however, few of the back trajectories met the filter criteria. One monitor,
Mira Loma (AQS ID: 60658005) had no back trajectories out of 894 that met the
criteria. These results show the difficulty in simulating conditions where an air parcel
travels from Texas and ends within the mixing layer of the Los Angeles area on an
elevated ozone day. This may indicate that there are not many situations when air
from Texas travels to the mixing layer over Los Angeles.

The endpoints for the filtered back trajectories are displayed on the map in Figure
3-58: HYSPLIT Back Trajectory Endpoints that Meet Filter Criteria from the Tagged
California Monitors. The green endpoints represent an air parcel that is located above
the mixing layer while the purple endpoints represent an air parcel that is located
within the mixing layer. It is important to know which endpoints are located within the
mixing layer because an endpoint in the mixing layer would demonstrate a clearer case
of emissions at that location being transported to the starting location. Although it is
difficult to see any trajectory detail in the California area, the map clearly shows very
few back-trajectory end points end in Texas. Out of the 1,660 back trajectories with
113,467 endpoints displayed in Figure 3-58, only 10 back trajectories with a total of 59
endpoints reach Texas. Of those 10 back trajectories, only 2 back trajectories and 4
endpoints are located within the mixing layer over Texas. Of those two back
trajectories that span from California to the mixing layer over Texas, one started at the
Rubidoux (AQS ID: 60658001) monitoring site and the other started at the Upland (AQS
ID: 60711004) monitoring site. This represents 0.3% of the elevated ozone days from 2012 through 2016 at each monitor.

Figure 3-58: HYSPLIT Back Trajectory Endpoints that Meet Filter Criteria from the Tagged California Monitors

While it appears that air from Texas can reach the Los Angeles area, based upon trajectory analysis, this transport seems to occur very infrequently.

In summary, trajectory analysis of transport from Texas to Los Angeles indicates that emissions from Texas are very unlikely to affect ozone concentrations in the mixing layer over Los Angeles on high ozone days. Although trajectory analysis can have uncertainty (Stein et al. 2017), the large data set examined greatly reduces the uncertainty related to small sample sizes. Filtering the back trajectories by only looking at trajectories during elevated ozone episodes that start within California’s mixing layer, do not hit the surface, and have endpoints within Texas’ mixing layer is an attempt to find a clear case where emissions in Texas could affect the ozone in California. Those filters showed that only 0.03% of days were affected at the Rubidoux and Upland monitors; therefore, Texas does not appear to hinder California’s progress toward attaining the 2015 ozone NAAQS.
3.4.3.5 Texas Contributions on Projected Future Year Elevated Ozone Days
Contributions from Texas to projected future year elevated ozone days at the tagged California monitors were evaluated. Similar to the analysis for Colorado monitors, the subset of 2023 days with modeled MDA8 greater than 70 ppb was identified and the average modeled Texas contributions for this subset of days for each of the 10 tagged California monitors was computed.

Table 3-16: Modeled Elevated Ozone Days in the Future Year shows the number of days with modeled MDA8 greater than 70 ppb, the average eight-hour Texas ozone contribution, the average MDA8 for each of the tagged California monitors, and the percentage of Texas contribution to the MDA8s.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>AQS ID</th>
<th>Number of Elevated Days in 2023</th>
<th>Average Texas Contribution on Elevated Ozone Days in 2023 (ppb)</th>
<th>Average MDA8 on Elevated Ozone Days in 2023 (ppb)</th>
<th>Percentage of Texas Contributions in MDA8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reseda</td>
<td>60371201</td>
<td>9</td>
<td>0.53</td>
<td>73.33</td>
<td>0.73%</td>
</tr>
<tr>
<td>Pomona</td>
<td>60371701</td>
<td>60</td>
<td>0.26</td>
<td>76.87</td>
<td>0.35%</td>
</tr>
<tr>
<td>Santa Clarita</td>
<td>60376012</td>
<td>13</td>
<td>0.41</td>
<td>73.94</td>
<td>0.56%</td>
</tr>
<tr>
<td>Rubidoux</td>
<td>60658001</td>
<td>57</td>
<td>0.30</td>
<td>77.67</td>
<td>0.39%</td>
</tr>
<tr>
<td>Mira Loma (Van Buren)</td>
<td>60658005</td>
<td>57</td>
<td>0.30</td>
<td>77.67</td>
<td>0.39%</td>
</tr>
<tr>
<td>Barstow</td>
<td>60710001</td>
<td>1</td>
<td>0.00(^{12})</td>
<td>70.82</td>
<td>0.00%</td>
</tr>
<tr>
<td>Victorville-Park Avenue</td>
<td>60710306</td>
<td>5</td>
<td>0.19</td>
<td>72.24</td>
<td>0.27%</td>
</tr>
<tr>
<td>Upland</td>
<td>60711004</td>
<td>57</td>
<td>0.31</td>
<td>77.21</td>
<td>0.41%</td>
</tr>
<tr>
<td>Hesperia-Olive Street</td>
<td>60714001</td>
<td>12</td>
<td>0.23</td>
<td>73.50</td>
<td>0.32%</td>
</tr>
<tr>
<td>Redlands</td>
<td>60714003</td>
<td>54</td>
<td>0.29</td>
<td>77.12</td>
<td>0.38%</td>
</tr>
</tbody>
</table>

Table 3-16 shows that the calculated average Texas contribution on projected future elevated ozone days is less than 1% of the projected average MDA8 at all of the monitors on these days.

3.4.3.6 Collective Interstate Contribution to the Future Design Value
The TCEQ calculated the collective interstate contributions\(^{33}\) to the future design values for the tagged California monitors. Table 3-17: Collective Interstate Contributions to Future Design Values at Tagged California Monitors provides the percentage of

\(^{12}\) The average Texas contribution on Future Elevated Ozone days for this monitor was 0.00035 ppb which was rounded to 0.00 ppb.

\(^{33}\) The collective contribution metric was calculated using the same methodology as used to calculate Texas contribution in section 3.3.
interstate, intra-state, and background contributions to the future design values at the 10 tagged California monitors.

**Table 3-17: Collective Interstate Contributions to Future Design Values at Tagged California Monitors**

<table>
<thead>
<tr>
<th>AQ$\text{S ID}$</th>
<th>Site Name</th>
<th>Percentage of Future Design Value from Background Contribution</th>
<th>Percentage of Future Design Value from Interstate Contribution</th>
<th>Percentage of Future Design Value from Intra-State Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>60371201</td>
<td>Reseda</td>
<td>32.49%</td>
<td>3.62%</td>
<td>52.55%</td>
</tr>
<tr>
<td>60371701</td>
<td>Pomona</td>
<td>30.88%</td>
<td>4.05%</td>
<td>54.87%</td>
</tr>
<tr>
<td>60376012</td>
<td>Santa Clarita</td>
<td>37.41%</td>
<td>3.60%</td>
<td>49.00%</td>
</tr>
<tr>
<td>60658001</td>
<td>Rubidoux</td>
<td>29.22%</td>
<td>3.20%</td>
<td>57.20%</td>
</tr>
<tr>
<td>60658005</td>
<td>Mira Loma (Van Buren)</td>
<td>29.22%</td>
<td>3.20%</td>
<td>57.20%</td>
</tr>
<tr>
<td>60710001</td>
<td>Barstow</td>
<td>58.53%</td>
<td>4.58%</td>
<td>30.64%</td>
</tr>
<tr>
<td>60710306</td>
<td>Victorville-Park Avenue</td>
<td>36.58%</td>
<td>3.98%</td>
<td>49.55%</td>
</tr>
<tr>
<td>60711004</td>
<td>Upland</td>
<td>30.74%</td>
<td>4.22%</td>
<td>54.69%</td>
</tr>
<tr>
<td>60714001</td>
<td>Hesperia-Olive Street</td>
<td>32.09%</td>
<td>3.97%</td>
<td>53.35%</td>
</tr>
<tr>
<td>60714003</td>
<td>Redlands</td>
<td>29.70%</td>
<td>3.25%</td>
<td>57.19%</td>
</tr>
</tbody>
</table>

The maximum collective contribution to the future design value is 4.58% at the Barstow (AQ$\text{S ID}$: 60710001) monitor. The 4.58% is insignificant compared to the intra-state contribution of 30.64%. A similar trend is seen at all 10 of the tagged monitors, thereby supporting the conclusion that interstate transport does not contribute significantly to nonattainment at these monitors.

Based on the detailed analysis at the tagged California monitors, the design value trends, back trajectory analysis on elevated ozone days, average Texas modeled contributions on projected future elevated ozone days, and collective interstate contributions to future design values, Texas emissions do not significantly contribute to nonattainment or interfere with maintenance at the 10 tagged California monitors.

### 3.5 CONCLUSION

Texas emissions do not contribute significantly to nonattainment or interfere with maintenance of the 2015 eight-hour ozone NAAQS at any downwind monitors. Modeling was used to project the nonattainment and maintenance status of downwind monitors in 2023. Among monitors projected to be in nonattainment or have maintenance issues, 16 monitors were tagged for further review, one in Arizona, 10 in California, and five in Colorado. Several factors were examined, such as design value trends, number of elevated ozone days, back trajectory analysis on elevated ozone days, modeled concentrations on future expected elevated ozone days, total interstate contributions at tagged monitors, and responsiveness of ozone to Texas emissions. Based on this rigorous analysis, it was concluded that emissions from Texas do not
contribute significantly to nonattainment or interfere with maintenance of the 2015
eight-hour ozone NAAQS at the tagged downwind monitors.

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CHAPTER 4: CONTROL STRATEGIES

4.1 INTRODUCTION
On November 16, 2017, the United States Environmental Protection Agency (EPA) made the first round of designations for the 2015 eight-hour ozone National Ambient Air Quality Standards (NAAQS), designating 205 of the 254 counties in Texas as attainment/unclassifiable, effective January 16, 2018 (82 Federal Register (FR) 54232). On December 22, 2017, the EPA sent 120-day letters responding to state recommendations for remaining area designations. The EPA is proposing nonattainment designations for Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, Tarrant, and Wise Counties in the Dallas-Fort Worth (DFW) area and Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties in the Houston-Galveston-Brazoria (HGB) area. The EPA also intends to designate all other counties listed in the proposal as attainment/unclassifiable. Under the 2008 eight-hour ozone NAAQS, the DFW area, consisting of Collin, Dallas, Denton, Tarrant, Ellis, Johnson, Kaufman, Parker, Rockwall, and Wise Counties, and the HGB area, consisting of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties, are designated nonattainment. The rest of the counties in Texas are designated unclassifiable/attainment for the 2008 eight-hour ozone NAAQS.

Attainment demonstration state implementation plan (SIP) revisions for any areas designated as nonattainment for the 2015 eight-hour ozone NAAQS would not be due until after this transport SIP revision is submitted to the EPA. Because designations for Texas under the 2015 eight-hour ozone NAAQS have not been completed, attainment demonstration SIP revision due dates have not been established and potential controls have not yet been contemplated. However, Texas has implemented stringent and innovative regulations that address emissions of nitrogen oxides (NOX) and volatile organic compounds (VOC) from a wide variety of major and minor source types under previous NAAQS. This chapter describes control measures for the DFW and HGB nonattainment areas as well as other areas of the state.

4.2 EMISSIONS REDUCTIONS FROM ELECTRIC GENERATING UNITS (EGU)
4.2.1 Utility Electric Generation in Ozone Nonattainment Areas
The rules in 30 Texas Administrative Code (TAC) Chapter 117, Subchapter C establish NOX emission specifications for utility electric generation for each ozone nonattainment area in Texas. These rules apply to each electric generating facility that generates electric energy for compensation, or are owned or operated by a municipality or Public Utility Commission of Texas (PUCT) regulated utility or any of its successors, regardless of whether the successor is a municipality or is regulated by the PUCT.

In the HGB area, the owner or operator of each affected utility boiler, auxiliary steam boiler, or stationary gas turbine must demonstrate compliance with the NOX emission specifications through a system cap and participation in the HGB area Mass Emissions Cap and Trade (MECT) Program. Affected sources were required to comply with the

MECT Program rules beginning January 1, 2002, and comply with the system cap requirements by March 31, 2004. Additional information about the MECT Program is available in Section 4.3.2: Mass Emissions Cap and Trade (MECT) Program.

In the DFW area, each utility boiler that is part of a large system must meet a NOX emission rate of 0.033 pound per million British thermal units (lb/MBtu) heat input, and each utility boiler that is part of a small system must meet a NOX emission rate of 0.06 lb/MMBtu heat input. Compliance with the NOX emission rates may be demonstrated on a daily average basis, a system-wide heat input weighted average basis for utility boilers that are part of a large system, or through the use of emission credits. Affected sources were required to comply with the rules by March 1, 2009.

In the Beaumont-Port Arthur (BPA) 1997 eight-hour ozone maintenance area, each utility boiler must meet a NOX emission rate of 0.10 lb/MMBtu heat input. Compliance with the NOX emission rates must be demonstrated on a daily average through the use of either a system cap or emission credits. Affected sources were required to comply with the rules by May 1, 2005.

4.2.2 Utility Electric Generation in East and Central Texas

The rules in 30 TAC Chapter 117, Subchapter E, Division 1 limit NOX emissions from utility electric generation in Atascosa, Bastrop, Bexar, Brazos, Calhoun, Cherokee, Fannin, Fayette, Freestone, Goliad, Gregg, Grimes, Harrison, Hood, Hunt, Lamar, Limestone, Marion, McLennan, Milam, Morris, Nueces, Parker, Red River, Robertson, Rusk, Titus, Travis, Victoria, and Wharton Counties. The rules apply to each utility electric power boiler and stationary gas turbine (including duct burners used in turbine exhaust ducts) that generate electric energy for compensation; is owned by an electric cooperative, independent power producer, municipality, river authority, or public utility; and was placed into service before December 31, 1995. Utility electric power boilers must meet a NOX emission rate of 0.14 lb/MMBtu for gas-fired units and 0.165 lb/MMBtu for coal-fired units. Stationary gas turbines (including duct burners used in turbine exhaust ducts) must meet an annual average NOX emission rate of 0.14 lb/MMBtu for units subject to Texas Utilities Code (TUC), §39.264 (except §39.264(i)) or 0.15 lb/MMBtu for units not subject to TUC, §39.264 and units designated in accordance with TUC, §39.264(i). Compliance with the NOX emission rates is based on average heat input for a calendar year. Affected sources were required to comply with the rules by May 1, 2005.

4.2.3 Senate Bill 7 (76th Texas Legislature)

Senate Bill (SB) 7 from the 1999 76th Texas Legislature, requires grandfathered, or unpermitted, electric generating facilities (EGFs) and other EGFs that choose to participate to achieve a 50% reduction in NOX emissions and a 25% reduction in sulfur dioxide (SO2) emissions from the 1997 emission levels. The reductions were implemented via participation in a cap and trade program in which participating EGFs are required to surrender allowances equivalent to the actual emissions each control source.

A large utility system is defined in 30 TAC Chapter 117 as: all boilers, auxiliary steam boilers, and stationary gas turbines that are located in the DFW eight-hour ozone nonattainment area, and were part of one electric power generating system on January 1, 2000, that had a combined electric generating capacity equal to or greater than 500 megawatts.
period. For grandfathered EGFs, the allowance allocations were determined using the following emission rates: 0.14 lb NOx/MMBtu and 1.38 lb SO2/MMBtu in the East Texas region, and 0.195 lb NOx/MMBtu in the West Texas and El Paso regions. For electing EGFs, the allowance allocations were equal to the emissions reported to the EPA’s Acid Rain Program in 1997, or if unavailable, by a method approved by the executive director not to exceed any annual emission limitation authorized under Chapter 116, Subchapter B or an applicable state or federal requirement. There are no coal-fired EGFs located in the West Texas and El Paso regions that are subject to the Emissions Banking and Trading Allowances Program. The SB 7 requirements were implemented through rules in 30 TAC Chapter 101, Subchapter H, Division 2 and became effective January 11, 2000. The initial control period for this program began on May 1, 2003.

4.3 EMISSION REDUCTIONS FROM OTHER SOURCES

4.3.1 East Texas Engines

The rules in 30 TAC Chapter 117, Subchapter E, Division 4 limit NOx emissions from certain engines located in Anderson, Brazos, Burleson, Camp, Cass, Cherokee, Franklin, Freestone, Gregg, Grimes, Harrison, Henderson, Hill, Hopkins, Hunt, Lee, Leon, Limestone, Madison, Marion, Morris, Nacogdoches, Navarro, Panola, Rains, Robertson, Rusk, Shelby, Smith, Titus, Upshur, Van Zandt, and Wood Counties. The rules apply to stationary, gas-fired, reciprocating internal combustion engines rated 240 horsepower (hp) and larger. Rich-burn gas-fired internal combustion engines rated less than 500 hp must limit NOx emissions to 1.0 grams per horsepower-hour (g/hp-hr). Rich-burn engines rated 500 hp or greater must limit NOx emissions to 0.60 g/hp-hr for landfill gas-fired engines or 0.05 g/hp-hr for all other rich-burn engines. Affected sources were required to comply with the rules by March 1, 2010.

The East Texas combustion rules reduce NOx emissions and ozone air pollution transport into the DFW area. While these rules are part of the May 2007 DFW Attainment Demonstration SIP Revision for the 1997 eight-hour ozone NAAQS, the Northeast Texas area also benefits from NOx reductions resulting from the rules. Using photochemical modeling sensitivity studies, the Texas Commission on Environmental Quality (TCEQ) estimated that implementation of the rules results in an overall reduction of approximately 22.4 tons per day (tpd) of NOx emissions in the 33 counties subject to the rules by March 1, 2010. The TCEQ estimated the rules benefit the DFW area by reducing ozone by an average of 0.1 to 0.2 parts per billion.

4.3.2 Mass Emissions Cap and Trade (MECT) Program

The MECT Program rules in 30 TAC Chapter 101, Subchapter H, Division 3 established a mandatory annual NOx emission cap on sites in the HGB 1997 eight-hour ozone nonattainment area that are either a major source of NOx with facilities subject to the NOx emissions specifications in 30 TAC §117.310 or §117.1210, or have an uncontrolled design capacity to emit at least 10.0 tons per year (tpy) of NOx from facilities subject to 30 TAC §117.2010. Affected facilities include: utility boilers, auxiliary steam boilers, or stationary gas turbines; industrial, commercial, or institutional boilers and process heaters; stationary gas turbines; stationary internal combustion engines; fluid catalytic cracking units (including carbon monoxide boilers, carbon monoxide furnaces, and catalyst regenerator vents); boilers and industrial furnaces that were regulated as existing facilities by the EPA under 40 Code of Federal Regulations Part 266, Subpart H (as in effect on June 9, 1993); duct burners used in
turbine exhaust ducts; pulping liquor recovery furnaces; lime kilns; lightweight aggregate kilns; heat treating furnaces and reheat furnaces; magnesium chloride fluidized bed dryers; and incinerators.

The MECT Program cap is enforced by the allocation, trading, and banking of allowances. An allowance is the equivalent of 1.0 ton of NO\textsubscript{x} emissions. The MECT Program cap was implemented on January 1, 2002 at historical emission levels with mandatory NO\textsubscript{x} reductions increasing over time until achieving the final cap on April 1, 2007. Affected facilities that do not meet the criteria for receiving an allocation of allowances must use allowances allocated to facilities already participating in the program to cover annual NO\textsubscript{x} emissions. The projected 2018 MECT cap is 39,866.1 tpy of NO\textsubscript{x} emissions.

4.3.3 Highly Reactive Volatile Organic Compounds (HRVOC) Rules and HRVOC Emissions Cap and Trade (HECT) Program

The HRVOC rules in 30 TAC Chapter 115, Subchapter H are performance-based, emphasizing monitoring, recordkeeping, reporting, and enforcement rather than establishing individual unit emission rates. The rules apply to HRVOC emissions from flares, process vents, cooling towers, and fugitive emission sources. In addition to the monitoring requirements, affected sources in Harris County must meet an annual HRVOC emission cap and a site-wide short-term HRVOC limit of 1,200 lb/hour from any flare, vent, pressure relief valve, cooling tower, or any combination thereof. Affected sources in Harris County must demonstrate compliance with these HRVOC emission limits through participation in the HECT Program.

The HECT Program rules in 30 TAC Chapter 101, Subchapter H, Division 6 established a mandatory annual HRVOC emission cap on sites in the HGB 1997 eight-hour ozone nonattainment area with the potential to emit greater than 10.0 tpy of HRVOC from facilities subject to 30 TAC Chapter 115, Subchapter H, Division 1 or Division 2. These facilities include vent gas streams, flares, and cooling tower heat exchange systems. Sites in Harris County are required to participate in the HECT Program. The program was implemented on January 1, 2007.

The HECT Program cap is enforced by the allocation, trading, and banking of allowances. An allowance is the equivalent of 1.0 ton of HRVOC emissions. The HECT Program cap was established at a level demonstrated as necessary to allow the HGB area to attain the one-hour ozone standard along with a 5% compliance margin to account for potential emissions variations. The total initial cap was 3,451.5 tpy.

Allowances allocated from 2007 through 2010 were based on historical levels of activity reported by affected sites. For 2011 and beyond, a site’s allocation was determined by multiplying the total HECT cap by an industry-sector factor and a site-specific factor. The industry-sector factor was determined by grouping sites into sectors and determining each site’s proportion based on actual emissions. The site-specific factor was based on a site’s uncontrolled emissions as a proportion of the total uncontrolled emissions from all sites in that industry sector. The reallocation includes a mandatory 10% cap reduction implemented during 2014, with additional 5% reductions implemented at the start of each control period for 2015, 2016, and 2017. The final HECT Program cap is set at 2,588.6 tpy for 2017 and all subsequent control periods. Affected sites that do not receive an allocation of allowances must obtain and
use allowances allocated to sites already participating in the program to cover annual HRVOC emissions.

4.3.4 Cement Kilns
The rules in 30 TAC Chapter 117, Subchapter E, Division 1 limit NOx emissions from cement kilns in Bexar, Comal, Ellis, Hays, and McLennan Counties. The rules require cement kilns in Bexar, Comal, Hays, and McLennan Counties to reduce NOx emissions 30% below 1996 levels or to meet a NOx emissions cap of 6.0 pounds of NOx per ton of cement clinker produced (lb NOx/ton of clinker) for wet kilns; 5.1 lb NOx/ton of clinker for dry kilns; 3.8 lb NOx/ton of clinker for preheater kilns; and 2.8 lb NOx/ton of clinker for preheater-precalciner or precalciner kilns. Affected sources were required to comply with the rules by May 1, 2005. The rules also require cement kilns located in Ellis County to meet an ozone season NOx emission source cap.

Ash Grove Cement Company operated three kilns in Ellis County, with an established source cap under §117.3123 of 4.4 tpd. However, a 2013 consent decree between Ash Grove and the EPA required by September 10, 2014 the shutdown of two kilns and reconstruction of kiln #3 with selective non-catalytic reduction (SNCR) with an emission limit of 1.5 lb NOx/ton of clinker and a 12-month rolling tonnage limit for NOx of 975 tpy. The reconstructed kiln is a dry kiln with year-round SNCR operation. The redesign allows 949,000 tpy of clinker, or 1.95 tpd of NOx, which is well below the 4.4 tpd source cap. Ash Grove's enforceable limit continues to be 4.4 tpd, although actual emissions are expected to be below the consent decree limit. Any modifications or new construction would be required to meet nonattainment new source review with best available control technology requirements, and would be subject to the same 1.5 lb NOx/ton of clinker emission limit in the New Source Performance Standards for Portland Cement Plants. It would also be subject to other regulatory requirements, including the National Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry.

Martin Marietta currently operates one dry preheater/precalkiner kiln #5. The permitted capacity of this kiln is 2,800,000 tons of clinker per year, and it has a permitted emission factor of 1.95 lb NOx/ton of clinker. Based on these permit limits, this kiln is therefore limited to a maximum of 7.48 tpd NOx, compared to the current §117.3123 source cap of 7.9 tpd NOx. Kiln #5 typically operates well below the source cap, at an average emission factor below 1.5 lb NOx/ton of clinker.

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

The SmartWay Transport Partnership is a market-driven partnership aimed at helping businesses move goods in the cleanest most efficient way possible. This is a voluntary EPA program primarily for the freight transport industry that promotes strategies and technologies to help improve fleet efficiency while also reducing air emissions.
There are over 3,000 SmartWay partners 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. Since its founding, SmartWay has reduced oil consumption by 170.3 million barrels and prevented the release of 1,458,000 tons of NO\textsubscript{x} and 59,000 tons of particulate matter into the atmosphere.\(^\text{36}\) 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 Environmental Defense Fund and the Houston-Galveston Area Council (H-GAC) in the Port Drayage Truck Bridge Loan Program received $9 million from the EPA’s Diesel Emissions Reduction Act (DERA) SmartWay Program in 2009. On average, four trucks a month, or about 50 trucks a year, were approved for replacement funding.

In April 2015, the EPA awarded the PHA with a DERA grant of nearly $900,000. This grant award, with matching funds of $1,669,560, had a total commitment of more than $2.5 million. A total of 24 trucks were replaced that operate at the Port of Houston. This included replacing 13 on-road over the road trucks that are only used inside the PHA’s Turning Basin terminal. The replacement trucks were on-road terminal tractors, with model year 2015 engines, which are built and designed to work on marine terminals. The other 11 trucks replaced with this grant were older on-road terminal tractors that operate in and around PHA’s Barbours Cut and Bayport container terminals. The replacements for these trucks were also on-road terminal tractors with model year 2016 engines.

In February 2015, the EPA awarded the PHA with a DERA grant of nearly $900,000. This grant award, with matching funds of $900,000, had a total commitment of $1.8 million. It is expected, that at the end of this grant, 17 drayage trucks will be replaced. The funding will provide for replacement trucks powered by certified engines that are model year 2011 or newer, which are estimated to be 90% cleaner. These drayage trucks operate in the Port of Houston and along the Houston Ship Channel. The replacement trucks will also have Global Positioning System units to collect data on idling and port operations, which will allow fleet owners and operators to gauge opportunities for additional fuel savings and emissions reduction.

Approximately 170 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, trailer aerodynamic kits, low-rolling resistance tire, and retrofit technologies are incorporated into SmartWay-verified technologies.

The Blue Skyways Collaborative was created to encourage voluntary air emission reductions by planning or implementing projects that use innovations in diesel engines, alternative fuels, and renewable energy technologies applicable to on-road and non-road sources. The Blue Skyways Collaborative partnerships include international, federal, state, and local governments, non-profit organizations, environmental groups, and private industries.

\(^{36}\) https://www.epa.gov/smartway/learn-about-smartway
4.4.2 Energy Efficiency and Renewable Energy (EE/RE) Measures

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

Texas leads the nation in RE generation from wind. As of the third quarter 2017, Texas has 21,450 megawatts (MW) of installed wind generation capacity,37 25% of all installed wind capacity in the United States (U.S.) and three times the installed wind capacity of Iowa, the state ranked second in installed wind capacity. Texas’ total net electrical generation from renewable wind generators in 2016 was 57.5 million megawatt-hours (MWh), approximately 25% of the total wind net electrical generation for the U.S. For the first eight months in 2017, total net electrical generation from renewable wind generators in Texas is estimated to be 44.8 million MWh,38 approximately 17% more than the same eight-month period in 2016.

While EE/RE measures are beneficial and do result in lower overall emissions from fossil fuel-fired power plants in Texas, emission reductions resulting from these programs are not explicitly included in photochemical modeling for SIP purposes because local efficiency or renewable energy efforts may not result in local emissions reductions or may be offset by increased demand in electricity. The complex nature of the electrical grid makes accurately quantifying emission reductions from EE/RE measures difficult. At any given time, it is impossible to determine exactly where a specific user's electricity was produced.

While specific emission reductions from EE/RE measures are not provided in the SIP, persons interested in estimates of energy savings and emission reductions from EE/RE measures can access additional information and reports from the Texas A&M Engineering Experiment Station's Energy Systems Laboratory (ESL) website (http://esl.tamu.edu/). The reports submitted to the TCEQ regarding EE/RE measures are available under Texas Emissions Reduction Plan (TERP) Letters and Reports.

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

76th Texas Legislature, 1999

- SB 7
- House Bill (HB) 2492

• HB 2960
77th Texas Legislature, 2001
 • SB 5
 • HB 2277
 • HB 2278
 • HB 2845

78th Texas Legislature, 2003
 • HB 1365 (Regular Session)

79th Texas Legislature, 2005
 • SB 20 (First Called Session)
 • HB 2129 (Regular Session)
 • HB 2481 (Regular Session)

80th Texas Legislature, 2007
 • SB 12
 • HB 66
 • HB 3070
 • HB 3693

81st Texas Legislature, 2009
 • None

82nd Texas Legislature, 2011
 • SB 898 (Regular Session)
 • SB 924 (Regular Session)
 • SB 981 (Regular Session)
 • SB 1125 (Regular Session)
 • SB 1150 (Regular Session)
 • HB 51 (Regular Session)
 • HB 362 (Regular Session)

83rd Texas Legislature, 2013
 • None

84th Texas Legislature, 2015
 • SB 1626
 • HB 1736

85th Texas Legislature, 2017
HB 1571 (Regular Session)

Renewable Energy

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

The 79th Texas Legislature, 2005, Regular and First Called Sessions, amended SB 5 through SB 20, HB 2129, and HB 2481 to add, among other initiatives, renewable energy initiatives that require: 5,880 MW of generating capacity from renewable energy by 2015; the TCEQ to develop a methodology for calculating emission reductions from renewable energy initiatives and associated credits; the ESL to assist the TCEQ in quantifying emissions reductions from EE/RE programs; and the PUCT to establish a target of 10,000 MW of installed renewable technologies by 2025. Wind power producers in Texas exceeded the renewable energy generation target by installing over 10,000 MW of wind electric generating capacity by 2010.

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

In addition to the programs discussed and analyzed in the ESL report, local governments may have enacted measures beyond what has been reported to SECO and the PUCT. The TCEQ encourages local political subdivisions to promote EE/RE measures in their respective communities and to ensure these measures are fully reported to SECO and the PUCT.

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

HB 362, 82nd Texas Legislature, 2011, Regular Session, helps property owners install solar energy devices such as electric generating solar panels by establishing requirements for property owners associations' approval of installation of solar energy
devices. HB 362 specifies the conditions that property owners associations may and may not deny approval of installing solar energy devices.

SB 1626, 84th Texas Legislature, 2015, modifies the provisions established by HB 362 from the 82nd Texas Legislature, 2011, Regular Session, regarding property owners associations' authority to approve and deny installations of solar energy devices such as electric generating solar panels. HB 362 included an exception that allowed developers to prohibit installation of solar energy devices during the development period. SB 1626 limits the exception during the development period to developments with 50 or fewer units.

Residential and Commercial Building Codes and Programs

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

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

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

HB 1736, 84th Texas Legislature, 2015, updates THSC §388.003 to adopt, effective September 1, 2016, the energy efficiency chapter of the International Residential Code as it existed on May 1, 2015. HB 1736 also establishes a schedule by which SECO could adopt updated editions of the International Residential Code in the future, not more often than once every six years.

Federal Facility EE/RE Projects


Political Subdivisions Projects

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

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

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

State Energy Efficiency Programs

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

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

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

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

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

SB 924, 82nd Texas Legislature, 2011, Regular Session, requires all municipally owned utilities and electric cooperatives that had retail sales of more than 500,000 MWh in 2005 to report each year to SECO information regarding the combined effects of the
energy efficiency activities of the utility from the previous calendar year, including the utility’s annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals.

HB 1571, 85th Texas Legislature, 2017, Regular Session, expanded Education Code and Government Code provisions for local governmental entities, schools, and state agencies entering into energy saving performance contracts by authorizing the entities to use any available money to pay the provider for energy or water conservation measures. Previously, only money other than money borrowed from the state could be used to pay for such conservation measures.

4.4.3 Consent Decrees with Refineries
The EPA's National Petroleum Refinery Initiative\(^39\) has resulted in multi-issue settlement agreements with the nation’s major petroleum refineries. As of October 2016, 112 refineries representing more than 95% of total domestic refining capacity are 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 95,000 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 continuous emissions monitoring systems (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.

4.4.4 Clean Air Interstate Rule (CAIR) and Cross-State Air Pollution Rule (CSAPR)
In March 2005, the EPA issued CAIR to address EGU emissions that transport from one state to another. The rule incorporated the use of three cap and trade programs to reduce 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 was required to 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 consisted of two phases for implementing necessary NO\(_x\) and SO\(_2\) reductions. Phase I addressed required reductions from 2009 through 2014. Phase II was intended to address reductions in 2015 and thereafter.

\(^39\) https://www.epa.gov/enforcement/petroleum-refinery-national-case-results
In July 2006, the commission adopted a SIP revision to address how the state would meet emissions allowance allocation budgets for NOx and SO2 established by the EPA to meet the federal obligations under CAIR. The commission adopted a second CAIR-related SIP revision in February 2010. This revision incorporated various federal rule revisions that the EPA had promulgated since the TCEQ’s initial submittal. It also incorporated revisions to 30 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 Federal Clean Air Act (FCAA) requirements and respond to the court’s order to issue a replacement program. Texas was included in CSAPR for ozone season NOx, annual NOx, and annual SO2 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 PM2.5 NAAQS in other states. As a result of numerous EGU emission reduction strategies already in place in Texas, the annual and ozone season NOx reduction requirements from CSAPR were relatively small but still significant. CSAPR required an approximate 7% reduction in annual NOx emissions and less than 5% reduction in ozone season NOx emissions.

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

The EPA and various environmental groups petitioned the Supreme Court of the United States to review the D.C. Circuit Court’s decision on CSAPR. On April 29, 2014, a decision by the Supreme Court reversed the D.C. Circuit and remanded the case. On October 23, 2014, the D.C. Circuit lifted the CSAPR stay and on November 21, 2014, the EPA issued rulemaking, which shifted the effective dates of the CSAPR requirements to account for the time that had passed after the rule was stayed in 2011. Phase 1 of CSAPR took effect January 1, 2015 and Phase 2 began January 1, 2017. On July 28, 2015, the D.C. Circuit Court ruled that the 2014 annual SO2 budgets and the 2014 ozone season NOx budgets for Texas were invalid because they required over control of Texas emissions, and remanded these budgets back to the EPA without vacatur.

On January 22, 2015, the EPA issued a memorandum to provide information on how it intends to implement FCAA interstate transport requirements for the 2008 ozone NAAQS. The EPA provided preliminary modeling results for 2018, which show contribution to nonattainment of the 2008 ozone NAAQS in the HGB area from sources outside of Texas. On July 23, 2015, the EPA issued a notice of data availability regarding updated ozone transport modeling results for a 2017 attainment year.

On June 27, 2016, the EPA issued a memorandum outlining the agency’s approach for responding to the D.C. Circuit’s July 2015 remand of the Phase 2 SO2 emissions budgets, providing a choice of two paths for states with remanded budgets. Under the first path, states could voluntarily continue to participate in CSAPR at the state’s current Phase 2 SO2 and annual NOx budget levels through a SIP revision. Under the second path, if a state does not choose to participate in CSAPR, the EPA would initiate rulemaking by fall of 2016 to remove the state’s sources from CSAPR’s SO2 and annual NOx programs and address any remaining interstate transport or regional haze.
obligations on a state-by-state basis. On November 10, 2016, the EPA published a proposed rule to remove Texas sources from the CSAPR SO₂ and annual NOₓ trading programs. The EPA also proposed to determine that, following withdrawal of the federal implementation plan (FIP) requirements, sources in Texas will not contribute significantly to nonattainment or interfere with maintenance of the 1997 PM₂.₅ NAAQS in any other state and that the EPA therefore will have no obligation to issue new FIP requirements for Texas sources to address transport for the 1997 PM₂.₅ NAAQS (81 FR 78954). The rule was finalized, effective immediately, on September 29, 2017 (82 FR 45481).

On September 7, 2016, the EPA signed the final CSAPR Update Rule for the 2008 eight-hour ozone standard. The EPA’s modeling shows that emissions from within Texas no longer significantly contribute to downwind nonattainment or interference with maintenance for the 1997 eight-hour ozone NAAQS even without implementation of the original CSAPR ozone season NOₓ emissions budget. Accordingly, sources in Texas are no longer subject to the emissions budget calculated to address the 1997 eight-hour ozone NAAQS. However, this rule finalized a new ozone season NOₓ emissions budget for Texas to address interstate transport with respect to the 2008 eight-hour ozone NAAQS. This new budget became effective for the 2017 ozone season, the same period in which the Phase 2 budget that was invalidated by the court was scheduled to become effective.

CSAPR budgets for Texas may be subject to change in the future based on any additional rulemaking to address remanded budgets or changes resulting from further appeals.

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

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

From 2001 through August 2017, $1,088,390,866 in DERI grants were awarded for projects projected to help reduce and estimated 179,427 tons of NOₓ over the life of the projects. This includes $448,288,693 going to activities in the HGB area and $377,422,749 to activities in the DFW area, with an estimated 78,445 tons of NOₓ reduced in the HGB area and 62,731 tons of NOₓ reduced in the DFW area over the life of the projects.

Three other incentive programs under the TERP program will result in the reduction in NOₓ emissions in the DFW and HGB areas, as well as other TERP areas.

The Drayage Truck Incentive Program was established in 2013 to provide grants for the replacement of drayage trucks operating in and from seaports and rail yards.
located in nonattainment areas. The name of this program was recently changed to the Seaport and Rail Yard Areas Emissions Reduction Program, and replacement or repower of cargo handling equipment was added to the eligible project list. Through August 2017, the program awarded $6,209,424, with an estimated 353 tons of NOₓ reduced over the life of the projects. In the HGB area the funding totaled $5.57 million, with projects estimated to reduce up to 325 tons of NOₓ over the life of the projects. $542,061 was awarded to projects in the DFW area, with an estimated 27 tons of NOₓ reduced over the life of the projects.

The Texas Clean Fleet Program (TCFP) was established in 2009 to provide grants for the replacement of light-duty and heavy-duty diesel vehicles with vehicles powered by alternative fuels, including: natural gas, liquefied petroleum gas, hydrogen, methanol (85% by volume), or electricity. This program is for larger fleets, therefore applicants must commit to replacing at least 10 eligible diesel-powered vehicles with qualifying alternative fuel or hybrid vehicles. From 2009 through August 2017, over $58.16 million in TCFP grants were awarded for projects to help reduce an estimated 660 tons of NOₓ over the life of the projects. Over $22.9 million in TCFP grants were awarded to projects in the HGB area, with an estimated 216 tons of NOₓ reduced over the life of the projects, and over $16.3 million was awarded in the DFW area, with an estimated 245 tons of NOₓ reduced over the life of the projects.

The Texas Natural Gas Vehicle Grant Program (TNGVGP) was established in 2011 to provide grants for the replacement of medium-duty and heavy-duty diesel vehicles with vehicles powered by natural gas. This program may include grants for individual vehicles or multiple vehicles. The majority of the vehicle’s operation must occur in the Texas nonattainment areas, other counties designated as affected counties under the TERP, and the counties in and between the triangular area between Houston, San Antonio, and DFW. From 2011 through August 2017, over $48.3 million in TNGVGP grants were awarded for projects to help reduce an estimated 1,676 tons of NOₓ over the life of the projects. Over $12.65 million in TNGVGP grants were awarded to projects in the HGB area, with an estimated 348 tons of NOₓ reduced over the life of the projects, and over $17.7 million was awarded to projects in the DFW area, with an estimated 658 tons of NOₓ reduced over the life of the projects.

4.4.6 Clean School Bus Program
HB 3469, 79th Texas Legislature, 2005, Regular Session, established the Clean School Bus Program, which provides monetary incentives for school districts in the state for reducing emissions of diesel exhaust from school buses through retrofit of older school buses with diesel oxidation catalysts, diesel particulate filters, and closed crankcase filters. As of August 2017, the TCEQ Clean School Bus Program had reimbursed approximately $34.6 million in grants for over 7,500 retrofit activities. This amount included $4.7 million in federal funds. As a result of recent legislative changes, this program will include replacement of older school buses with newer, lower-emitting models going forward.

4.4.7 Local Initiatives
Local strategies in the DFW nonattainment area are being implemented by the North Central Texas Council of Governments and local strategies in the HGB nonattainment area are being implemented by H-GAC. Due to the continued progress of these
measures, additional air quality benefits are expected to be gained that will further reduce precursors to ground level ozone formation. A summary of local strategies for the DFW nonattainment area is included in Appendix H: *Local Initiatives Submitted by the North Central Texas Council of Governments* of the DFW 2008 Eight-Hour Ozone Attainment Demonstration for the 2017 Attainment Year and information on local measures in the HGB nonattainment area is available on the [Houston-Galveston Area Council](http://www.h-gac.com/home/residents.aspx) website.

### 4.4.8 Voluntary Measures

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

### 4.5 2008 OZONE NAAQS SIP REVISIONS ADOPTED SINCE 2015

All Texas SIP revisions are available on the [Texas SIP Revisions](http://www.tceq.texas.gov/airquality/sip/sipplans.html) webpage.

Since 2015, Texas has adopted several SIP revisions to further address the 2008 eight-hour ozone standard in the DFW and HGB areas. These latest SIP revisions and plans are detailed in this section.

#### 4.5.1 DFW 2008 Eight Hour Ozone SIP Revisions

On June 3, 2015, the commission adopted two revisions to the Texas SIP for the DFW 2008 eight-hour ozone moderate nonattainment area: the DFW 2008 Eight-Hour Ozone Attainment Demonstration SIP Revision and the DFW 2008 Eight-Hour Ozone Reasonable Further Progress (RFP) SIP Revision. On December 7, 2016, the EPA published final approval of the DFW RFP SIP revision (81 FR 88124). Following proposal of these SIP revisions, the attainment date for the DFW 2008 eight-hour ozone moderate nonattainment area changed from December 31, 2018 to July 20, 2018 as a result of the December 23, 2014 D.C. Circuit Court ruling and the EPA’s final 2008 ozone standard SIP requirements rule. Because the attainment year ozone season is the ozone season immediately preceding a nonattainment area’s attainment date, the attainment year for the DFW moderate nonattainment area also changed from 2018 to 2017. As a result of the change in the attainment year, it was necessary for the TCEQ to develop a revised attainment demonstration. The DFW 2008 eight-hour ozone nonattainment area attainment demonstration SIP revision for the 2017 attainment year was adopted by the commission on July 6, 2016. On June 14, 2017, the EPA approved part of the attainment demonstration SIP revision that describes how FCAA requirements for vehicle inspection and maintenance and nonattainment new source
review are met in the DFW area for the 2008 ozone NAAQS (82 FR 22291), effective on September 12, 2017. On September 22, 2017, the EPA conditionally approved the TCEQ's cement kiln NOx RACT analysis for Martin Marietta (82 FR 44320) predicated on the TCEQ's commitment to establish the permitted emission limit of 1.95 lb NOx/ton of clinker for kiln #5 in the SIP. The TCEQ committed to the EPA in a letter dated July 29, 2016 to prepare a SIP revision containing the 1.95 lb NOx/ton of clinker limit for Martin Marietta and subsequently submit the SIP revision to the EPA if it is approved by the commission. In the September 22, 2017 final rule, the EPA also fully approved NOx RACT for all other affected sources in the 10-county DFW 2008 eight-hour ozone nonattainment area. The EPA published final approval of VOC RACT on December 21, 2017 (82 FR 60546).

4.5.2 HGB 2008 Eight-Hour Ozone SIP Revisions
On December 15, 2016, the commission adopted two revisions to the Texas SIP for the HGB 2008 eight-hour ozone moderate nonattainment area: the HGB 2008 Eight-Hour Ozone Attainment Demonstration SIP Revision (Non-Rule Project No. 2016-016-SIP-NR) and the HGB 2008 Eight-Hour Ozone RFP SIP Revision (Non-Rule Project No. 2016-017-SIP-NR). These SIP revisions were adopted to meet federal obligations for the 2008 eight-hour ozone NAAQS for a moderate nonattainment area with a July 20, 2018 attainment deadline and a 2017 attainment year. The attainment demonstration SIP revision incorporated revisions to 30 TAC Chapter 115 to update reasonably available control technology for VOC storage tanks in the HGB area. The SIP and rule revisions were submitted to the EPA on December 29, 2016. On May 15, 2017, the EPA approved Section 4.9 of the attainment demonstration SIP revision that describes how FCAA requirements for vehicle inspection and maintenance, nonattainment new source review, and emission statements for large stationary point sources are met in the HGB area for the 2008 ozone NAAQS (82 FR 22291). On June 6, 2017, the EPA published its finding that the motor vehicle emissions budgets in the HGB RFP SIP revision are adequate and must be used for transportation conformity determinations in the HGB area (82 FR 26091). These budgets became effective June 21, 2017.

4.6 CONCLUSIONS
Texas has numerous control measures in place to address ozone precursor emissions that are federally enforceable through SIP revisions. These measures have resulted in significant decreases in eight-hour ozone design values in Texas. Any additional control strategies necessary to address requirements for the 2015 eight-hour ozone NAAQS will be evaluated when attainment demonstration and RFP SIP revisions are developed and implemented.
5.1 INTRODUCTION
The Federal Clean Air Act (FCAA), §110(a)(2)(D)(i)(II), requires states to submit a state implementation plan (SIP) revision that contains adequate provisions to prohibit any source or other type of emissions activity within the state from emitting any air pollutants in amounts that will interfere with measures required to meet an implementation plan for any other state related to prevention of significant deterioration (PSD) or interfere with measures required to meet the implementation plan for any other state related to regional haze and visibility. The following sections provide information on how Texas meets the requirements of FCAA, §110(a)(2)(D)(i)(II).

5.2 PSD
Texas has a SIP-approved PSD and nonattainment New Source Review (NSR) permitting program that contains requirements for sources of air pollutants to obtain an approved permit before beginning construction of a facility and before modifying an existing facility. The Texas Commission on Environmental Quality (TCEQ) has established rules governing the enforcement of control measures, including attainment plans and permitting programs that regulate construction and modification of stationary sources.

On January 6, 2014, the United States Environmental Protection Agency (EPA) published approval of Texas' public participation requirements for air quality permits (79 FR 551). On November 10, 2014, the EPA published partial approval of the October 2010 and April 2014 SIP submittals that revise Texas' PSD program to provide for the regulation of greenhouse gas (GHG) emissions and clarify the applicability of best available control technology for all PSD permit applications (79 FR 66626). The EPA also approved revisions to the NSR permitting program as consistent with federal requirements for PSD permitting of GHG emissions. Although the EPA originally disapproved the Texas infrastructure SIP for the 1997 eight-hour ozone, and for the 1997 and 2006 PM$_{2.5}$ National Ambient Air Quality Standards (NAAQS) for not containing provisions for the permitting of GHGs, on September 4, 2015 the EPA published a direct final rule in the Federal Register (FR) to correct the Code of Federal Regulations to reflect that Texas now has a SIP-approved GHG permitting program (80 FR 53467). The rule became effective November 3, 2015.

On June 12, 2015, in response to a petition for rulemaking from the Sierra Club, the EPA finalized a SIP call related to provisions in SIPs concerning how air agency rules in EPA-approved SIPs treat excess emissions during periods of startup, shutdown, and malfunction (SSM) of industrial source process or emission control equipment. Although not one of the states named in the Sierra Club’s petition, the EPA’s final rule included Texas. The State of Texas and the TCEQ disagree with the EPA that the TCEQ's
SIP-approved affirmative defense rule for certain excess emissions is substantially inadequate to meet FCAA requirements and are challenging the EPA’s SIP call.

The following chapters of 30 Texas Administrative Code (TAC) contain rules relevant for this federal requirement:

Chap. 35 Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions; Subchapters A, B, C, K

Chap. 39 Public Notice

Chap. 55 Requests for Reconsideration and Contested Case Hearings; Public Notice

Chap. 101 General Air Quality Rules

Chap. 106 Permits by Rule, Subchapter A, General Requirements

Chap. 112 Control of Air Pollution from Sulfur Compounds

Chap. 115 Control of Air Pollution from Volatile Organic Compounds

Chap. 116 Control of Air Pollution by Permits for New Construction or Modification

Chap. 117 Control of Air Pollution from Nitrogen Compounds

Texas has a robust, SIP-approved permitting program and therefore has met the infrastructure requirements of §110(a)(2)(D)(i)(II).

5.3 VISIBILITY TRANSPORT

On December 16, 2014, the EPA published a proposed rule to partially disapprove the Texas 2009 Regional Haze SIP revision and issue a federal implementation plan (FIP) (79 FR 74818). The EPA also proposed to approve the Texas Best Available Retrofit Technology (BART) rule for non-electric generating units (EGUs), and replace the TCEQ’s reliance on the Clean Air Interstate Rule (CAIR) with a FIP implementing the Cross-State Air Pollution Rule (CSAPR) in Texas for BART for EGUs. On January 5, 2016, the EPA partially approved (for non-EGU BART) and partially disapproved the Texas SIP and adopted a FIP for the reasonable progress goals and long-term strategy requirements that were disapproved. The EPA did not finalize the EGU BART portion of the proposal. On July 15, 2016, the 5th Circuit stayed EPA’s FIP of the Texas Regional Haze Rule.

Because of litigation since the 2009 Texas Regional Haze SIP submission, EGUs are no longer covered under CAIR or subsequent program provisions; and the EPA did not finalize the disapproval of Texas EGU BART on January 5, 2016. In accordance with a consent decree, the EPA published a proposed BART FIP on January 4, 2017 covering

42 The D.C. Circuit lifted the stay on CSAPR and the EPA began implementing the rule on January 1, 2015. However, on July 28, 2015 the D.C. Circuit ruled that the 2014 annual SO2 budgets and the 2014 ozone season NOx budgets for Texas were invalid because they required overcontrol of Texas emissions, and remanded these budgets back to the EPA without vacatur.
EGUs. The consent decree required the EPA to sign a final FIP in September 2017. On September 29, 2017, the EPA Administrator signed a FIP to address BART requirements for Texas EGUs, specifically with regard to nitrogen oxides (NOx), particulate matter (PM), and sulfur dioxide (SO2). The final rule was published in the *Federal Register* on October 17, 2017 (82 FR 48324). Additionally, on September 29, 2017, the EPA finalized a rule withdrawing Texas from the CSAPR Group 2 SO2 and Annual NOx Programs (82 FR 45481). The BART FIP relies on Texas’ participation in the CSAPR Ozone Season NOx Program to fulfill NOx BART. Because Texas is no longer participating in the CSAPR Group 2 SO2 Program, CSAPR cannot be relied upon to satisfy SO2 BART. Therefore, the FIP establishes an SO2 trading program that applies to select Texas EGUs. The EPA approved the TCEQ's PM screening for EGUs from the 2009 Texas Regional Haze SIP submittal, eliminating the need to require controls for PM BART. Additionally, the EPA disapproved portions of the Texas SIP with regard to interstate visibility transport for the following NAAQS: 1997 eight-hour ozone; 1997 PM2.5 (annual and 24-hour); 2006 PM2.5 (24-hour); 2008 eight-hour; 2010 one-hour nitrogen dioxide; and 2010 one-hour SO2. The EPA also made a finding that the BART alternatives adopted as the FIP meet the interstate visibility transport requirements for these NAAQS under FCAA §110(a)(2)(D)(i)(II).

Regional haze program requirements include progress reports due to the EPA every five years, to demonstrate progress toward the visibility goal. The 2014 Five-Year Regional Haze Progress Report SIP Revision was submitted to the EPA in March 2014. On January 10, 2017, the EPA published the final Regional Haze Rule Amendments (82 FR 3078) extending the SIP submittal deadline for the second planning period from July 31, 2018 to July 31, 2021 and adjusting the interim progress report submission deadline so that second progress reports would be due by January 31, 2025. The following SIP submittal would be due in 2028 and then every 10 years thereafter, through 2064.

The following chapter of 30 TAC contains rules relevant for this federal requirement:

- Chap. 101 General Air Quality Rules
- Chap. 122 Subchapter E, Division 2, Clean Air Interstate Rule
- Chap. 115 Control of Air Pollution from Volatile Organic Compounds
- Chap. 116 Control of Air Pollution by Permits for New Construction or Modification
- Chap. 117 Control of Air Pollution from Nitrogen Compounds

The modeling analysis in this SIP revision demonstrates that Texas does not contribute to nonattainment or interfere with maintenance in another state for the 2015 ozone NAAQS. The EPA has not established a separate visibility standard for ozone because ozone does not directly impair visibility or substantially produce or contribute to the production of the secondary air contaminants that cause visibility impairment or regional haze. Particulate matter, rather than ozone, is the pollutant primarily responsible for visibility impairment at Class I areas covered by the Regional Haze Rule. Emissions from Texas EGUs that potentially contribute to both ozone nonattainment and visibility impairment are already controlled under the ozone
NAAQS, BART under the Regional Haze Rule, and interstate transport obligations. Texas is also subject to the ozone season NOx budget under the CSAPR Update Rule for the 2008 ozone standard. Based on the finding that emissions from Texas do not interfere with measures to protect visibility in nearby states, Texas meets the visibility transport provision for six other NAAQS under the BART FIP (82 FR 48324). When considered alongside the modeling analysis in this SIP revision, and Texas' inclusion in the CSAPR Update Rule ozone season NOx trading program, it is concluded that Texas meets the visibility transport provision for the 2015 ozone NAAQS as well.
6.1 INTRODUCTION
The requirements of Federal Clean Air Act (FCAA), §110(a)(2)(D)(ii) are satisfied by demonstrating compliance with the applicable requirements of FCAA, §126(a), 126(b) and (c), and 115.

6.2 INTERSTATE POLLUTION ABATEMENT
6.2.1 Compliance with FCAA, §126(a)
Under section 126(a)(1) of the FCAA, a state implementation plan (SIP) must contain provisions requiring each new or modified major source required by FCAA title I part C to be subject to prevention of significant deterioration (PSD) permitting to notify neighboring air agencies of potential impacts from the source. Per guidance on development and submission of infrastructure SIPs issued by the United States Environmental Protection Agency (EPA) on September 13, 2013, the EPA considers the notification by the permitting authority to satisfy the requirement of FCAA, §126(a)(1)(A) that a new or modified major source subject to part C notify neighboring air agencies of its potential downwind impact. Texas has a SIP-approved PSD permitting program that contains requirements for the permitting authority to notify air agencies whose lands may be affected by emissions from that source.

6.2.2 Compliance with FCAA, §126(b) and (c)
The required content of an infrastructure SIP with respect to FCAA, §110(a)(2)(D)(ii) is affected by sections 126(b) and 126(c) of the FCAA only if: (1) the Administrator has, in response to a petition, made a finding under section 126(b) of the FCAA that emissions from a source or sources within the air agency’s jurisdiction emit prohibited amounts of air pollution relevant to the new or revised NAAQS for which the infrastructure SIP submission is being made; and (2) under section 126(c) of the FCAA, the Administrator has required the source or sources to cease construction, cease or reduce operations, or comply with emissions limitations and compliance schedule requirements for continued operation.

No source or sources within Texas are the subject of an active finding under section 126 of the FCAA with respect to the 2015 ozone NAAQS.

6.3 INTERNATIONAL AIR POLLUTION
6.3.1 Compliance with FCAA, §115
Section 115 of the FCAA authorizes the EPA Administrator to require a state to revise its SIP under certain conditions to alleviate international transport into another country. When acting on an infrastructure SIP submission for a new or revised NAAQS, the EPA will look to whether the Administrator has made a finding with respect to

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emissions of the particular NAAQS pollutant and its precursors, if applicable. There are no final findings under section 115 of the FCAA against the State of Texas with respect to the 2015 ozone NAAQS.
CHAPTER 7: CONCLUSIONS

Texas has numerous control measures in place to address ozone precursor emissions and these measures have resulted in significant decreases in eight-hour ozone design values in Texas. Statewide trend analysis of ozone precursor emissions from 2005 through 2014 shows a 17% reduction in volatile organic compounds and a 35% reduction in nitrogen oxides. These reductions have assisted the state in attaining both the one-hour and 1997 eight-hour ozone National Ambient Air Quality Standards (NAAQS) and are expected to help the state attain the 2008 and 2015 NAAQS in the future. Over the past 25 years, all areas in Texas have observed some decrease in eight-hour ozone design values with the greatest decreases observed in the Houston-Galveston-Brazoria and Beaumont-Port Arthur areas with decreases of 34% and 33% respectively.

The modeling analysis provided in this state implementation plan (SIP) revision demonstrates that Texas emissions do not contribute significantly to nonattainment or interfere with maintenance of the 2015 eight-hour ozone NAAQS at any downwind monitors in 2023. Factors such as design value trends, number of elevated ozone days, back trajectory analysis on elevated ozone days, modeled concentrations on future expected elevated ozone days, total interstate contributions at tagged monitors, and responsiveness of ozone to Texas emissions were examined for 16 monitors projected to be in nonattainment or projected to have maintenance issues in other states. Based on this modeling analysis, it is concluded that emissions from Texas do not contribute significantly to nonattainment or interfere with maintenance of the 2015 eight-hour ozone NAAQS in any other state.

Additionally, Texas has a robust, SIP-approved new source review permitting program and therefore has met the Federal Clean Air Act (FCAA) infrastructure requirements relating to prevention of significant deterioration (PSD). The Texas Commission on Environmental Quality has also determined that Texas meets the visibility transport provisions for the 2015 ozone NAAQS as the state is not contributing significantly to nonattainment or maintenance issues in any other state, the EPA has not established a separate visibility standard for ozone, Texas is subject to the ozone season NOx budget under the Cross-State Air Pollution Rule Update, and the EPA has made a finding that Texas meets the visibility transport provision for six other NAAQS under the Best Available Retrofit Technology FIP.

Finally, Texas meets the FCAA requirements related to interstate pollution abatement and international air pollution. Texas has a SIP-approved PSD permitting program that contains requirements for the permitting authority to notify air agencies whose lands may be affected by emissions from that source, no sources within Texas are the subject of an active finding under section 126 of the FCAA with respect to the 2015 ozone NAAQS, and there are no final findings under section 115 of the FCAA against the State of Texas with respect to the 2015 ozone NAAQS.

In conclusion, this SIP revision demonstrates that Texas meets the interstate transport requirements of FCAA, §110(a)(2)(D)(i)(I) as well as the requirements of FCAA, §110(a)(2)(D)(i)(II) for prevention of significant deterioration and visibility transport and the interstate pollution abatement and international air pollution requirements of FCAA, §110(a)(2)(D)(ii).
CHAPTER 8: FUTURE REVISIONS TO THE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Federal Clean Air Act (FCAA), §110(a)(1) requires states to submit state implementation plans within three years after the promulgation of new or revised NAAQS to meet the requirements of FCAA, §110(a)(2), including FCAA, §110(a)(2)(D), relating to interstate transport. Therefore, if the NAAQS are revised in the future, the Texas Commission on Environmental Quality will need to take the adequate steps relating to the interstate transport of air pollution.