Transportation Air Quality Conformity Report for the Houston-Galveston-Brazoria Region

For Amendments to the 2045 Regional Transportation Plan Update and to the 2025-2028 Transportation Improvement Program

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LIST OF ABBREVIATIONS

AADT	Average Annual Daily Traffic
ACS	American Community Survey
ANSWT	Average Non-summer Weekday Traffic
APU	Auxiliary Power Unit
ATR	Automated Traffic Recorder
AVFT	Alternate Vehicle Fuel Technology
BD	Biodiesel
BPR	Bureau of Public Roads
CAAA	Clean Air Act Amendments of 1990
CFR	Code of Federal Regulations
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CNG	Compressed Natural Gas
CO	Carbon Monoxide
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FR	Federal Register
FTA	Federal Transit Administration
FY	Fiscal Year
GVWR	Gross Vehicle Weight Rating
HBW	Home-Based Work Trips
HC	Hydrocarbon
H-GAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria
HPMS	Highway Performance Monitoring System
I/M	Inspection and Maintenance

LOS	Level of Service
MOSERS	Mobile Source Emission Reduction Strategies
MOVES	Motor Vehicle Emission Simulator
MPA	Metropolitan Planning Area
MPO	Metropolitan Planning Organization
MVEB	Motor Vehicle Emissions Budget
NAAQS	National Ambient Air Quality Standards
NOx	Nitrogen Oxides
OBD	Onboard Diagnostics
OD	Origin-Destination
ONI	Off-Network Idling
PACP	Pre-Analysis Consensus Plan
RIF	Road Idle Fraction
RFP	Reasonable Further Progress
RTP	Regional Transportation Plan
SHEI	Source Hours Extended Idling
SHI	Source Hours Idling
SHO	Source Hours Operating
SHP	Source Hours Parked
SIP	State Implementation Plan
SRF	Speed Reduction Factor
SUT	Source Use Type
TAZ	Traffic Analysis Zone
TCEQ	Texas Commission on Environmental Quality
TCM	Transportation Control Measure
TDM	Travel Demand Model
TERM	Transportation Emission Reduction Measure

TIF	Total Idle Fraction
TIP	Transportation Improvement Program
TMA	Transportation Management Area
TPC	Transportation Policy Council
TTI	Texas A&M Transportation Institute
TxDMV	Texas Department of Motor Vehicles
TxDOT	Texas Department of Transportation
USC	U.S. Code
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel
VOC	Volatile Organic Compound
VPGF	Vehicle Population Growth Factor

1. EXECUTIVE SUMMARY

1.1 Conformity Overview

The Clean Air Act Amendments of 1990 (CAAA) require transportation plans, programs, and projects in nonattainment and maintenance areas, funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA), to conform to the motor vehicle emissions budgets (MVEB) established in the state implementation plan (SIP) and deemed adequate or approved by the U.S. Environmental Protection Agency (EPA). Nonattainment areas with no MVEBs must demonstrate conformity by satisfying interim emissions tests. Satisfying MVEBs or interim emissions tests ensure that transportation plans, programs, and projects do not produce new air quality violations, worsen existing violations, or delay the timely attainment of National Ambient Air Quality Standards (NAAQS). Section 176(c)(4) of the CAAA requires metropolitan planning organizations (MPO), for areas designated as nonattainment and/or maintenance for a NAAQS, to conduct an air quality conformity analysis to demonstrate that regional transportation plans (RTP) and transportation improvement programs (TIP) are consistent with the region's air quality goals.

This conformity analysis requires MVEB tests that must demonstrate that the total emissions for the nonattainment or maintenance area are less than or equal to the applicable SIP MVEBs, which establish emissions ceilings for the regional transportation network.

As the Houston-Galveston-Brazoria (HGB) regional MPO, the Houston-Galveston Area Council (H-GAC) is responsible for conducting the air quality conformity analysis to address the severe designation for the 2008 8-hour ozone standard and the serious designation for the 2015 8-hour ozone standard.

1.2 Air Quality and Nonattainment Area

1.2.1 Air Pollution

Pollutants addressed in this conformity analysis include the following:

> **Precursors to ozone:** Volatile organic compounds (VOC) and nitrogen oxides (NOx): "Ground-level ozone is a colorless compound formed when NOx and VOC chemically react in the presence of sunlight. It is not directly emitted into the air. Ground level ozone is known to trigger a variety of health problems and is particularly harmful to children, older adults, and people of all ages who have lung diseases, such as asthma[1]".

1.2.2 Nonattainment Area

Figure 1-1 shows the H-GAC boundary map along with boundaries for the severe designation for the 2008 8-hour ozone standard and the serious designation for the 2015 8-hour ozone standard.

[1] https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics

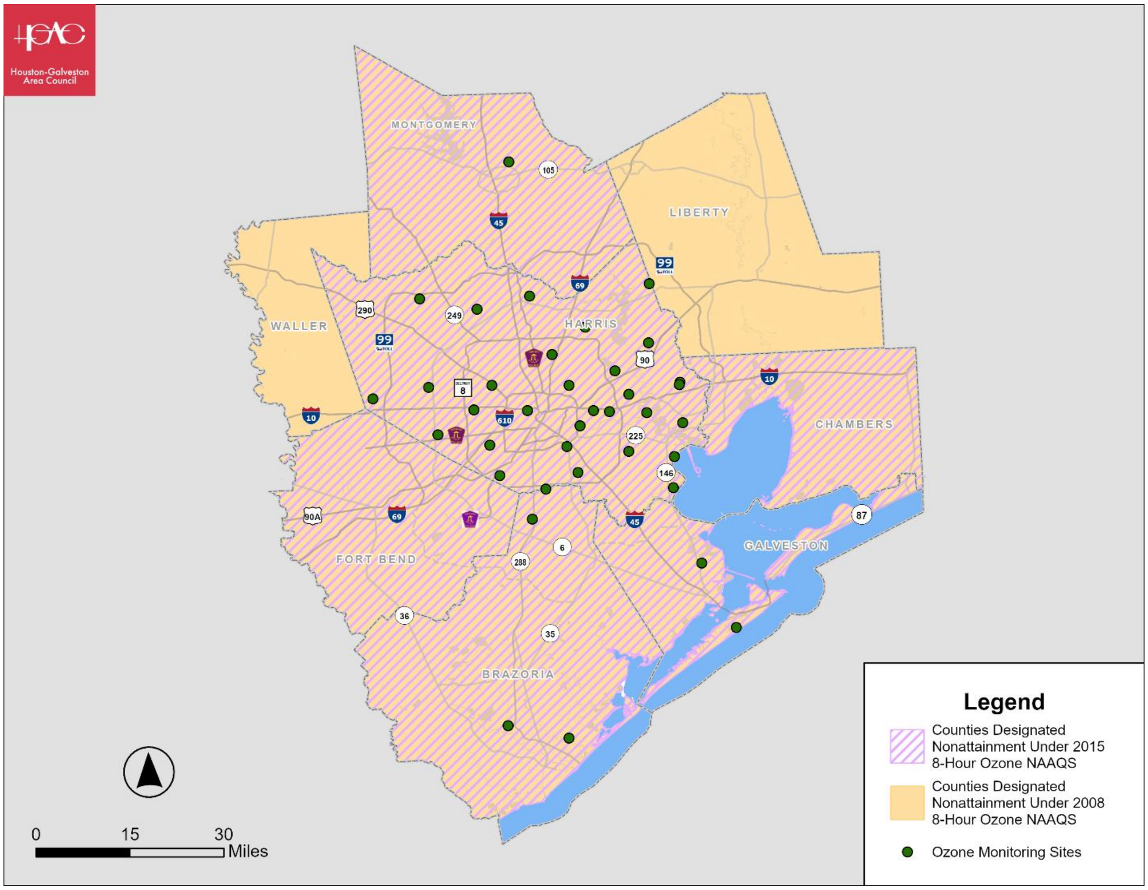

Figure 1-1. HGB Nonattainment and Maintenance Boundaries

2008 8-Hour Ozone Standard Designations: Severe nonattainment, effective November 7, 2022 (87 FR 60926). On March 27, 2008, the EPA lowered the primary and secondary 8-hour ozone NAAQS to 0.075 ppm (73 FR 16436). An eight-county HGB area including Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties was designated nonattainment and classified marginal under the 2008 8-hour ozone NAAQS, effective July 20, 2012. The HGB area includes the same eight counties that were designated nonattainment under the 1997 8-hour ozone standard. The attainment deadline for the HGB marginal nonattainment area was July 20, 2015. On May 4, 2016, the EPA published a final rule in the Federal Register (FR) granting a one-year extension to the attainment deadline for the HGB 2008 8-hour ozone marginal nonattainment area to July 20, 2016 (81 FR 26697). Because the HGB area's 2015 design value exceeded the 2008 8-hour ozone NAAQS, the EPA published a final determination of nonattainment and reclassification of the HGB 2008 8-hour ozone nonattainment area from marginal to moderate nonattainment on December 14, 2016, effective on the same date (81 FR 90207). The attainment deadline for the HGB moderate nonattainment area was July 20, 2018. On August 23, 2019, the EPA reclassified the eight-county HGB area from moderate to serious nonattainment. The attainment date for serious nonattainment areas was July 20, 2021, with a 2020 attainment year. On October 7, 2022, the EPA reclassified the eight-county HGB area from serious to severe nonattainment. The attainment date for severe nonattainment areas is July 20, 2027, with a 2026 attainment year.

2015 8-Hour Ozone Standard Designations: Serious nonattainment, effective July 22, 2024 (89 FR 51829). On October 1, 2015, the EPA lowered the primary and secondary 8-hour ozone NAAQS to 0.070 parts per million (ppm) (80 FR 65292). A six-county HGB area including Brazoria, Chambers, Fort Bend, Galveston, Harris, and Montgomery Counties was designated nonattainment and classified marginal under the 2015 8-hour ozone NAAQS, effective August 3, 2018. The HGB nonattainment area includes six of the eight counties that were designated nonattainment under the 2008 8-hour ozone standard but does not include Liberty or Waller Counties, which were designated attainment/unclassifiable. The attainment date for the HGB marginal nonattainment area was August 3, 2021, with a 2020 attainment year. On October 7, 2022, the EPA reclassified the six-county HGB area from marginal to moderate nonattainment, effective November 7, 2022 (87 FR 60897). The attainment date for the HGB moderate nonattainment area was August 3, 2024, with a 2023 attainment year. On June 20, 2024, the EPA reclassified the six-county HGB area from moderate to serious nonattainment, effective July 22, 2024 (89 FR 51829). The attainment date for serious nonattainment areas is August 3, 2027, with a 2026 attainment year.

1.3 Amendments to the RTP and to the TIP

This conformity determination is being prepared to ensure that the amendments to the 2045 RTP Update and to the 2025-2028 TIP meet the conformity-related requirements of the CAAA, SIP, and final conformity rule (Title 40 of the Code of Federal Regulations [CFR], Parts 51 and 93).

Per 23 CFR 450.324, all projects are constrained by the financial resources estimated to be reasonably available within the transportation plan time frame. A list of the projects in the 2045 RTP Update and 2025-2028 TIP that affect this conformity analysis is included in Appendix B—RTP/TIP of this conformity report.

1.4 Analysis

This emissions analysis for determining conformity was performed under 40 CFR 93.109(c)(2)(ii)(B): The analysis years for this conformity are 2023 (the base year for the amendments to the 2045 RTP Update), 2026 (the attainment year for the severe 2008 8-hour standard and the serious 2015 8-hour standard), 2030, 2040, and 2045 (the RTP horizon year).

EPA is reviewing the 2023 and 2026 Reasonable Further Progress (RFP) MVEBs for the Severe 2008 ozone SIP submitted by the Texas Commission on Environmental Quality (TCEQ) on May 7th, 2024. Although EPA has not yet found adequate/approved these MVEBs, they will be addressed in this conformity as a contingency should EPA find adequate/approve these MVEBs within the timeframe of this conformity process.

1.5 FINDINGS

The NOx and VOC vehicle summer weekday results shown in Tables 1-1a and 1-1b below demonstrate that the HGB nonattainment region meets the regional air quality conformity requirements for the 2008 8-hour ozone severe and the 2015 8-hour ozone serious designations.

Table 1-1a. HGB Conformity Analysis Results for Approved 2020 RFP MVEBs[1]

Analysis Year	Total Vehicle Miles of Travel (VMT) (miles)	NOx Budget (tons/day)	NOx Emissions (tons/day)	VOC Budget (tons/day)	VOC Emissions (tons/day)
2023	195,013,204	87.69	62.07	57.70	35.42
2026	205,429,415	87.69	49.60	57.70	29.89
2030	221,533,727	87.69	42.36	57.70	25.91
2040	261,440,802	87.69	41.41	57.70	22.68
2045	280,966,835	87.69	43.86	57.70	22.80

Table 1-1b. HGB Conformity Analysis Results for the Proposed 2023 & 2026 RFP MVEBs[2,3]

Analysis Year	Total VMT (miles)	NOx Budget (tons/day)	NOx Emissions (tons/day)	VOC Budget (tons/day)	VOC Emissions (tons/day)
2023	195,013,204	67.77	62.07	37.27	35.42
2026	205,429,415	56.12	49.60	31.88	29.89
2030	221,533,727	56.12	42.36	31.88	25.91
2040	261,440,802	56.12	41.41	31.88	22.68
2045	280,966,835	56.12	43.86	31.88	22.80

The results of the conformity determination demonstrate that the amendments to the 2045 RTP Update and to the 2025-2028 TIP meet the requirements of the air quality SIP for the HGB nonattainment area per the CAAA (Title 42 U.S. Code [USC], Parts 7504, 7506 [c], and 7506 [d]), as amended on November 15, 1990, and the final conformity rule (40 CFR 51 and 93).

[1] The MVEBs for NOx and VOC are applicable under the 2020 HGB Serious Classification RFP SIP Revision for the 2008 8-hour Ozone NAAQS unless or until the HGB Severe Area RFP SIP Revision for the 2008 8-hour Ozone NAAQS has been approved.
[2] EPA is reviewing the 2023 and 2026 RFP MVEBs submitted by the TCEQ in the HGB Severe Area RFP SIP Revision for the 2008 8-hour Ozone NAAQS on May 7th, 2024. Although EPA has not yet found adequate/approved these MVEBs, they will be addressed in this conformity as a contingency should EPA find adequate/approve these MVEBs within the timeframe of this conformity process.
[3] Attainment year is 2026.

2. TRANSPORTATION CONFORMITY REQUIREMENTS

2.1 What Is Transportation Conformity?

As mandated under the Clean Air Act Amendments of 1990 (CAAA) Section 176(c), transportation conformity ensures that federally supported transportation activities align with and conform to the objectives outlined in a state implementation plan (SIP). A SIP serves as the state air quality blueprint for meeting the National Ambient Air Quality Standards (NAAQS). The SIP consists of a compilation of legally enforceable rules and regulations crafted by a state or local air quality agency. The governor of the state submits this plan to the U.S. Environmental Protection Agency (EPA) for approval. The primary goal of a SIP is to enhance air quality by achieving, progressing toward, or maintaining compliance with the NAAQS. Each SIP specifies emissions reductions for every pollutant or precursor, categorized by source type, including on-road motor vehicles, non-road equipment and vehicles, stationary sources, and area sources.

Before a regional transportation plan (RTP) or transportation improvement program (TIP) can be adopted, approved, or accepted in nonattainment areas, metropolitan planning organizations (MPO) and the U.S. Department of Transportation must make conformity determinations on these documents. As described in Section 176(c)(1) of the CAAA, transportation conformity is granted when the following conditions are met:

(A) Conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards.

(B) That such activities will not:
   i. Cause or contribute to any new violation of any standards in any area;
   ii. Increase the frequency or severity of any existing violation of any standard in any area; or
   iii. Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

A new conformity determination must be performed any time an RTP is amended in a significant manner, when a region or state's air quality goals change, and/or every four years.

2.2 Conformity Requirements

The CAAA requires transportation plans, programs, and projects in nonattainment and maintenance areas, which are funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA), to conform to the motor vehicle emissions budgets (MVEB) established in the SIP, or to satisfy applicable interim emissions tests, absent MVEBs. A regional emissions analysis is the key analytic component of the transportation conformity process. It is conducted to demonstrate that:

- Regional emissions from on-road sources are beneath the established MVEBs or satisfy interim emissions test(s), absent an MVEB.

- Regional emissions from on-road sources do not cause or contribute to violations of EPA's NAAQS.
- Transportation activities are consistent with air quality goals identified in the SIP.

As stipulated by the CAAA, requirements for conformity analysis include:

- Use of the latest planning assumptions (Title 40 of the Code of Federal Regulations [CFR], Part 83, Section 110).
- Analysis based on the latest emission estimation model available (40 CFR 93.111).
- Interagency consultation and a public involvement process, which must be conducted during the analysis (40 CFR 93.112).
- Timely implementation of transportation control measures (TCM) (40 CFR 93.113).
- A transportation plan and TIP that are consistent with the MVEBs established in the applicable SIP (if there is an adequate or approved SIP budget) (40 CFR 93.118).
- Inclusion of all regionally significant projects expected in the nonattainment and maintenance area in the transportation plan and/or TIP (40 CFR 93.114 and 93.115).

The determination of the analysis is a two-step process in metropolitan areas. The first step is for the MPO to make the initial transportation conformity determination at the local level. For the Houston-Galveston-Brazoria (HGB) region, the Houston-Galveston Area Council (H-GAC) Transportation Policy Council (TPC) makes this decision. The second step is for FHWA and FTA to make a joint transportation conformity determination at the federal level. Upon federal approval, a four-year window begins during which projects, programs, and policies identified in the RTP and TIP may move toward implementation.

2.3 Emissions Analysis

A regional emissions analysis is the key analytic component of the transportation conformity process. The emissions analysis is conducted to demonstrate that:

- Regional emissions from on-road sources are beneath the established MVEBs (or, if no MVEB exists for the area, analysis-year build emissions are beneath analysis-year no-build emissions and/or are beneath baseline-year emissions).
- Regional emissions from on-road sources do not cause or contribute to violations of the EPA NAAQS.
- Transportation activities are consistent with air quality goals identified in the SIP.

2.3.1 Regional Inventory

This conformity analysis of the HGB nonattainment area accounts for emissions resulting from amendments to the nonattainment area's 2045 RTP Update and to the 2025-2028 TIP, which includes all regionally significant projects located within the HGB nonattainment area, and the effects of emission control programs adopted by an enforcing jurisdiction.

2.3.2 Emissions Tests

Conformity determinations must demonstrate consistency between expected emissions from implementing the RTP and TIP with the MVEBs in the applicable implementation plan.

This conformity analysis requires MVEB tests that must demonstrate that the total emissions for the nonattainment or maintenance area is less than or equal to the applicable SIP MVEBs, which establishes emissions ceilings for the regional transportation network.

As the HGB nonattainment area's MPO, the H-GAC is responsible for conducting the air quality conformity analysis to address the 2008 8-hour ozone Standard severe designation and the 2015 8-hour ozone Standard serious designation. The MVEBs for the HGB region are summarized in Table 2-1a and 2-1b.

Table 2-1a. NAAQS and Approved 2020 Reasonable Further Progress (RFP) MVEBs[1]

NAAQS	Years	Pollutant	MVEB (tons/day)
2008 Serious 8-hour ozone	2023, 2026, 2030, 2040, 2045	Volatile Organic Compounds (VOC)	57.70
2008 Serious 8-hour ozone	2023, 2026, 2030, 2040, 2045	Nitrogen Oxides (NOx)	87.69

Table 2-1b. NAAQS and Proposed 2023 & 2026 RFP MVEBs[2,3]

NAAQS	Years	Pollutant	MVEB (tons/day)
2008 Severe 8-hour ozone	2023	VOC	37.27
2008 Severe 8-hour ozone	2026, 2030, 2040, 2045	VOC	31.88
2008 Severe 8-hour ozone	2023	NOx	67.77
2008 Severe 8-hour ozone	2026, 2030, 2040, 2045	NOx	56.12

[1] The MVEBs for NOx and VOC are applicable under the 2020 HGB Serious Classification RFP SIP Revision for the 2008 8-hour Ozone NAAQS unless or until the HGB Severe Area RFP SIP Revision for the 2008 8-hour Ozone NAAQS has been approved.

[2] EPA is reviewing the 2023 and 2026 RFP MVEBs submitted by the TCEQ in the HGB Severe Area RFP SIP Revision for the 2008 8-hour Ozone NAAQS on May 7th, 2024. Although EPA has not yet found adequate/approved these MVEBs, they will be addressed in this conformity as a contingency should EPA find adequate/approve these MVEBs within the timeframe of this conformity process.

[3] Attainment year is 2026.

2.3.3 Analysis Years

According to the conformity rule (40 CFR 93.106), the choice of analysis years for the budget test is subject to the following restrictions:

- Analysis years may be no more than 10 years apart;
- The first analysis year may be no more than 10 years from the base year used to validate the travel demand model (TDM);
- The attainment year must be an analysis year if it is in the timeframe of the transportation plan and conformity determination; and
- The last year of the transportation plan forecast period.

Table 2-2 shows the conformity analysis years and describes their corresponding requirements for calculations.

Table 2-2. Conformity Analysis Years

Requirements	Years
RTP Update Base Year	2023
Attainment Year	2026
Intermediate Analysis Years	2030 and 2040
RTP Horizon Year	2045

2.4 CHECKLIST

Table 2-3 shows the checklist detailing information relevant to this conformity document.

Table 2-3. Checklist of Items Required in This Conformity Review

Item	Regulation Referenced	Item Format	Location within Report
2045 RTP Update	40 CFR Part 93 Subpart A	Independent self-supporting document (electronic file)	Appendix B.1 RTP Project Listings
2025-2028 TIP	40 CFR Part 93 Subpart A	Independent self-supporting document (electronic file)	Appendix B.2 2025-2028 TIP
Transportation Air Quality Conformity Report for the Houston-Brazoria-Galveston Region for Amendments to the 2045 RTP Update and to the 2025-2028 TIP	40 CFR Part 93 Subpart A	Independent self-supporting document (electronic file)	Conformity Determination
Description of version of Motor Vehicle Emission Simulator (MOVES) model being used	40 CFR 93.111	Discussion contained in conformity document	Section 5.1

Item	Regulation Referenced	Item Format	Location within Report
MOVES input and output files		Electronic (ASCII or txt file format)	Appendix D.1 MOVES Input and Output
MOVES emission factors		Electronic (ASCII or txt file format)	Appendix D.2 MOVES Emission Factors
MOVES activity		Electronic (ASCII or txt file format)	Appendix D.3 Activities
MOVES external reference files		Electronic (ASCII or txt file format)	Appendix D.1 MOVES Input and Output
MOVES utilities		Electronic (ASCII or txt file format)	Appendix D.4 Emissions Modeling Utilities
Highway Performance Monitoring System (HPMS) adjustment(s), factors, and approach	40 CFR 93.122(b)(3)	Discussion contained in conformity document	Section 4.4
Description of TDM validation, including validation year	40 CFR 93.106(a)(1)(ii)	Discussion contained in conformity document	Section 4.1 & Appendix C.1 Travel Model Validation
VMT		Electronic file	Appendix D.5 VMT, Speed, and Emissions Summaries
Average loaded speeds		Electronic file	Section 4.6.3
Centerline mile summaries for each analysis year		Electronic file	Appendix C.2 Links, Miles, Centerline, and Lane Miles Summaries
Definition of regionally significant roadway system		Discussion contained in conformity document	Section 3.3
Network link listing for each analysis year		Discussion contained in conformity document (electronic file) (electronic files should include TransCAD files, SHAPE files, and spreadsheet files)	Section 4.5 & Appendix C.3 Link Listing and Capacity Staging

Item	Regulation Referenced	Item Format	Location within Report
Files containing hourly distribution by county, roadway type, and vehicle type for VMT, vehicle hours, average operational speed, vehicle population, NO_x emissions, and VOC emissions		Electronic files in tab-delimited summary tables	Appendix D.5 VMT, Speed, and Emissions Summaries
TCMs in SIP, including emission reductions, methodologies, implementation dates, etc.		Electronic file	Section 6.2.2.1
Timely implementation of TCMs	40 CFR 93.113	Discussion contained in conformity document	Section 6.2.2.1
Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects containing emission benefits, methodologies, and implementation dates		Identified in TIP: independent self-supporting document (electronic file)	Appendix B.2 2025-2028 TIP
Roadway system (capacity staging)		Electronic file	Appendix C.2 Links, Miles, Centerline, and Lane Miles Summaries
List of non-federal projects	In response to March 2, 1999, court ruling	Electronic file	Appendix B—RTP/TIP
List of exempt projects	40 CFR 93.105(c) 40 CFR 93.126 40 CFR 93.127 40 CFR 93.128	Electronic file	Appendix B.1 RTP Project Listings
Evidence of fiscal constraint	40 CFR 93.108	Electronic file	Appendix B.2 2025-2028 TIP Appendix B.4 Fiscal Constraint
Evidence of RTP specifically describing the transportation system envisioned for each analysis year	40 CFR 93.106(a)	Electronic file	Appendix B—RTP/TIP
Evidence of public participation and response to comments	40 CFR 93.105	Electronic file	Appendix G.1 Meeting Information
Endorsements and/or resolutions		Electronic file	Appendix A—Resolution of Adoption
Memorandum of agreements		Electronic file	Appendix A—Resolution of Adoption
Applicable *Federal Register* (FR) notices and related documents		Discussion contained in conformity document	Throughout the conformity document and appendices

Item	Regulation Referenced	Item Format	Location within Report
Interagency consultation		Electronic file	Appendix F—Interagency Consultation Process

3. RTP AND TIP

3.1 AMENDMENTS TO THE 2045 RTP UPDATE AND TO THE 2025-2028 TIP

3.1.1 Overview

H-GAC serves eight counties in the HGB metropolitan area. This region includes the 2008 8-hour ozone eight-county nonattainment area and the 2015 8-hour ozone six-county nonattainment area, which covers Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties and Brazoria, Chambers, Fort Bend, Galveston, Harris, and Montgomery Counties, respectively.

On October 24, 2025, the amendments to the 2045 RTP Update and to the 2025-2028 TIP were considered for approval by the H-GAC TPC. The 2045 RTP Update covers a planning period of 2023 through 2045 and contains a list of projects fiscally constrained by estimates of reasonably available revenues. This update reflects the priorities for transportation investments within the H-GAC metropolitan planning area (MPA). A complete listing of fiscally constrained projects, as proposed under this conformity determination, is provided in Appendix B.1 RTP Project Listings. This listing denotes projects that are regionally significant or otherwise subject to transportation conformity and those projects that are exempt from transportation conformity, are exempt from regional emissions analysis, or have been determined to be not regionally significant.

3.1.2 Submittal Frequency

Consistent with the requirements of Title 23 U.S. Code (USC), Part 134, the transportation plan and/or TIP are required to be updated every four years. Given the HGB region's severe nonattainment status for the 2008 8-hour ozone standard and its serious nonattainment status for the 2015 8-hour ozone standard, amendments to the 2045 RTP Update and to the 2025-2028 TIP must demonstrate conformity to the most recently approved SIP MVEBs. If more than four years elapses after DOT's transportation conformity determination for a plan update, a 12-month grace period shall be in force. At the end of this 12-month grace period, DOT's existing transportation conformity determination will lapse.

A conformity determination for a transportation plan must be based on the transportation plan and all amendments. According to 40 CFR 93.104, each new transportation plan and/or TIP update or amendment must be demonstrated to conform before amendments are approved by the H-GAC TPC or accepted by DOT unless the amendment merely adds or deletes exempt projects listed in 40 CFR 93.126, 93.127, or 93.128.

According to 42 USC 7506 I(2)(E), the MPO must redetermine the conformity of existing transportation plans and programs not later than two years after the date on which the administrator:

i. Finds a motor vehicle emissions budget to be adequate per 40 CFR 93.118(e)(4) (as in effect on October 1, 2004);

ii. Approves an implementation plan that establishes a motor vehicle emissions budget if that budget has not yet been determined to be adequate per clause (i); or
iii. Promulgates an implementation plan that establishes or revises a MVEB.

3.1.3 Fiscal Constraints

All transportation plans prepared by the MPO are required to be fiscally constrained. Fiscal constraint is demonstrated by a financial plan that outlines reasonably available future revenues to implement the projects listed in the transportation plan. The constraints are:

- **Long-range financial constraint:** The transportation plan's financial element must identify all sources of funds reasonably expected to be available and any innovative financial strategies that may be necessary to implement the transportation plans. The 2045 RTP Update estimates $141 billion of revenue to be reasonably available to implement the recommendations. The 2045 RTP Update's total expenditure is estimated to be approximately $131 billion.
- **Short-range financial constraint:** Financial constraint is also required for a conforming TIP, with funds programmed being equal to the total funds available. The TIP comprises the first four years of transportation activities in the transportation plan. Short-range financial constraint is demonstrated by a financial plan that identifies all the reasonably available future revenues for programming. Chapter 2 of the Fiscal Year (FY) 2025-2028 TIP outlines the financial plan utilized to implement the projects programmed through the FY 2025-2028 TIP. All costs for projects in the FY 2025-2028 TIP were counted in the $131 billion total expenditures for the 2045 RTP Update amendment.

3.2 Regionally Significant Travel Projects/Programs

Per 40 CFR 93.101, regionally significant projects are transportation projects (other than an exempt project) that are on a facility that serves regional transportation needs (e.g., access to and from the area outside of the region; major activity centers in the region; major planned developments such as new retail malls, sports complexes, etc.; or transportation terminals and most terminals themselves). Regionally significant projects would normally be included in the modeling of a metropolitan area's transportation network, including at a minimum all principal arterial highways and all fixed guideway transit facilities that offer an alternative to regional highway travel.

Regionally significant roadways include:

- All freeways, tollways, and other highways classified as principal arterial or higher; and
- Selected highways as identified in Figure 3-1, currently designated as minor arterials that serve significant interregional and intraregional travel and connect rural population centers not already served by a principal arterial or connect with intermodal transportation terminals not already served by a principal arterial.

Non-exempt projects on regionally significant roadways will be treated as Regionally Significant Roadway Projects if they:

i. Provide additional through traffic lanes greater than one mile in length.
ii. Construct a bypass to a principal arterial/interstate along a new alignment.
iii. Add or extend freeway auxiliary/weaving lanes from one interchange to a point beyond the next interchange.
iv. Construct a new interchange that provides access from or allows movement between facilities that was not previously possible; and/or
v. Remove an existing interchange and result in the elimination of access from or movement between facilities which previously existed.

Figure 3-1 shows roadway systems that meet the definition of regionally significant. These roads are subjected to transportation and project-level determinations.

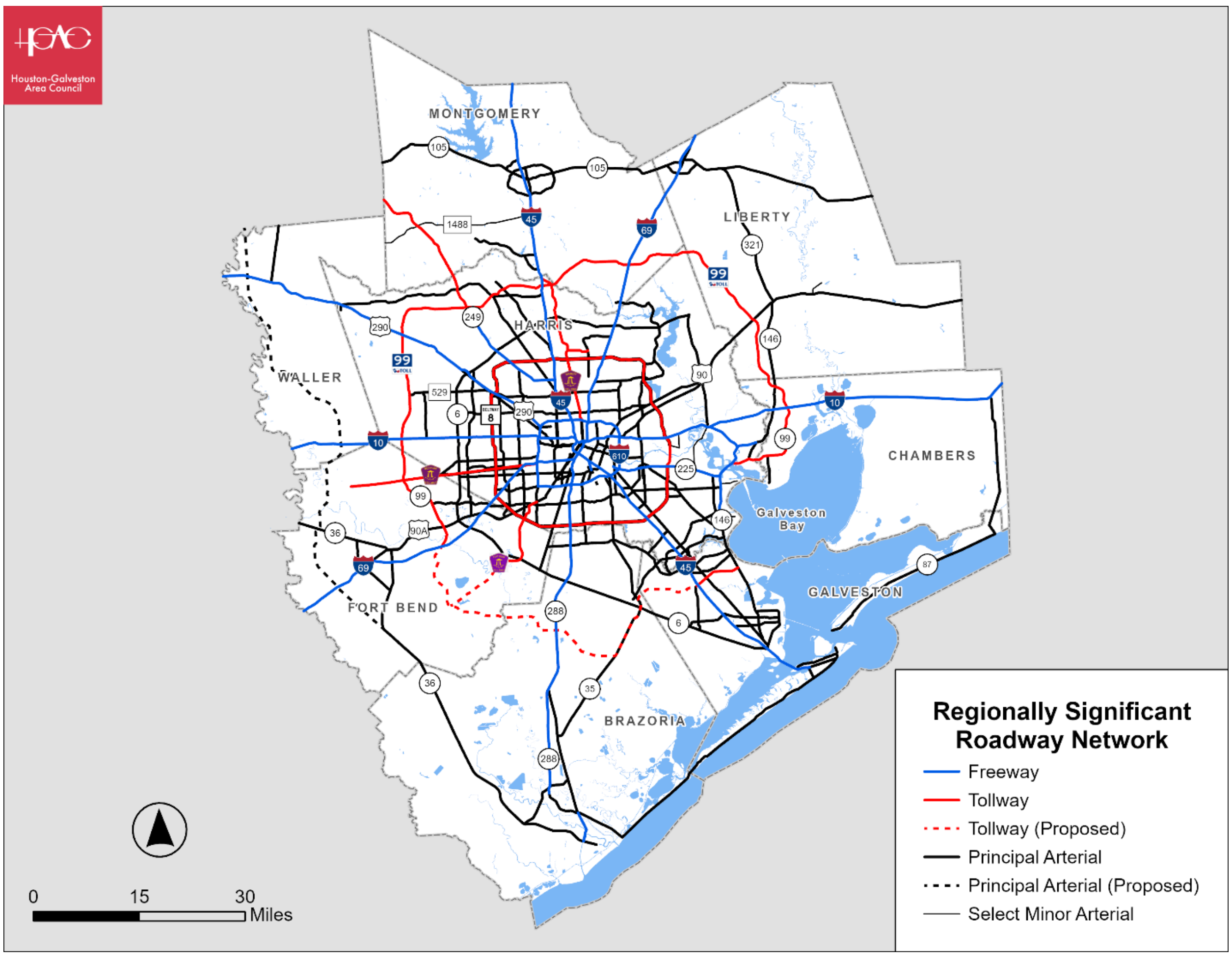

Figure 3-1. Regionally Significant Roads in the MPO MPA

3.3 OTHER PROJECTS/PROGRAMS

3.3.1 Non-Federal Projects/Programs

Non-federal projects funded by sources such as local governments and local transportation authorities, such as signal improvements, intersection improvements, and local roadway widening, may be of insufficient scale or scope to require inclusion within a transportation conformity regional emissions analysis. These non-regionally significant projects that do not require any federal project approval actions (e.g., environmental clearance or permit approvals) are not individually listed within the transportation plan and/or TIP.

3.3.2 Exempt Projects/Programs

The regulation 40 CFR 93.126 identifies several project types that are exempt from the requirement of a conformity determination. When a conforming transportation plan or TIP is revised to add or remove an exempt project, a new conformity determination is not required. Some of the exempt projects listed under 40 CFR 93.126 include the continuation of ridesharing and vanpooling promotion activities at current levels, bicycle and pedestrian facilities, railroad/highway crossings, fencing, shoulder improvements, the purchase of replacement transit vehicles, and road landscaping.

Additionally, 40 CFR 93.127 identifies project types that are exempt from a regional emissions analysis but may still require project-level conformity. These include intersection channelization projects, intersection signalization projects at individual intersections, interchange reconfiguration projects, changes in vertical and horizontal alignment, truck size and weight inspection stations, and bus terminals and transfer points.

Finally, 40 CFR 93.128 exempts traffic signal synchronization projects; however, regionally significant traffic signal synchronization projects must be included in subsequent regional emissions analyses.

4. VEHICLE ACTIVITY ESTIMATION

4.1 OVERVIEW OF THE TRAVEL MODEL

The H-GAC TDM serves as the source for forecasting VMT and other travel characteristics for Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. The TDM is executed in the Cube Voyager environment and has a TDM validation year of 2016. The model base year is 2023 and the forecasted years are 2026, 2030, 2040, and 2045. The trip characteristics forecasted include the number of trips, trip origins-destinations (OD), and travel mode. The model assigns all vehicle trips to the roadway network and produces VMT at the link level. The assigned roadway network with forecasted VMT is then processed by the emissions model for mobile emission analysis, as discussed in Chapter 5.

4.2 TRANSPORTATION MODELING PROCESS

The forecasting technique is based on a four-step sequential process designed to model travel behavior and predict the level of travel demand at regional, sub-area, or small-area levels. These four steps are trip generation, trip distribution, mode choice, and roadway assignment.

4.2.1 Trip Generation Model

The basic geographic unit for the TDM is the traffic analysis zone (TAZ). Trip generation was performed using a trip production model and a trip attraction model for each trip purpose. The travel model covers 8,750 square miles and eight counties (including Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller), and contains 5,263 TAZs, of which 5,217 are internal zones and 46 are external zones or stations.

For this conformity analysis, the defined base year for the forecast is 2023 The demographic estimates and forecasts were developed by an in-house population and household micro-simulation model that evolves population and households' overtime by applying fertility, survival, in-migration, out-migration, marriage and divorce rates. The model forecasts population and household control totals for the region.

The base-year data for the model is constructed from the block-level 2010 Census data (SF1 tables). The data sources utilized in the model include: 2010 Decennial Census, 2005 to 2016 American Community Survey (ACS) Public Use Microdata Sample, Texas State Data Center fertility and survival rates, and ACS five-years estimates 2013 to 2017.

The base year demographic is fed into an in-house demographic evolution model to simulate future population mix. H-GAC then applies the historic labor force participation rates and unemployment rates to the forecasted population control totals to forecast employment control totals for the region.

H-GAC uses Infogroup (now called Data Axle) to assign jobs to individual buildings in the TDM validation year 2016. Data Axle provides business-level data, including physical location, employee counts, and industry codes. Using parcel addresses, we match businesses to buildings and allocate base-year jobs accordingly. In contrast, Woods & Poole, Inc. provides county-level population and employment forecasts. H-GAC takes Woods & Poole's industry-level projections, calculates their shares, and applies them to H-GAC's base-year industry employment control totals to generate future industry-level employment projections.

H-GAC uses an in-house parcel-level land use micro-simulation model to forecast the location of future residential and non-residential spaces. The model then allocates future households and jobs to the new/vacant residential units and commercial space, respectively. The base year population and jobs are allocated to individual buildings and parcels collected from county appraisal districts throughout the eight-county H-GAC Transportation Management Area (TMA): Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties.

H-GAC periodically updates its Regional Growth Forecast, which projects population, employment, and land use trends across the TMA. Each forecast update integrates the latest data on planned developments, population and employment trends, economic conditions, regional travel networks, and user feedback.

The forecast is developed in phases:

1. Estimating the total population and number of households in the region.
2. Forecasting the number of jobs based on the future labor force.
3. Predicting the location, type, and scale of residential and non-residential developments needed to support projected household and job growth.

Allocating expected household and job growth across different areas, ensuring every household has a housing unit and every job has a designated work site.

4.2.2 Trip Distribution Model

The trip distribution model determines the interaction between each zone within the study area. The model connects trip ends estimated in the trip generation model, creating origin-destination (OD) TAZ pairs and resulting in OD trip tables. This step is performed using the disaggregated trip distribution model, or atomistic model, a gravity-analogy-based model.

Trips were allocated based on connecting trip ends estimated in the trip generation model, creating OD TAZ pairs and resulting in OD trip tables. The atomistic model considers the effects of impedance and accessibility of potential zonal destinations by assigning the number of trips produced from one originating TAZ to each destination TAZ. Then, a reasonableness check was performed to ensure that the modeled trip information was consistent with household survey observed trips.

4.2.3 Mode Choice Model

The mode choice model subsequently determines the mode of travel selected by travelers. This determination is performed using the time-of-day model. These decisions are based on the characteristics of:

- The trip maker (income and auto sufficiency).

- The trip (purpose, length, and orientation).
- The availability and utility of the competing transportation modes.

Table 4-1 shows the mode choices included.

Table 4-1. Mode Choices Modeled

Number	Mode Choice
1	Drive Alone Auto
2	Two-Person Auto
3	3+ Person Auto
4	Transit Walk Access
5	Transit Park-and-Ride Access
6	Transit Kiss-and-Ride Access

4.2.4 Roadway Assignment Model

The Roadway Assignment Model loads the travel demand (trips) to the roadway network, calculates delay for congested links, and reassigns as necessary to achieve network equilibrium. This step is performed using a Time-of-Day model. The time-of-day model distributes the daily auto travel demands into one of the four time-of-day periods. The four-time-of-day periods are AM Peak (6 am to 8:59 am), Mid-Day (9 am to 2:59 pm), PM Peak (3 pm to 6:59 pm), and Overnight period (7 pm to 5:59 am).

Using data from the 2007-2009 regional household travel survey, time-of-day (or diurnal) factors for each time-of-day periods were developed. These diurnal factors perform two functions: First, to factor the daily demand to the time period of interest, and second, impart the appropriate directionality of travel for time period of interest. The time-of-day models utilize these diurnal factors to produce the trip table inputs for the Roadway Assignment Model.

The Roadway Assignment Model consists of multi-class, generalized-cost, user equilibrium assignments for each of the four time periods defined above. The travel time is calculated using the assigned route’s volume-capacity ratio and distance. The user equilibrium applies an iterative process to achieve a convergent solution in which no travelers can improve their path by shifting routes, otherwise known as user-optimized equilibrium.

The toll demands are estimated through the generalized cost method which makes use of values-of-time that are segmented by trip purpose, income, and mode. Tolls are converted into travel time equivalent according to values-of-time. In this way, toll demands may be responsive not only to the time-of-day, but also to a trip’s purpose and occupancy (e.g., Single Occupancy Vehicle or High-Occupancy Vehicle).

The Roadway Assignment Model performs the vehicle assignment for each time-of-day period independently, using the trip tables produced in the Time-of-Day model. The daily demand is the sum of the four-time-of-day assignment results.

The roadway assignment is validated using the year 2016 annual traffic counts collected by the Texas Department of Transportation (TxDOT).

Iterative Feedback

The model uses two measures of zonal impedance in the distribution of trip ends. A set of assumed zonal impedances were used in trip distribution and mode choice models, and another set of zonal impedances were calculated upon the assigned volumes. These two sets of zonal impedances would be interpreted as the difference between perceived impedance of travelers and the actual impedance on the roads. As travelers perceive zonal impedance based upon their experience travelling on the transportation network, there should be some similarity between the two sets of zonal impedance. The iterative feedback ensures that the zonal impedances used in trip distribution and mode choice model are within acceptable range of difference with impedances calculated from subsequent traffic assignment travel times. These impedance measures were iteratively updated following traffic assignment and fed-back as inputs to the trip distribution models for repetitive applications of the trip distribution, mode choice, and traffic assignment models (see Table 4-1). This iterative feedback ends when the gap of impedance used in trip distribution models and the impedance calculated from successive assignment results reaches the predefined threshold. Appendix C.1 Travel Model Validation outlines and discusses these convergence criteria.

For home-based work (HBW) trips, a composite measure of AM peak period congestion was fed-back. The composite measure is developed by combining highway travel times based upon speeds from the AM peak period traffic assignment and transit travel time based on peak transit service levels. The technique used to feedback congested travel times to the non-work trip distribution process used speeds from a midday period traffic assignment. Both the HBW and non-work feedback used the method of successive average technique to calculate values of the traffic volumes to be used to calculate the travel times to be fed-back to the trip distribution model.

4.3 Speed Estimation Procedure

As part of the TDM calibration process, speeds for each roadway facility type are estimated and further categorized by area type. These input speeds reflect the average daily travel speeds.

The original Houston Speed Model is based on the speed estimation procedures suggested in a report, Highway Vehicle Speed Estimation Procedures for Use in Emissions Inventories (a draft report prepared for the EPA by Cambridge Systematics Inc., September 1991). The original Houston Speed Model is described in the technical memorandum, *Implementation and Calibration of a Speed Model for the Houston-Galveston Region*, prepared by Texas A&M Transportation Institute (TTI) for H-GAC, March 1993. The model approach used to estimate freeway speeds in the original Houston Speed Models could be described as the speed reduction factor (SRF) approach. This approach is used for freeways, arterials, and collectors. Using the SRF approach requires estimates of both free-flow speed (i.e., the speed at a v/c ratio approaching 0.0) and the level of service (LOS) E speed (i.e., LOS E speed, or speed at a v/c ratio of 1.0). The analyst provides these paired speed factors for each functional class and area type that can be applied to the link-data input speed to estimate a link's free-flow speed and LOS E speed. The analyst supplied SRFs describe the general shape of the speed curve for v/c ratios varying from 0.0 to 1.0. These estimate the speeds for v/c ratios between 0.0 and 1.0. The extensions of the models for v/c ratios exceeding 1.0 are based on the traditional Bureau of Public Roads (BPR) impedance adjustment function. The following provides a more detailed description of the congested speed estimation process. The directional v/c ratios, free-flow speeds, and LOS E speeds for a non-directional assignment are calculated as follows:

$$\mathbf{VC1(A,B)} = \frac{\mathbf{VOL1(A,B)}}{\mathbf{CAP24ndir(A,B) \times CAPFAC(AT,FC) \times 0.5}} \quad \textbf{(1)}$$

$$\mathbf{VC2(A,B)} = \frac{\mathbf{VOL2(A,B)}}{\mathbf{CAP24ndir(A,B) \times CAPFAC(AT,FC) \times 0.5}} \quad \textbf{(2)}$$

$$\mathbf{SPD0(A,B) = SPD24(A,B) \times SPD0FAC(AT,FC)} \quad \textbf{(3)}$$

$$\mathbf{SPD1(A,B) = SPD24(A,B) \times SPD1FAC(AT,FC)} \quad \textbf{(4)}$$

Where:

A,B = the A-Node and B-Node of the link obtained from the link data;

AT = the area type number obtained from the link data;

FC = the functional classification number obtained from the link data;

VC1(A,B) = the estimated time-of-day v/c ratio in one direction;

VC2(A,B)[1] = the estimated time-of-day v/c ratio in the other direction;

VOL1(A,B) = the estimated time-of-day volume in one direction.

VOL2(A,B)[1] = the estimated time-of-day volume in the other direction.

CAP24ndir(A,B) = the link's 24-hour non-directional capacity from the assignment data set;

CAPFAC(AT,FC) = the analyst-supplied factor used to estimate time-of-day nondirectional capacity from the 24-hour non-directional capacity. Half of the non-directional time-of-day capacity is used for each direction;

SPD0(A,B) = estimated free-flow speed on link A,B;

SPD1(A,B) = estimated LOS E speed (i.e., the expected speed at a v/c ratio of 1.0) on link A,B;

[1] If the assignment is directional, then both VC2(A,B) and VOL2(A,B) will be 0.0.

SPD24(A,B) = the input speed for the link data (i.e., the 24-hour input link data speed);

SPD0FAC(AT,FC) = the analyst-supplied factor used to estimate time-of-day free-flow speed from the input link-data speed; and

SPD1FAC(AT,FC) = the analyst-supplied factor used to estimate time-of-day LOS E speed from the link-data input speed.

For directional assignments, the same process discussed previously is used except only one volume and one v/c ratio exist. Since the capacity for the link is also directional, the capacity is not split in half. For a directional assignment, the v/c ratio is calculated as follows:

$$\mathbf{VC1(A,B) = \frac{VOL1(A,B)}{CAP24dir(A.B) \times CAPFAC(AT,FC)}} \quad \textbf{(5)}$$

Where:

CAP24dir(A,B) = the link's 24-hour directional capacity from the assignment data set.

The speed factors are applied to the link's TDM coded speed to estimate the link's free flow speed (i.e., the speed for a v/c ratio approaching 0.0) and the LOS E speed (i.e., the speed for a v/c ratio of 1.0). The SRFs, which essentially describe the shape of the speed curve, are by area type and functional group. These factors are inputs for v/c ratios from 0.0 to 1.0 in increments of 0.05. The analyst-supplied SRFs describe the decay from a free-flow speed to a LOS E speed for a v/c ratio of 1.0. The values of the SRFs vary from 0.0 to 1.0.

The speed model (for v/c ratios from 0.0 to 1.0) may be described as:

$$\mathbf{S_{V/C} = S_{0.0} - SRF_{V/C} \times (S_{0.0} - S_{1.0})} \quad \textbf{(6)}$$

Where:

$S_{V/C}$ = estimated directional speed for the forecast v/c ratio on the link in the selected direction;

$S_{0.0}$ = estimated free-flow speed for the v/c ratio equal to 0.0;

$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0;

$SRF_{V/C}$ = SRF for the forecast v/c ratio; and

V/C = the forecast v/c ratio on the link. The v/c ratio can be 0.0 to 1.0.

In TDMs, the traffic assignment model can produce v/c ratios greater than 1.0, hence a model extension like that used in the Houston Speed Model is used. The extension is based on the BPR model where for links with a v/c ratio greater than 1.0 and less than 1.5, the following model extension is used to estimate the link's speed:

$$S_{V/C} = S_{1.0} \times \left[\frac{1.15}{1 + 0.15(V/C)^4}\right] \quad (7)$$

Where:

$S_{V/C}$ = estimated directional speed for the forecast v/c ratio on the link in the selected direction;

$S_{1.0}$ = estimated LOS E speed for the v/c ratio equal to 1.0; and

V/C = the forecast v/c ratio on the link. The v/c ratio can be 1.0 to 1.5.

For v/c ratios greater than 1.5, the speed is calculated using the model extension shown above for the v/c ratio of 1.5. Capacity data are not used for centroid connectors and intrazonal links. Thus, for local streets, which these represent, the free-flow speed factors and LOS E speed factors should be defined as 1.0, and the SRFs should be set to 0 for all v/c entries. The operational speed (i.e., assignment speed) for centroid connectors is assumed to be the speed input from the link data.

4.4 Local Street VMT

The roadway network of the regional TDM does not contain details of local (residential) streets. However, a VMT estimate is possible based on data provided by the travel model. Local street VMT is calculated for each county by multiplying the number of intrazonal trips by the intrazonal trip length and then adding the VMT from the zone centroid connectors. The temporal distribution is assumed to be the same as for non-local streets.

4.5 Model VMT Adjustments

An adjustment factor based on TxDOT's HPMS was applied to the TDM VMT to ensure consistent reporting across the state. The HPMS adjustment factor is applied to the model estimated time-of-day VMT before the estimation of time-of-day speed. In this way, the time-of-day speeds used in the estimation of emissions are based on HPMS-adjusted VMT. This methodology is consistent with the procedures used by TTI in developing model adjustment factors for the rest of Texas.

4.5.1 HPMS Adjustments

In order to compare model-estimated regional VMT to HPMS-estimated VMT for TDM validation year 2016, an estimate of total model-estimated regional VMT is calculated. Model-assigned regional network VMT is combined with the assigned regional centroid connector VMT for an estimate of travel within each zone (i.e. intrazonal VMT).

Since the reconciliation is made for estimated non-summer weekday VMT, both the model- and HPMS-estimated VMT also represent non-summer weekday VMT. In its original form, the model-estimated VMT is produced as non-summer weekday VMT. HPMS-estimated VMT represents average annual daily traffic (AADT) and is adjusted to represent average non-summer weekday traffic (ANSWT) based on a factor developed using TxDOT permanent traffic recorder data as follows:

$$\mathbf{HPMS_{ANSWT} = HPMS_{AADT} \times AADT \cdot to \cdot ANSWT\ Factor} \quad \mathbf{(8)}$$

Where:

$HPMS_{ANSWT}$ = the HPMS-estimated average non-summer weekday VMT;

$HPMS_{AADT}$ = the HPMS-estimated VMT; and

AADT-to-ANSWT Factor = a conversion factor.

The factor used to reconcile model-estimated regional VMT to HPMS-estimated regional VMT is calculated by dividing the HPMS-estimated average non-summer weekday VMT by the model- estimated average non-summer weekday VMT as follows:

$$\mathbf{HPMS\ Factor = \frac{HPMS_{ANSWT}}{TDM_{ANSWT}}} \quad \mathbf{(9)}$$

Where:

HPMS Factor = the HPMS adjustment factor; and

TDM_{ANSWT} = the model-estimated average non-summer weekday VMT.

As shown in Table 4-2, the HPMS adjustment factor was calculated based on this methodology. The HPMS adjustment factor is applied to the model estimated time-of-day VMT prior to the estimation of time-of-day speed. In this way, the time-of-day speeds used in the estimation of emissions are based on the HPMS-adjusted VMT.

Table 4-2. 2016 HPMS Factor

HPMS AADT VMT[1]	AADT-to-ANSWT Factor	HPMS-Based ANSWT VMT	TDM VMT[1]	HPMS Factor[2]
165,009,090	1.06178	175,203,352	186,710,076	0.93837

4.5.2 Seasonal and Daily Adjustments

Seasonal adjustment factors are used to adjust the TDM's VMT to summer weekday VMT. The seasonal, daily, and hourly adjustment factors were developed using the TxDOT automated traffic recorder (ATR) data over the years 2014-2023. To adjust the representative seasonal weekday traffic VMT from TDM to the specified day types in the summer season, ratios were

[1] Total counties included. Counties included Harris, Galveston, Brazoria, Fort Bend, Montgomery, Liberty, Chambers, and Waller.
[2] Applied to all analysis years and areas in the TDM.

calculated by dividing the average day-of-week (weekday) count for the summer (June–August) episodes by the ANSWT count. Table 4-3 shows the seasonal adjustment factors.

Table 4-3. Seasonal Adjustment Factors

Season	Counties	Adjustment Factor
Summer weekday	Harris, Galveston, Fort Bend, Brazoria, Montgomery, and Waller	0.985568
Summer weekday	Chambers and Liberty	0.989918

4.5.3 Hourly Adjustments

The hourly factors in Table 4-4 are used to convert the TDM output into hourly VMT. The hourly factors were calculated using 2014-2023 ATR data.

Table 4-4. Example of Summer Weekday Hourly VMT Distribution

Period	Hour	Summer 24-hour	Summer 4-Period
Overnight	00:00-00:59	0.009209	0.038973
Overnight	01:00-01:59	0.006157	0.026057
Overnight	02:00-02:59	0.005702	0.024131
Overnight	03:00-03:59	0.006737	0.028511
Overnight	04:00-04:59	0.014475	0.061259
Overnight	05:00-05:59	0.038700	0.163780
AM Peak	06:00-06:59	0.060460	0.333109
AM Peak	07:00-07:59	0.064376	0.354685
AM Peak	08:00-08:59	0.056666	0.312206
Midday	09:00-09:59	0.051333	0.159592
Midday	10:00-10:59	0.050327	0.156464
Midday	11:00-11:59	0.052292	0.162573
Midday	12:00-12:59	0.054431	0.169223
Midday	13:00-13:59	0.055189	0.171580
Midday	14:00-14:59	0.058080	0.180568
PM Peak	15:00-15:59	0.063351	0.243141
PM Peak	16:00-16:59	0.067754	0.260039
PM Peak	17:00-17:59	0.069611	0.267166
PM Peak	18:00-18:59	0.059837	0.229654
Overnight	19:00-19:59	0.047415	0.200662
Overnight	20:00-20:59	0. 036784	0.155671

Period	Hour	Summer 24-hour	Summer 4-Period
Overnight	21:00-21:59	0. 030844	0.130533
Overnight	22:00-22:59	0.023974	0.101459
Overnight	23:00-23:59	0.016296	0.068965

4.5.4 Nonrecurring Congestion

The regional TDM does not model for nonrecurring congestion, and this emission model does not use any adjustment factor developed to account for nonrecurring congestion. H-GAC is not aware of any up-to-date, systematic, and empirical studies on observed data which quantify the impact of non-recurring congestion on emission within the eight-county region.

4.6 Estimation of On-Network Activity

4.6.1 Transit Systems

In the regional TDM, the mode choice model forecasts the number and location of transit trips. The transit trips are excluded from the highway assignment and do not contribute to roadway VMT. Transit vehicle emissions are included in the regional emissions analysis through the MOVES model using the appropriate source types and operational characteristics, ensuring that emissions associated with transit operations are fully represented in the conformity determination.

4.6.2 Roadway VMT

Roadway VMT is provided by hour, county, road type and area type. Appendix D.5 VMT, Speed, and Emissions Summaries contains all the network years with the final VMT estimates.

4.6.3 Average Loaded Speeds

Average loaded speeds are provided by hour, county, road type, and area type. The final average loaded speeds are listed in Appendix D.5 VMT, Speed, and Emissions Summaries.

4.6.4 Centerline and Lane Miles

Centerline miles and lane miles are provided by functional class and area type for each analysis year and are listed in Appendix C.2 Links, Miles, Centerline, and Lane Miles Summaries.

4.7 Estimation of Off-Network Activity

County-level, hourly estimates of the source hours parked (SHP) and starts activity were required for each vehicle type to estimate the off-network (or parked vehicle) emissions. Source hours extended idling (SHEI) and auxiliary power unit (APU) hours estimates were needed for combination long-haul trucks. For the estimation of the SHP and vehicle starts, vehicle population estimates were also needed.

The vehicle population and hourly SHP, starts, source hours idling (SHI), and APU hours are available in Appendix D.3 Activities.

4.7.1 Vehicle Populations

Vehicle population data were used to estimate the off-network activity from SHP and vehicle starts. The vehicle population estimates were derived from the end of year 2021, county-specific vehicle registration data provided by the Texas Department of Motor Vehicles (TxDMV), TxDOT district-level VMT mix data, and HPMS-reported county-level VMT totals.

The following steps were used to disaggregate the TxDMV vehicle registration data to vehicle population data by vehicle type:

1. VMT mix data were used to calculate the proportional representation of each MOVES vehicle type within each TxDMV aggregation class (first column of Table 4-5).

Table 4-5. Vehicle Registration Aggregations and Vehicle Types

Vehicle Registration[1] Aggregation	Associated Vehicle Type[2]
Motorcycles	MC_Gas
Passenger cars	PC_Gas; PC_Diesel; PC_Electricity
Trucks ≤ 8.5 K gross vehicle weight rating (GVWR) (pounds)	PT_Gas; PT_Diesel; PT_Electricity LCT_Gas; LCT_Diesel; LCT_Electricity
Trucks > 8.5 and ≤ 19.5 K GVWR	RT_Gas; RT_Diesel; RT_Electricity SUShT_Gas; SUShT_Diesel; SUShT_Electricity MH_Gas; MH_Diesel; MH_Electricity Obus_Gas; Obus_Diesel; Obus_Electricity TBus_Gas; TBus_Diesel; TBus_Electricity SBus_Gas; SBus_Diesel; SBus_Electricity
Trucks > 19.5 K GVWR	CShT_Gas; CShT_Diesel; CShT_Electricity
NA[1]	SULhT_Gas; SULhT_Diesel; SULhT_Electricity CLhT_Gas; CLhT_Diesel; CShT_Electricity

2. The proportional fractions calculated in Step 1 were multiplied by the total number of vehicles reported in each TxDMV vehicle registration category to obtain the estimated number of vehicles (populations) for each modeled MOVES vehicle type.

Since HPMS data is not available for years in the future, vehicle type populations were derived by applying a vehicle population growth factor (VPGF). To calculate the VPGF for each analysis year, the VMT of an analysis year was divided by the county-level HPMS-reported total VMT for the registration data year (2021).

[1] The four long-haul SUT/fuel type populations are estimated using a long-haul-to-short-haul weekday SUT VMT mix ratio applied to the short-haul SUT population estimate.
[2] The year-end TxDMV county registrations data extracts were used (i.e., the three-file dataset consisting of light-duty cars, trucks, and motorcycles; heavy-duty diesel trucks; and heavy-duty gasoline trucks) for estimating the vehicle populations.

4.7.2 Off-Network Idling (ONI) Hours

ONI is the additional idling activity that occurs off the roadway network while a vehicle is idling in a parking lot, drive-through, or driveway while waiting to pick up passengers or loading/unloading cargo. ONI applies to all MOVES source types.

TTI estimates ONI hours activity (i.e., $SHI_{off\text{-}network}$) for each hour of the day using the following formula:

$$\textbf{ONI Hours} = \frac{\mathbf{SHO_{network} \times TIF - SHI_{network}}}{\mathbf{(1 - TIF)}} \quad \textbf{(10)}$$

Where:

ONI Hours = the idling activity time that occurs off the roadway network.

$SHO_{network}$ = the source hours operating (SHO) on each link of the roadway network, calculated by dividing the VMT associated with each link by the congested speed of the link.

$SHI_{network}$ = the total SHI that occurs on the network as a component of drive cycles, calculated by multiplying $SHO_{network}$ by a road idle fraction (RIF). RIF is the proportion of idling in units of time that occurs within a drive cycle at a specified operational speed. Default values for RIF were used as defined in the MOVES data table *roadIdleFraction*.

TIF = the total idle fraction calculated by dividing total SHI on- and off-network by total SHO on- and off-network.

4.7.3 SHP

The first activity measure needed to estimate the off-network emissions is county-level estimates of SHP by hour and vehicle type. The SHP was estimated as a function of total hours (hours a vehicle exists) minus its hours of operation on roads (ONI and SHO, where SHO is the same as vehicle hours of travel [VHT]).

The vehicle-type SHP estimates were calculated for each hour of the day based on the link VMT and speeds, the VMT mix used in the link-based emissions analysis, and the vehicle population estimates.

The VMT mix was applied to the link VMT to produce VMT estimates by vehicle type. Link VMT was divided by the link speed to produce SHO estimates. SHO was aggregated across links and then subtracted from source hours (equal to the vehicle population since source hours equal the number of hours in the period), resulting in SHP estimates by vehicle type. This was performed for each analysis year, county, and hour of day.

4.7.4 Starts

Vehicle starts were estimated using county-level vehicle-type populations and data from MOVES representing the average number of starts per vehicle type per hour. The starts per vehicle were calculated using MOVES with data on the age distribution and fuel fractions of the local fleet.

TTI used local age distributions and fuel fractions inputs to MOVES combined with MOVES default parameters (startsageadjustment, startsmonthadjust [June through August average], and startspervehicle) to produce hourly starts per vehicle output representative of the June through August summer period. The output was then post-processed to produce the scenario-specific starts per vehicle for the summer (or non-school) period defined by the study scope.

MOVES was used to calculate starts per vehicle (i.e., the average number of starts per vehicle type per hour) for the weekday day type for the June through August summer period. To produce the scenario-specific non-school period (June 10 through August 10), the MOVES output summer period starts per vehicle were multiplied by conversion factors based on period weighted-average MOVES default startsmonthadjust data. Using the startsmonthadjust default data, the non-school conversion factor is the ratio of the non-school period to the average June through August summer period.

The local vehicle start activity estimates were calculated as the product of national default starts per vehicle and the local vehicle-type population estimates. The weekday vehicle start estimates for each vehicle type were calculated by county, analysis year, and hour of the day.

4.7.5 Hotelling: SHEI and APU Hours

Hotelling hours were calculated for heavy-duty, long-haul trucks only (i.e., source use type [SUT] 62) in several steps. First, total hotelling hours were calculated using information from a Texas Commission on Environmental Quality (TCEQ) extended idling study.[1] Scaling factors were then used to convert these base hotelling hours to those relevant to each analysis year, which were then allocated to each hour of the day. Estimations were then made of the proportions of hotelling hours that occur in each of the four hotelling categories: idling using the main engine (SHEI), diesel APU operation, electric APU operation, or main engine off and no auxiliary power.[2]

4.7.5.1 Estimating 24-Hour Hotelling

Consistent with the 2019 extended idling study by TCEQ, county-level hotelling scaling factors were developed to transform base 2017 winter weekday total daily hotelling hours to daily hotelling hours for each conformity analysis-year scenario. Scaling factors were calculated using the ratio of heavy-duty long-haul VMT for each scenario relative to heavy-duty long-haul VMT for a 2017 winter weekday (scenario SUT 62 VMT divided by 2017 winter weekday SUT 62 VMT).

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[1] *Heavy-Duty Vehicle Idle Activity Study, Final Report*. TTI, Environment and Air Quality Division, July 2019, revised December 2019.

[2] Only SHEI and APU diesel hotelling generates emissions. The other fractions are calculated for completeness.

Total daily hotelling for each county and scenario was calculated by multiplying the appropriate scaling factor by the total daily hotelling hours contained in the 2017 winter weekday total daily hotelling hours study.

4.7.5.2 Hotelling by Hour Estimation

Daily hotelling hours were allocated to each hour of the day as a function of the inverse of activity scenario hourly VHT fractions for SUT 62. The hourly VHT fractions were calculated using the hourly VHT from the SHP estimation process (VHT = SHO). The inverses of these hourly VHT fractions were calculated and then normalized across all hours to produce the county-level, hotelling hours hourly distribution.

If the hourly hotelling hours were greater than the SHP (for SUT 62), the final hotelling hours estimate was set to the SHP.

4.7.5.3 SHEI and APU

Consistent with the extended idling study by TCEQ, county, analysis year, and summer weekday hotelling hours were first estimated using 24-hour weekday hotelling hour estimates for a 2017 baseline year; baseline and analysis year scenario VMT, speeds, and VMT mix; and analysis-year scenario SHP estimation data.

The baseline-year county hotelling hours estimates for a 24-hour weekday from the TCEQ study were scaled to each analysis scenario using the ratio of analysis-scenario-to-baseline combination long-haul truck 24-hour VMT (as truck VMT increases, so does hotelling activity).

The 24-hour hotelling estimates were then distributed to each hour of the day using the hotelling hours hourly distribution calculated for the analysis scenario as the inverse of the hourly distribution of VHT (or SHO, from the SHP calculation process) for combination long-haul trucks. Within each hour, SHP and hotelling hours were compared, and if hotelling hours exceeded the SHP, hotelling hours were set equal to the SHP.

SHEI and APU hours components of hotelling hours were then estimated for each hour using the hourly hotelling hours estimates, combination long-haul truck travel fractions (calculated from local age distributions and MOVES default relative mileage accumulation rates), and hotelling activity distributions for each model year.

The SHEI and APU hours activity distribution fractions (see Table 4-6) were each first multiplied by the travel distribution (model-year operating mode activity fraction multiplied by the associated model-year travel fraction). The products of the SHEI fractions and travel fractions were then summed to produce the total SHEI fraction, and the same process was performed for APU hours to produce the total APU hours fraction. (The sum of the SHEI and APU hours fractions subtracted from 1.0 results in the fraction of hotelling hours with electric power or no power in use.)

Table 4-6. Hotelling Activity Distribution by Model Year

First Model Year	Last Model Year	200 Extended Idling	201 Hotelling Diesel Auxiliary	203 Hotelling Battery AC	204 Hotelling APU Off
1960	2009	0.80	0.00	0.00	0.20
2010	2020	0.73	0.07	0.00	0.20
2021	2023	0.48	0.24	0.08	0.20
2024	2026	0.40	0.32	0.08	0.20
2027	2060	0.36	0.32	0.12	0.20

The total SHEI and APU hours fractions were then multiplied by the hotelling hours for each hour of the day to produce the SHEI and APU hours estimates for each hour. This was performed for each analysis scenario (analysis-year summer weekday).

5. EMISSIONS FACTOR ESTIMATION

A regional emissions analysis must be conducted for multiple analysis years to satisfy the requirements of 40 CFR 93.109 of the conformity rule for ozone nonattainment areas. Specifically, the regional emissions analysis is used to conduct the emission budget test (or interim emission tests) and to determine any contributions to emission reductions. The procedures for determining regional transportation-related emissions are described in 40 CFR 93.118 of the conformity rule. This section discusses the analysis years, and the modeling processes used to conduct the analysis.

5.1 EMISSIONS FACTOR ESTIMATION MODEL

According to 40 CFR 93.111 of the conformity rule, the determination must be based on the latest emission estimation model. In September 2023, EPA announced the release of MOVES4 with an effective date of September 12, 2023. A two-year conformity grace period is in effect with the release and ends on September 12, 2025. According to 88 FR 62567, any transportation conformity analysis initiated after this date must use MOVES4 to complete the conformity analysis. Transportation conformity analyses initiated but not completed prior to this date are able to use the most recent prior version of the model following consultation with and approval by Interagency Consultative Partners.

As outlined in the Pre-Analysis Consensus Plan (PACP), included in Appendix F.1 Approved Pre-Analysis Consensus Plan, the Interagency Consultation Partners approved the use of MOVES3.1 to develop 2023, 2026, 2030, 2040, 2045 vehicle emission factors. Emission factors are one component to determine VOC and NOx, etc. emissions from the region's on-road vehicles.

During the development of the PACP, H-GAC indicated that existing emissions controls could be included as part of this analysis for conformity credit. Since the results of this conformity analysis have demonstrated that the total emissions for the HGB nonattainment region are less than the applicable SIP MVEBs, as shown in Table1-1a and Table 1-1b, it was determined that these strategies were no longer necessary. Therefore, the existing controls referenced in the PACP were not included in the formal conformity analysis.

Table 5-1 through Table 5-7 list MOVES3.1 input parameters with the appropriate data source and/or methodology applied. The information listed applies to all counties and analysis years unless otherwise specified.

Table 5-1. MOVES Input Parameters and Data Sources

Input Parameter	Description	Base Data Source	Notes
Vehicle population by source type	Input the number of vehicles in the geographic area to be modeled for each source type.	TxDMV data (year end 2021) MOVES defaults for rate runs	• Local gasoline- and diesel-powered source-type populations by analysis year were estimated for use external to MOVES in the estimation of county-level vehicle starts and SHP, needed in the external emissions calculations, per TTI's rates-per-activity, TDM-based method. • Populations by SUT and fuel type are a function of TxDMV year-end vehicle registration data and VMT mix and, in the case of base and future years, population scaling factors.
Fleet age distribution by source type	Input data that provide the distribution of vehicle counts by age for each calendar year and vehicle type. TxDMV registration data were used to estimate the age distribution of vehicle types up to 31 years.	TxDMV data (year end 2021) MOVES defaults for refuse trucks, motor homes, and buses	• Age distributions were developed using TxDMV registration data aggregated at the county level for all source types except for short-haul source types, which are region level; long-haul source types, which are statewide level; and buses, refuse trucks, and motor homes, which are MOVES defaults. • The Age Distribution dataset was derived from the latest TxDMV Registration dataset and MOVES default values. • The dataset contains five columns: RegionID, yearID, sourceTypeID, ageID (which ranges from 0 to 30, and ageFractionID. • The distribution of age fractions totals to 1.0 for each SUT for each analysis year.
Fleet VMT by HPMS vehicle type	Distribute MOVES default VMT to five HPMS vehicle types.	MOVES defaults for rate runs	• Local activity estimates were applied in emissions calculations external to MOVES.
Road type VMT distributions	Input MOVES default VMT by road type.	MOVES defaults for rate runs	• The VMT fraction was distributed between the road type and must sum to 1.0 for each source type.
Average speed distribution	Input average speed data specific to vehicle type, road type, and hour of day/type of day into 16 speed bins.	MOVES defaults for rate runs	• The sum of speed distribution over all speed bins for each road type, vehicle type, and hour/day type is 1.0.
Fuel supply (Table 5-2)	Input data to assign existing fuels to counties, months, and years, and to assign the associated market share for each fuel.	TCEQ, EPA Fuel Surveys and default MOVES input where local data unavailable.	• Fuel supply is based on the latest available survey data from the (2023) Summer Fuel Field Study, sponsored by TCEQ, and other information such as motor gasoline sales volume and transportation-sector consumption.

Input Parameter	Description	Base Data Source	Notes
			• Fuel supply information is uniform across each MOVES fuel region (there are six fuel regions in Texas: 132 western Texas counties [ID 300000000], 95 eastern Texas counties [ID 178010000], El Paso [ID 370010000], etc.). • The exception would be the reformulated gasoline regions, where HGB has a separate fuel formulation. • For each analysis year and season, the fuel supply consisted of one conventional gasoline formulation and one biodiesel formulation.
Fuel formulation (Table 5-3)	Input Texas fuel region-specific fuel properties applicable to the county.	TCEQ, EPA Fuel Surveys and default MOVES input where local data unavailable.	• Reformulated Gasoline (RFG) formulations based on the EPA's summer 2020 fuel survey samples. • The 2023 RFG properties are actual averages (fuel grade averages weighted by relative sales volumes). • The future years RFG properties are the latest available actual averages except with average sulfur level set to the expected values (MOVES3.1 defaults, consistent with the pertinent regulatory standards). • The 2023 diesel sulfur level is the statewide average from TCEQ's 2023 survey. • Future year diesel sulfur was set to the current expected future year value (6 ppm), which is conservative and consistent with the statewide diesel sulfur average from TCEQ's latest (2023) survey. • The biodiesel (BD) ester volume percentages for future years were based on the latest available (2022) Department of Energy state-level transportation sector BD consumption estimates. • Fuel subtype IDs 12 and 21 are 10% ethanol-blend gasoline and biodiesel, respectively.

Input Parameter	Description	Base Data Source	Notes
Fuel engine fraction	Input fuel engine fractions (i.e., gasoline versus diesel versus flex-fuel engine types in the vehicle population) by model year for all vehicle types.	TxDMV year-end 2021 registration data for particular source type diesel fractions; MOVES defaults for other source types.	• Locality-specific/MOVES default. • TTI developed the evaluation year-specific local diesel fractions for the MOVES single-unit and combination truck SUTs using the latest TxDMV data, for all analysis years, aggregated to the statewide level. For all source types, compressed natural gas (CNG) and electricity fractions were set to zero, and the gasoline/diesel/flex-fuel fractions were normalized (sum to 1.0) for each source type and model year. Fuel usage for flex-fuel vehicles was set to 100% gasoline (in the fuel usage fraction input table). • The alternate vehicle fuel technology (AVFT) table allows users to customize the distribution of vehicles capable of using various fuels and technologies for each model year, which includes defining the proportion of vehicles using diesel, gasoline, E-85, CNG, and electricity for each vehicle type and model year. • TTI developed the AVFT table using the latest available (2021) TxDMV registration data, along with default MOVES AVFT data.
Meteorology (Table 5-4a and Table 5.4b)	Input county-specific data on temperature, humidity, and barometric pressure.	Average hourly data from weather stations within HGB nonattainment area counties, provided by TCEQ.	• The summer season temperature and humidity data are the same values used in TCEQ's 2011 Air Emissions Reporting Requirements AERR inventory analysis. • These inputs were developed as seasonal hourly temperature and relative humidity, and 24-hour barometric pressure averages, using the hourly data from multiple weather stations within HGB nonattainment area counties, provided by TCEQ.
Inspection and maintenance (I/M) coverage (Table 5-6)	Input I/M coverage records for each combination of pollutants, process, county, fuel type, regulatory class, and model year specified using this input.	TCEQ provided I/M program statistics for calculating the compliance factor input. TTI developed these inputs essentially in consultation with TCEQ.	• The begin and end model years (X and Y) define the range of model years covered—where X and Y are calculated as YearID 24 and YearID 2, respectively. • TTI calculated the I/M compliance factor estimates, using the MOVES I/M compliance factor equation; the HGB I/M-program-specific I/M waiver rates and failure rates; and the statewide average I/M compliance rates; in combination with MOVES3.1 regulatory class coverage adjustments. • The model processes/pollutants affected were starting and running exhaust hydrocarbon (HC), CO, NOx, and tank vapor venting HC; the fuel type is gasoline; the frequency is annual.

Table 5-2. Fuel Supply

Fuel Type	Fuel Formulation ID	Market Share	Market Share CV[1]
Gasoline	2379 (2023), 2479 (2024+)	1.0	N/A
Diesel	30236 (2023), 30600 (2024+)	1.0	N/A

Table 5-3. Fuel Properties[2]

Factor[3]	Information			
Fuel Type	Gasoline	Gasoline	Diesel	Diesel
Fuel Formulation ID	2379	2479	30236	30600
Fuel Subtype ID	12	12	21	21
Analysis Year	2023	2024+	2023	2024+
Season	Summer	Summer	Summer	Summer
RVP	7.15	7.15	0	0
Sulfur Level	9.98	10.00	5.91	6
ETOH Volume	9.56	9.56	0	0
MTBE Volume	0	0	0	0
ETBE Volume	0	0	0	0
TAME Volume	0	0	0	0
Aromatic Content	16.92	16.92	0	0
Olefin Content	10.24	10.24	0	0
Benzene Content	0.41	0.41	0	0
e200	48.2	48.2	0	0
e300	84.92	84.92	0	0
Vol to Wt Percent Oxy	0.3653	0.3653	0	0
BioDieselEster Volume	N/A	N/A	2.82	2.82
Cetane Index	N/A	N/A	N/A	N/A
PAH Content	N/A	N/A	N/A	N/A
T50	206.36	206.36	0	0
T90	326.7	326.7	0	0

[1] The market share CV is the coefficient variation of the market share. MOVES requires that market shares of all fuel types be included in order to run the model, including alternative fuel types of E85, CNG, and electricity.
[2] Note: MOVES requires all on-road mobile fuel types to run, so MOVES default E85, CNG, and electricity fuel formulations were included in the input. N/A denotes not applicable.
[3] Factor: RVP—Reid vapor pressure, ETOH—ethanol, MTBE—methyl tert-butyl ether, ETBE—ethyl tert-butyl ether, TAME—tert-amyl methyl ether, e200—lower volatility percentage, e300—upper volatility percentage, PAH—polycyclic aromatic hydrocarbons, T50—temperature at which 50% of fuel has evaporated, T90—temperature at which 90% of fuel has evaporated.

Table 5-4a. Hourly Meteorological Data (Temperature, °F)

Factor	Information							
County/ Area(s)	Brazoria	Chambers	Fort Bend	Galveston	Harris	Liberty	Montgomery	Waller
Season	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Hour	**Temperature (°F)**							
00:00–00:59	81.78	81.78	81.78	81.78	81.78	81.78	81.78	81.78
1:00–1:59	81.05	81.05	81.05	81.05	81.05	81.05	81.05	81.05
2:00–2:59	80.42	80.42	80.42	80.42	80.42	80.42	80.42	80.42
3:00–3:59	79.88	79.88	79.88	79.88	79.88	79.88	79.88	79.88
4:00–4:49	79.38	79.38	79.38	79.38	79.38	79.38	79.38	79.38
5:00–5:59	78.92	78.92	78.92	78.92	78.92	78.92	78.92	78.92
6:00–6:59	78.66	78.66	78.66	78.66	78.66	78.66	78.66	78.66
7:00–7:59	79.91	79.91	79.91	79.91	79.91	79.91	79.91	79.91
8:00–8:59	82.99	82.99	82.99	82.99	82.99	82.99	82.99	82.99
9:00–9:59	85.64	85.64	85.64	85.64	85.64	85.64	85.64	85.64
10:00–10:59	88.01	88.01	88.01	88.01	88.01	88.01	88.01	88.01
11:00–11:59	90.11	90.11	90.11	90.11	90.11	90.11	90.11	90.11
12:00–12:59	91.82	91.82	91.82	91.82	91.82	91.82	91.82	91.82
13:00–13:59	92.94	92.94	92.94	92.94	92.94	92.94	92.94	92.94
14:00–14:59	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6
15:00–15:59	93.82	93.82	93.82	93.82	93.82	93.82	93.82	93.82
16:00–16:59	93.55	93.55	93.55	93.55	93.55	93.55	93.55	93.55
17:00–17:59	92.67	92.67	92.67	92.67	92.67	92.67	92.67	92.67
18:00–18:59	91.15	91.15	91.15	91.15	91.15	91.15	91.15	91.15
19:00–19:59	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9
20:00–20:59	86.34	86.34	86.34	86.34	86.34	86.34	86.34	86.34
21:00–21:59	84.64	84.64	84.64	84.64	84.64	84.64	84.64	84.64
22:00–22:59	83.45	83.45	83.45	83.45	83.45	83.45	83.45	83.45
23:00–23:59	82.54	82.54	82.54	82.54	82.54	82.54	82.54	82.54

Table 5-4b. Hourly Meteorological Data (Relative Humidity, %)

Factor	Information							
County/ Area(s)	Brazoria	Chambers	Fort Bend	Galveston	Harris	Liberty	Montgomery	Waller
Season	Summer	Summer	Summer	Summer	Summer	Summer	Summer	Summer
Hour	**Relative Humidity (%)**							
00:00–00:59	77.92	77.92	77.92	77.92	77.92	77.92	77.92	77.92
1:00–1:59	80.26	80.26	80.26	80.26	80.26	80.26	80.26	80.26
2:00–2:59	82.41	82.41	82.41	82.41	82.41	82.41	82.41	82.41
3:00–3:59	83.82	83.82	83.82	83.82	83.82	83.82	83.82	83.82
4:00–4:49	85.06	85.06	85.06	85.06	85.06	85.06	85.06	85.06
5:00–5:59	86.09	86.09	86.09	86.09	86.09	86.09	86.09	86.09
6:00–6:59	86.78	86.78	86.78	86.78	86.78	86.78	86.78	86.78
7:00–7:59	84.25	84.25	84.25	84.25	84.25	84.25	84.25	84.25
8:00–8:59	76.56	76.56	76.56	76.56	76.56	76.56	76.56	76.56
9:00–9:59	67.93	67.93	67.93	67.93	67.93	67.93	67.93	67.93
10:00–10:59	59.29	59.29	59.29	59.29	59.29	59.29	59.29	59.29
11:00–11:59	52.73	52.73	52.73	52.73	52.73	52.73	52.73	52.73
12:00–12:59	48.13	48.13	48.13	48.13	48.13	48.13	48.13	48.13
13:00–13:59	45.45	45.45	45.45	45.45	45.45	45.45	45.45	45.45
14:00–14:59	43.78	43.78	43.78	43.78	43.78	43.78	43.78	43.78
15:00–15:59	43.29	43.29	43.29	43.29	43.29	43.29	43.29	43.29
16:00–16:59	43.99	43.99	43.99	43.99	43.99	43.99	43.99	43.99
17:00–17:59	45.94	45.94	45.94	45.94	45.94	45.94	45.94	45.94
18:00–18:59	49.19	49.19	49.19	49.19	49.19	49.19	49.19	49.19
19:00–19:59	54.47	54.47	54.47	54.47	54.47	54.47	54.47	54.47
20:00–20:59	61.24	61.24	61.24	61.24	61.24	61.24	61.24	61.24
21:00–21:59	66.62	66.62	66.62	66.62	66.62	66.62	66.62	66.62
22:00–22:59	71.05	71.05	71.05	71.05	71.05	71.05	71.05	71.05
23:00–23:59	74.73	74.73	74.73	74.73	74.73	74.73	74.73	74.73

Table 5-5. Barometric Pressure

Period	County	Barometric Pressure (Inches of Mercury)
24-hour	Brazoria	29.95
24-hour	Chambers	29.94
24-hour	Fort Bend	29.94
24-hour	Galveston	29.95
24-hour	Harris	29.95
24-hour	Liberty	29.94
24-hour	Montgomery	29.95
24-hour	Waller	29.95

Table 5-6. I/M Inputs

Factor	I/M Information		
Test standards description	Evaporative gas cap check	Exhaust onboard diagnostics (OBD) check	Evaporative gas cap and OBD check
Test Standards ID	45	51	45
Year ID	2023	2023, 2026, 2030, 2040, 2045	2026, 2030, 2040, 2045
I/M program ID	60	40	60
Pollutant Process ID	112	101, 102, 201, 202, 301, 302	112
SUT[1]	21, 31, 32	21, 31, 32	21, 31, 32
Begin model year	1999	1999, 2002, 2006, 2016, 2021	2002, 2006, 2016, 2021
End model year	2021	2021, 2024, 2028, 2038, 2043	2024, 2028, 2038, 2043
I/M compliance	21 – 94.80% 31 – 91.12% 32 – 71.34%	21 – 94.80% 31 – 91.12% 32 – 71.34%	21 – 94.80% 31 – 91.12% 32 – 71.34%

Table 5-7. MOVES Emissions Factor Post-Processing to Be Performed by County and Year

Strategy and Post-processing Result	Analysis Year	Counties
Texas Low Emission Diesel (TxLED) [2]	All analysis years	N/A

[1] SUT: 21—passenger car, 31—passenger truck, 32—light commercial truck.
N/A denotes not applicable.
[2] TxLED would apply to all analysis years but is not applicable to the counties in this conformity analysis.

5.2 MODELED EMISSION ESTIMATES

Modeled emission estimates are calculated using TTI emission inventory estimation utilities using MOVES: TTI MOVES3 Utilities, developed by TTI for MOVES. This utility combines vehicle activity and emissions factors to create emission estimates at the link level.

5.2.1 Vehicle Registration Distribution

Vehicle registration (age) distributions were developed using the latest available TxDMV analysis-year-specific county vehicle registration data. Data from 2021 were used for the 2023 base year. The latest available data (2021 year-end) were used for the future analysis years (2026, 2030, 2040, 2045). MOVES defaults were used where the required information was not available in the TxDMV data.

The input values for each vehicle class are 31 age fractions representing the fraction of vehicles by age for that vehicle class as of December of the evaluation year. These age fractions start with the evaluation year as the first age fraction and work back in annual increments to end with the 30th fraction, which represents the fraction of vehicles of age 30 years and older. The fractions are calculated as the model-year-specific registrations in a class divided by the total vehicles registered in that class.

5.2.2 Alternative Vehicle Fuel Technology

AVFT fractions were developed using the latest available TxDMV analysis-year-specific county vehicle registration data. Data from 2021 were used for the 2023 base year. The latest available data (2021 year-end) were used for the future analysis years (2026, 2030, 2040, 2045). MOVES defaults were used where the required information was not available in the TxDMV data.

TTI developed the evaluation-year-specific local diesel fractions for the MOVES single-unit and combination truck SUTs using the latest TxDMV data, for all analysis years, aggregated to the statewide level. For all source types, CNG and electricity fractions were set to zero and the gasoline/diesel/flex-fuel fractions were normalized (sum to 1.0) for each source type and model year. Fuel usage for flex-fuel vehicles was set to 100 percent gasoline (in the fuel usage fraction input table).

5.2.3 VMT Mix

VMT mix (or fractions) is very important to be able to estimate link emissions. The VMT mix is applied to the emission factors in a post-process methodology. The VMT mix enables the assignment of emission factors by vehicle type to VMT to calculate emissions on a specified roadway facility or functional class. VMT mix is estimated for four MOVES roadway types: rural restricted (rural freeways), rural unrestricted (rural arterials and collectors), urban restricted (urban freeways), and urban unrestricted (urban arterials and collectors) for daily time periods for each of the modeled counties. Each county's roadway sections are classified as rural or urban by the vehicle activity behavior and the demographics of the county. The VMT mix methodology uses data, assumptions, and procedures from the TxDOT, TTI, and HGB region TDM.

Consistent with the prior analysis, the VMT mixes were produced in five-year increments and applied to analysis years as follows:

- 2015 VMT mix for 2013 through 2017 analysis years.
- 2020 VMT mix for 2018 through 2022 analysis years.
- 2025 VMT mix for 2023 through 2027 analysis years, etc.

Using the latest available vehicle classification counts (2014-2023) and MOVES3.1 defaults, TTI estimated the time-of-day (AM peak, midday, PM peak, and overnight) VMT mixes by the four MOVES road types. No seasonal adjustments were made for VMT mix.

6. REGIONAL EMISSIONS DETERMINATION

To report final emission analysis results, it is necessary to account for modeled link-level emission inventories, emission factor adjustments, and MOSERS emission benefits.

6.1 Modeled Emissions

Table 6-1a. Modeled Emissions for the Approved Serious 2008 Ozone SIP

Analysis Year	VMT	NOx (tons/day)	VOC (tons/day)
2023	195,013,204	62.07	35.42
2026	205,429,415	49.60	29.89
2030	221,533,727	42.36	25.91
2040	261,440,802	41.41	22.68
2045	280,966,835	43.86	22.80

Table 6-1b. Modeled Emissions for the Proposed Proposed Severe 2008 Ozone SIP

Analysis Year	VMT	NOx (tons/day)	VOC (tons/day)
2023	195,013,204	62.07	35.42
2026	205,429,415	49.60	29.89
2030	221,533,727	42.36	25.91
2040	261,440,802	41.41	22.68
2045	280,966,835	43.86	22.80

6.2 Impacts from Adjustments and MOSERS

6.2.1 Adjustments to Emission Factors

Post-processing adjustments are applied to the emission factor post-process utility developed by TTI. These adjustments are applied either before or simultaneously with the emission calculation procedures to establish the model results. This process is detailed in Chapter 5.

6.2.2 MOSERS Projects

MOSERS is a collection of transportation projects or related activities with identifiable emission reduction benefits. To meet the requirements of the SIP, nonattainment areas may make specific commitments in their SIP to implement MOSERS, called TCMs. Finally, a nonattainment area may include transportation emission reduction measures (TERM) in transportation conformity analysis that are outside of commitments in its SIP.

6.2.2.1 Transportation Control Measures (TCM)

Transportation control measures (TCM) are projects, programs, and related activities designed to achieve on-road mobile source emission reductions and are included as control measures in an applicable SIP. TCMs are strategies to reduce vehicle use or change traffic flow and/or congestion conditions to decrease vehicular emissions. TCMs are further defined in 40 CFR 93.101, as amended by 62 FR 43780. The CAAA requires that TCMs be included in SIPs for regions designated as serious and above ozone nonattainment areas.

40 CFR 93.113 of the conformity rule requires MPOs to verify that the RTP and TIP provide for the timely implementation of TCMs in the applicable SIP. The RTP was reviewed to confirm that the goals, directives, recommendations, and projects do not contradict the specific requirements or commitments of the applicable SIP. The TIP was reviewed to confirm that implementation and expected implementation of projects through federal, state, and local funding sources are on schedule.

Appendix E.1 TCM Timely Implementation shows emission estimates associated with each project included as a TCM. While emissions were calculated for each project, these credits were not applied in this conformity analysis because additional emission reductions from TCMs were not required to demonstrate transportation conformity.

Table 6-2. Applicable SIP Actions Which Committed TCMs

#	TCM	Strategies	Effective Date
1	TCM	2000 HGB RFP and AD SIP, ID#2000-011-SIP-AI	November 2001
2	TCM	2004 HGB Mid-Course Review SIP, ID# 2004-42-NR	December 2004
3	TCM	TCM Substitution for HGB	April 2006
4	TCM	2010 HGB AD SIP for the 1997 8-hour Ozone Standard (2009-017-SIP-NR)	March 2010

6.2.2.2 TERM

TERMs are transportation projects and related activities that are designed to achieve on-road mobile source emission reductions but are not included as control measures in the SIP.

H-GAC has a number of TERMs, or locally implemented strategies in the HGB nonattainment area including projects, programs, partnerships, and policies. The following is a summary of these strategies.

- The Commute Solutions program works with businesses, local governments, and other organizations to promote travel alternatives to reduce traffic and improve air quality in the region. Strategies include carpooling, vanpooling, transit, walking, biking, teleworking, and working a compressed workweek.
- Active transportation efforts help to enable communities to be less dependent on motor vehicles and make streets safer for those who walk or bicycle. This can encourage the use of non-motorized transportation options with a resulting decrease in ozone precursor emissions.

- METRO STAR VanPool receives support from H-GAC to provide ridesharing services for commuters within the region.
- The Commuter and Transit Services Pilot Program supports the development of new and innovative commuter transit services.
- The Houston-Galveston Clean Cities Coalition works to assist fleets throughout the region to better understand the benefits of alternative fuels and helps local businesses locate and secure funding for alternative fuel vehicle projects.
- The Clean Vehicles Program provides grant assistance to local governments, school districts, and businesses operating in the region to retrofit or replace high-emitting heavy-duty vehicles with newer, cleaner models.
- The Gulf Coast Regional Tow and Go Program provides highway motorists with no-cost towing when their vehicle breaks down within the eight-county H-GAC region.
- The Transportation Safety Program of the MPO is a multi-faceted effort to address the region's many traffic safety challenges.
- The Livable Centers Program works with local communities to conduct planning studies that identify specific recommendations that can help create places where people can live, work, and play with less reliance on their cars and support more trips by foot, bicycle, transit, or carpool.

6.2.2.3 CMAQ

The CMAQ program is a major funding source for most MOSERS. Appendix B.2 2025-2028 TIP provides a list of CMAQ projects eligible for inclusion.

6.3 FINAL ANALYSIS RESULTS

Table 6-3a and Table 6-3b show the final mobile emission results of this conformity analysis as compared to the EPA MVEB budgets for NOx and VOCs that were approved as part of the Serious 2008 Ozone RFP SIP (Table 6-3a) and the budgets for the currently under review Severe 2008 Ozone RFP SIP (Table 6-3b). In both cases, the final analyzed final emissions are below the maximum allowable level set forth by the respective SIP MVEBs.

Table 6-3a. Conformity Analysis for the Approved Serious 2008 Ozone RFP SIP MVEB

Analysis Year	VMT	NOx Budget (tons/day)	NOx (tons/day)	VOC Budget (tons/day)	VOC (tons/day)
2023	195,013,204	87.69	62.07	57.70	35.42
2026	205,429,415	87.69	49.60	57.70	29.89
2030	221,533,727	87.69	42.36	57.70	25.91
2040	261,440,802	87.69	41.41	57.70	22.68
2045	280,966,835	87.69	43.86	57.70	22.80

Table 6-3b. Conformity Analysis for the Proposed Severe 2008 Ozone RFP SIP MVEB

Analysis Year	VMT	NOx Budget (tons/day)	NOx (tons/day)	VOC Budget (tons/day)	VOC (tons/day)
2023	195,013,204	67.77	62.07	37.27	35.42

2026	205,429,415	56.12	49.60	31.88	29.89
2030	221,533,727	56.12	42.36	31.88	25.91
2040	261,440,802	56.12	41.41	31.88	22.68
2045	280,966,835	56.12	43.86	31.88	22.80

7. INTERAGENCY CONSULTATION

Regulation 40 CFR 93.112 of the conformity rule includes procedures for interagency consultation, resolution of conflict, and public consultation of the conformity analysis affecting the RTP and TIP. Local, state, and federal transportation and air quality agencies affected by this conformity analysis were consulted on the scope, methodologies, and products of the conformity finding. A conformity steering committee composed of representatives from H-GAC, TxDOT, TCEQ, TTI, FHWA, FTA,[1] and EPA were consulted regularly during the conformity process. The purpose of this group is to ensure the modeling methodology used in this conformity analysis is consistent with the on-road modeling used in the SIP and that the most recent planning assumptions were used.

Appendix F.2 Consultation Review and Meeting Summary provides a comprehensive list of the steering committee's meeting agenda and decisions.

[1] FHWA acts as the executive agent for FTA.

8. PUBLIC INVOLVEMENT

Public participation is recognized as an integral part of the planning process. The public participation process for transportation conformity and other transportation plans, projects, and policies includes timely public notice, full public access to technical and policy information, opportunities for early and continuing involvement, and explicit consideration and response to public input.

Public participation strategies and procedures are designed to inform the public about transportation and air quality issues, provide opportunities to involve the public in the decision-making process, and seek public and stakeholder input. Additionally, this process builds support among the public who are stakeholders in transportation investments. Public views and opinions are included in the final RTP and TIP documents.

One hybrid public meeting was held to support this public involvement process. This meeting consisted of an overview presentation, detailed presentations about the project selection process as well as the transportation conformity development process, a question-and-answer session, and various avenues for submitting public comments. The meeting began at 6:00pm. The public meeting presentation was recorded and made available on the MPO's website for public viewing and feedback. Table 8-1 provides the public meeting date, location addresses, and links to the meeting's agenda/recording.

Table 8-1. Public Involving Meeting Information

Number	Meeting Date	Address	Link to Additional Meeting Information
1	9/17/2025	3555 Timmons Lane Houston, TX 77027 and online	Appendix G.1 Meeting Information (Agenda) Conformity Website (Recording)

The public comment period began on Wednesday, September 10, 2025, and ended on Friday, October 10, 2025, at 11:59 p.m. Public inputs were collected via questions at the public meeting, emails, letters, an online web form at the H-GAC conformity website and speaking opportunities at H-GAC advisory committees including the Transportation Advisory Committee and the TPC. In total, three comments were received, two questions at the public meeting and one written comment. Appendix G.1 Meeting Information provides a full list of comments and the MPO's responses.

APPENDIX A—RESOLUTION OF ADOPTION

A.1 RTP Resolution of Adoption

A.2 2025-2028 TIP Resolution of Adoption

APPENDIX B—RTP/TIP

B.1 RTP Project Listings

B.2 2025-2028 TIP

B.3 2025-2028 TIP Amendments

B.4 Fiscal Constraint

APPENDIX C—TRANSPORTATION MODELING SYSTEM

C.1 Travel Model Validation

C.2 Links, Miles, Centerline, and Lane Miles Summaries

C.3 Link Listing and Capacity Staging

C.4 Roadway Network Files

APPENDIX D—EMISSIONS MODELING INFORMATION

D.1 MOVES Input and Output

D.2 MOVES Emission Factors

D.3 Activities

D.4 Emissions Modeling Utilities

D.5 VMT, Speed, and Emissions Summaries

APPENDIX E—TIMELY IMPLEMENTATION DOCUMENTATION FOR TCM

E.1 TCM Timely Implementation

APPENDIX F—INTERAGENCY CONSULTATION PROCESS

F.1 Approved Pre-Analysis Consensus Plan

F.2 Consultation Review and Meeting Summary

APPENDIX G—PUBLIC INVOLVEMENT PROCESS

G.1 Meeting Information