ATTACHMENT G

DEVELOPMENT OF AIR EMISSIONS INVENTORIES FOR NONROAD MODEL CATEGORY MOBILE SOURCES (TASK 3)

Development of Air Emissions Inventories for NONROAD Model Category Mobile Sources (Task 3)

Final Report

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Task 3

Prepared for:

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Air Quality Division

Prepared by:

Eastern Research Group, Inc.

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LIST OF ACRONYMS

AACOG	Alamo Area Council of Governments
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DCE	Diesel Construction Equipment
DFW	Dallas-Fort Worth
EDA	Equipment Data Associates
EPA	Environmental Protection Agency
ERG	Eastern Research Group
HGB	Houston-Galveston-Brazoria
HP	Horsepower
LPG	Liquefied Petroleum Gas
MHC	McGraw Hill Corporation
NCDC	National Climatic Data Center
NH_3	Ammonia
NOAA	National Oceanic and Atmospheric Administration
NO_X	Oxides of Nitrogen
PM_{10}	Particulate Matter < 10 microns in diameter
$PM_{2.5}$	Particulate Matter < 2.5 microns in diameter
REMI	Regional Economic Models, Inc.
RFG	Reformulated Gasoline
RTF	Rough Terrain Forklift
SCC	Source Classification Code
SIP	State Implementation Plan
SIP	Spark Ignition
SO_2	Sulfur Dioxide
TCEQ	Texas Commission on Environmental Quality
TexN	Texas NONROAD Model
TPD	Tons Per Day
TWC	Three-way Catalyst
TX	Texas
TxDOT	Texas Department of Transportation
TxLED	Texas Low Emission Diesel
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

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1.0 Introduction

The purpose of Task 3 of this Work Order was to develop a set of emissions inventories for all NONROAD model category mobile sources for selected years, estimating both controlled and uncontrolled emissions, for the Dallas-Fort Worth nine-county and Houston-Galveston-Brazoria eight-county 1997 eight-hour ozone nonattainment areas.

The TexN model is a tool for developing emissions estimates for nonroad mobile sources in Texas for the mobile source categories under the United States Environmental Protection Agency's (EPA) NONROAD model. TexN has a user-friendly graphical user interface and stores data in a MySQL database. TexN executes EPA's NONROAD2008a model and allows TCEQ staff to replace EPA default data with local specific data. Currently, the TexN model is used by TCEQ staff, local air quality planning agencies, and other nonroad mobile stakeholders in order to facilitate the use of locally developed activity and population data for nonroad mobile sources, and to standardize the emissions estimation methodologies among the different submitting agencies in Texas. The TCEQ supplies all interested parties with the latest model, which reflects TCEQ updates to specific data, and coordinates the integration of all local changes. The emissions estimates developed using this integrated model are used for state implementation plan modeling efforts, the EPA's reporting requirements, trends analyses, and air quality modeling purposes.

Using the latest version of the Texas NONROAD (TexN) model[1], which incorporates all of the latest available data updates, ERG developed both controlled and uncontrolled average summer weekday emissions for VOC and NOX for the analysis years 2012, 2014, 2017, 2020, 2023, 2026, and 2028 for the DFW nine-county and HGB eight-county 1997 eight-hour ozone nonattainment areas.

This report presents the summaries of the emissions modeling results and provides a very brief summary from where each of the critical model inputs were derived from. Please note that TCEQ has a number of reports that have been generated over the evolution of the TexN model that go into greater detail about the development of each of the model inputs and subsequent data updates.

2.0 Input Data Sources

The following sections are meant only to provide a very brief summary of where the TexN inputs were derived from. Additional detail may be found in the numerous reports for studies conducted by TCEQ throughout the life of TexN.

[1] TexN version 1.7.1

2.1 Equipment Population, Allocation, and Activity Data[2]

The TCEQ and others have conducted several studies over the years to collect region specific population and activity data for selected non-road engine categories, in order to improve upon NONROAD default estimates. Working with TCEQ staff, ERG compiled a comprehensive list of the most recent data developed for different equipment types and regions of the State for inclusion in the TexN model. The sources of the data for each equipment type and region are presented in Tables 1 - 6 below. The methods used to estimate equipment populations and activity levels can be quite complex; in depth discussions of the various methodologies used are provided in the referenced studies.

Table 1. Sources of Equipment Population Data

Equipment Types	Region	Data Source
Diesel Construction Equipment > 25 hp	Dallas-Fort Worth (DFW) 9-county nonattainment area [3]	Eastern Research Group, Ozone Science and Air Modeling Research Project H43T163: Diesel Construction Equipment Activity and Emissions Estimates for the Dallas/Ft. Worth Region, prepared for The Houston Advanced Research Center, August 31, 2005
Diesel Construction Equipment > 25 hp, except HGB[4] cranes	Statewide excluding 9-county DFW area	Eastern Research Group, Nonroad Ammonia Emissions Inventory Development, prepared for Texas Commission on Environmental Quality, November 24, 2006
Mining and Quarry, Special Trades, Scrap and Recycling, Utility, Rough Terrain Forklifts (RTFs), and Skid Steer Loaders Diesel Construction Equipment	Statewide	Eastern Research Group, Update of Diesel Construction Equipment Emissions Estimates for the State of Texas, Prepared for TCEQ, August 31, 2008.
Mining and Quarry Diesel Construction Equipment	Alamo Area Council of Governments area	AACOG Chapter 2, Table 2-27, 2005 Non-road Emissions Inventory

[2] Information taken from TexN User's Guide unless otherwise noted. *Eastern Research Group, Texas NONROAD (TexN) Model Version 1.0 User's Guide, Work Order No. 582-7-84003-FY-08-09, August 18, 2008.*
[3] Includes Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant Counties.
[4] Includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties.

Equipment Types	Region	Data Source
Heavy Highway Diesel Construction Equipment	Statewide	Eastern Research Group, Update of DCE Emission Estimates for the State of Texas Phase I and Phase II, July 31,2009 and Eastern Research Group, Update of Heavy-Highway Portion of Diesel Construction Equipment Inventory Using New Data Sources, prepared for TCEQ, July 15, 2014.
Diesel Cranes	Houston-Galveston-Brazoria (HGB) nonattainment area	Eastern Research Group, Nonroad Mobile Source Emissions Inventory Development for the Houston-Galveston-Brazoria Area, submitted to the Houston-Galveston Area Council, July 28, 2006
LPG Forklifts	DFW 9-county area and HGB nonattainment areas	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
Terminal Tractors and Transportation Refrigeration Units	DFW 9-county nonattainment area	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
Transportation Refrigeration Units	HGB nonattainment area	Eastern Research Group, Nonroad Mobile Source Emissions Inventory Development for the Houston-Galveston-Brazoria Area, submitted to the Houston-Galveston Area Council, July 28, 2006
Commercial Lawn and Garden	Statewide	Eastern Research Group, Development of Commercial Lawn and Garden Emissions Estimates for the State of Texas and Selected Metropolitan Areas, prepared for Texas Commission on Environmental Quality, November 24, 2003
Recreational Marine	Statewide (except HGB area)	Eastern Research Group, Recreational Marine Emissions Inventory, prepared for the Texas Commission on Environmental Quality, August 28, 2002

Equipment Types	Region	Data Source
Recreational Marine	HGB nonattainment area	E.H. Pechan & Associates, Development of 2007 Recreational Marine Emissions Inventory: Spatial and Temporal Allocation In the Houston-Galveston-Brazoria 8-County Area, 2008[5]
Agricultural Equipment	Statewide	E.H. Pechan & Associates, Inc.
All remaining equipment – see below	See below	NONROAD defaults - User's Guide for the Final NONROAD2005 Model, EPA420-R-05-013, December 2005

Equipment population estimates were taken from NONROAD defaults for the following equipment categories.

- Commercial – all equipment/fuel types
- Logging – all equipment/fuel types
- Railroad – all equipment/fuel types
- Recreational vehicles – all equipment/fuel types
- Residential lawn and garden – all equipment/fuel types
- Industrial – all equipment/fuel types excluding LPG forklifts in DFW and HGB, Transportation Refrigeration Units and Terminal Tractors in DFW
- Construction and Mining – all gasoline, LPG, CNG
- Construction and Mining – diesel < 25 hp
- Construction and Mining – diesel > 25 hp:
  - Tampers/Rammers
  - Plate Compactors
  - Signal Boards/Light Plants
  - Concrete/Industrial Saws
  - Crushing/Processing Equipment
  - Cement/Mortar Mixers
  - Dumpers/Tenders
  - Off-Highway Tractors
  - Other Construction Equipment

Table 2. Spatial Allocation Surrogates for Diesel Construction Equipment

Sector	Surrogate
Agricultural	Dollar value outputs from Texas Regional Economic Models, Inc. (REMI) model*
Boring and Drilling Equipment	EDA data and dollar value outputs from TX REMI model*
Brick and Stone Operations	Dollar value outputs from TX REMI model*
City and County Road Construction	Project Dollar Value from Reed Construction Data

[5] E.H. Pechan & Associates, Development of 2007 Recreational Marine Emissions Inventory: Spatial and Temporal Allocation in the Houston-Galveston-Brazoria 8-County Area, 2008.

Sector	Surrogate
Commercial Construction	Building footprint data from McGraw Hill Corporation (MHC)
Concrete Operations	Dollar value outputs from TX REMI model*
County-Owned Construction Equipment	County level census projections
Cranes	EDA data and dollar value outputs from TX REMI model*
Heavy Highway Construction	Project lane-mile data by county from TxDOT
Landfill Operations	Landfill disposal volumes from TCEQ
Landscaping Activities	Dollar value outputs from TX REMI model*
Manufacturing Operations	Dollar value outputs from TX REMI model*
Mining and Quarry Operations	Million Tons of Coal Production and Annual non-office employee hours respectively (2007)[6]
Municipal-Owned Construction Equipment	County level census projections
Transportation Sales/Services	Dollar value outputs from TX REMI model*
Residential Construction	County-level housing permit data from the Texas A&M Real Estate Center for 1980 through 2013; County-level census projections from the Texas State Data Center for 2014 through 2050; Housing start for the southern region of the country from the U.S. Census Bureau prior to 1980
Rough Terrain Forklifts, Special Trades Construction, and Trenchers	2007 Economy.com[6]
Scrap/Recycling Operations	USA Data© (2007)[6]
Skid Steer Loaders	EDA data and dollar value outputs from TX REMI model*
TxDOT Construction Equipment	None – TxDOT provided complete county-level population data
Utility Construction	Project Dollar value from Reed Construction Data and MHC

* State level extrapolation and county allocation using 9-county DFW population as basis.

Table 3. Sources of Geographic Allocation Data (Non-DCE)

Equipment Types	Region	Data Source
LPG Forklifts	9-county DFW area and HGB nonattainment areas	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005

[6] Eastern Research Group, Update of Diesel Construction Equipment Emissions Estimates for the State of Texas, Prepared for TCEQ, August 31, 2008.

Equipment Types	Region	Data Source
Terminal Tractors and Transportation Refrigeration Units	9-county DFW nonattainment area	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
Transportation Refrigeration Units	HGB nonattainment area	Eastern Research Group, Nonroad Mobile Source Emissions Inventory Development for the Houston-Galveston-Brazoria Area, submitted to the Houston-Galveston Area Council, July 28, 2006
Commercial Lawn and Garden	Statewide	Eastern Research Group, Development of Commercial Lawn and Garden Emissions Estimates for the State of Texas and Selected Metropolitan Areas, prepared for Texas Commission on Environmental Quality, November 24, 2003
Recreational Marine	Statewide	Eastern Research Group, Recreational Marine Emissions Inventory, prepared for the Texas Commission on Environmental Quality, August 28, 2002
All remaining equipment – see below	See below	NONROAD defaults - User's Guide for the Final NONROAD2005 Model, EPA420-R-05-013, December 2005

Geographic allocation surrogates were taken from NONROAD defaults for the following equipment categories.

- Agricultural – all equipment
- Commercial – all equipment
- Logging – all equipment
- Railroad – all equipment
- Recreational vehicles – all equipment
- Residential lawn and garden – all equipment
- Industrial – all equipment/fuel types excluding LPG forklifts in DFW and HGB, TRUs and Terminal Tractors in DFW

Table 4. Sources of Equipment Activity Data

Equipment Types	Region	Data Source
Diesel Cranes	HGB nonattainment area	Eastern Research Group, Nonroad Mobile Source Emissions Inventory Development for the Houston-Galveston-Brazoria Area, submitted to the Houston-Galveston Area Council, July 28, 2006

Equipment Types	Region	Data Source
Diesel Construction Equipment > 25 hp	9-county DFW nonattainment area	Eastern Research Group, Ozone Science and Air Modeling Research Project H43T163: Diesel Construction Equipment Activity and Emissions Estimates for the Dallas/Ft. Worth Region, prepared for The Houston Advanced Research Center, August 31, 2005
Diesel Construction Equipment > 25 hp	Remainder of State, except HGB cranes	Eastern Research Group, Nonroad Ammonia Emissions Inventory Development, prepared for Texas Commission on Environmental Quality, November 24, 2006
LPG Forklifts	9-county DFW and HGB nonattainment areas	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
Terminal Tractors and Transportation Refrigeration Units	9-county DFW nonattainment area	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
Transportation Refrigeration Units	HGB nonattainment area	Eastern Research Group, Nonroad Mobile Source Emissions Inventory Development for the Houston-Galveston-Brazoria Area, submitted to the Houston-Galveston Area Council, July 28, 2006
Commercial Lawn and Garden	Statewide	Eastern Research Group, Development of Commercial Lawn and Garden Emissions Estimates for the State of Texas and Selected Metropolitan Areas, prepared for Texas Commission on Environmental Quality, November 24, 2003
All remaining equipment – see equipment population list above	See equipment population list above	NONROAD defaults - User's Guide for the Final NONROAD2005 Model, EPA420-R-05-013, December 2005

Table 5. Activity Surrogates for Construction Equipment

Sector	Primary Estimation Method
Agricultural	Industry expert profiles
Boring and Drilling Equipment	Industry expert profiles
Brick and Stone Operations	Industry expert profiles
City and County Road Construction	Reed Construction profile
Commercial Construction	Square feet of installed building space from MHC
Concrete Operations	Industry expert profiles
County-Owned Construction Equipment	Survey findings from HARC study

Sector	Primary Estimation Method
Cranes	Industry expert profiles
Heavy Highway Construction	Survey findings from H-GAC study
Landfill Operations	Survey profile from TCEQ study
Landscaping Activities	Industry expert profiles
Manufacturing Operations	Industry expert profiles
Municipal-Owned Construction Equipment	Survey findings from HARC study
Transportation Sales/Services	Industry expert profiles
Residential Construction	Single family housing construction profile
Rough Terrain Forklifts	Industry expert profiles
Scrap/Recycling Operations	Industry expert profiles
Skid Steer Loaders	Industry expert profiles
Special Trades Construction	Industry expert profiles
Trenchers	Industry expert profiles
TxDOT Construction Equipment	Engine clock hours provided by TxDOT
Utility Construction	Linear feet installed from Reed Construction Data

Table 6. Sources of Temporal Allocation Factors

Equipment Types	Region	Data Source
Diesel Construction Equipment > 25 hp	9-county DFW nonattainment area	Eastern Research Group, Ozone Science and Air Modeling Research Project H43T163: Diesel Construction Equipment Activity and Emissions Estimates for the Dallas/Ft. Worth Region, prepared for The Houston Advanced Research Center, August 31, 2005
Diesel Construction Equipment > 25 hp	Statewide excluding 9-county DFW area	Eastern Research Group, Nonroad Ammonia Emissions Inventory Development, prepared for Texas Commission on Environmental Quality, November 24, 2006
LPG Forklifts	9-county DFW and HGB nonattainment areas	Eastern Research Group, Data Collection, Sampling and Emissions Inventory Preparation Plan for Selected Commercial and Industrial Equipment: Phase II, Final Report, prepared for the Texas Commission on Environmental Quality, August 31, 2005
All remaining equipment – see equipment population list above	See equipment population list above	NONROAD defaults - User's Guide for the Final NONROAD2005 Model, EPA420-R-05-013, December 2005

2.2 Diesel Construction Equipment Population Growth Surrogates[7]

The TexN model contains 25 distinct "sectors" with distinct equipment population and activity profiles. Diesel construction equipment (DCE) comprises most of these "sectors". Two "sectors" within TexN, being miscellaneous equipment having less than 25 horsepower and all non-DCE, use the default profiles from EPA's NONROAD model. The remaining 23 of these sectors represent independent DCE profiles developed specifically for the TCEQ and the TexN model under numerous projects funded by the TCEQ. The TCEQ has focused on DCE specifically, as DCE has the single largest impact on total NOx emissions from all nonroad mobile equipment represented within the model, which is a driving precursor to ozone formation. Table 7 presents a summary of the growth surrogates applied to a 2012 base-year population to forecast equipment population for each of the DCE subsectors.

Table 7. DCE Growth Surrogates

Non-DCE*	**NONROAD default**
DCE - Agricultural Activities	2012 Texas Agricultural Census
DCE – Boring & Drilling Equipment	Economy.com
DCE – Brick & Stone Operations	Economy.com
DCE – City and County Road Construction	Texas State Data Center county-level census population
DCE – Commercial Construction	Economy.com
DCE – Concrete Operations	Economy.com
DCE – County-Owned Construction Equipment	Texas State Data Center county-level census population
DCE – Cranes	Economy.com
DCE – Heavy-Highway Construction	Annual highway expenditures from the Texas Comptroller's Office, for the period 2007 – 2013, appended the data to the 1998-2006 dataset normalized to 1998 dollars using the Consumer Price Index (CPI); Economy.com data prior to 1998 and after 2013
DCE – Landfill Operations	Texas State Data Center county-level census population
DCE – Landscaping Activities	Tx REMI model outputs up to 2013; Texas State Data Center census population data for 2014-2050
DCE – Manufacturing Operations	Economy.com
DCE – Municipal-Owned Construction Equipment	Texas State Data Center county-level census population
DCE – Transportation/Sales/Services	Economy.com

[7] Eastern Research Group, Texas NONROAD Model Update and Enhancement, Work Order No. 582-11-99776-FY14-25, July 30, 2014.

Non-DCE*	NONROAD default
DCE – Residential Construction	County-level housing permit data from the Texas A&M Real Estate Center for 1980 through 2013; County-level census projections from the Texas State Data Center for 2014 through 2050; Housing start for the southern region of the country from the U.S. Census Bureau prior to 1980
DCE – Rough Terrain Forklifts	Economy.com
DCE – Scrap Recycling Operations	Tx REMI model outputs up to 2013; Texas State Data Center census population data for 2014-2050
DCE – Skid Steer Loaders	Equipment Data Associates Sales
DCE – Special Trades Construction	Economy.com
DCE – Trenchers	Economy.com
DCE – TxDOT Construction Equipment*	Zero growth per TxDOT Equipment Replacement Policy
DCE – Utility Construction	Economy.com
DCE – Mining & Quarry Operations	Economy.com
Off-road tractors, Miscellaneous , and all Equipment < 25 hp*	NONROAD default

2.3 Meteorological Data[8]

TexN utilizes high, low and average temperature data, primarily to calculate evaporative emissions from gasoline engines. These data are required as part of TexN's primary input file. In addition, related data on relative humidity and atmospheric pressure are used during post-processing of the TexN model outputs to adjust diesel NOx emissions for ambient effects. The TexN meteorological data is based on historical climate data from December 1996 through June 2014 from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) (http://cdo.ncdc.noaa.gov/qclcd_ascii/).

2.4 Fuel Property Data

In order to maintain a high confidence level in the fuel parameters used in the development of emission inventories, trend analysis and control strategy analysis, the TCEQ has undertaken a program to periodically collect and analyze fuel samples. The data ensures the accuracy of local specific fuel information and also provides the best data available to be used in analyses to support Texas State Implementation Plan (SIP) and control strategy development. The latest fuel sampling data, conducted in the summer of 2014[9], was incorporated into TexN for this modeling effort.

[8] Eastern Research Group, Texas NONROAD Model Update and Enhancement, Work Order No. 582-11-99776-FY14-25, July 30, 2014.
[9] Eastern Research Group, 2014 Summer Fuel Field Study (Revised), prepared for Texas Commission on Environmental Health (TCEQ), Revised January 2015.

2.5 Emission Factors and Control Phase-In[10]

The TexN model uses the default emission factor and technology type files provided with US EPA NONROAD model, thus using the same phase-in schedule and emission factors for Federal controls. However, unlike the NONROAD model which does not estimate ammonia emissions, there are four ammonia emission factors in TexN: one for diesel engines, one for spark ignition engines (gasoline and gaseous fuel) without three-way catalysts (TWCs), one for gasoline engines with TWCs, and one for natural gas/LPG engines with TWCs. For more information on how these emission factors were derived, please refer to the TexN User's Guide (2008) and the Addendum (2009)[11].

2.6 Post Processing Adjustments and Additional Controls[12]

TexN applies adjustment factors to the emissions estimates in the output files to generate the final criteria pollutant and ammonia emissions values. Post-processing applies county specific adjustments to emissions estimates for the appropriate SCCs. Depending upon the SCC and county, the following adjustments may be applied within the database:

- County and year specific temperature and humidity adjustments for NOx emissions;
- Adjustments for Texas Low Emission Diesel (TxLED) impacts;
- Altitude, correcting for decreased engine efficiency at increasing elevation;
- Soil compaction, reflecting relative ease or difficulty digging;
- Ground cover, reflecting relative ease or difficulty in land-clearing activity; and
- Reformulated gasoline.

3.0 Emissions Estimation

Using the latest version of the Texas NONROAD (TexN) model[13], which incorporates all of the latest available data updates, ERG developed both controlled and uncontrolled average summer weekday emissions for VOC and NOX for the analysis years 2012, 2014, 2017, 2020, 2023, 2026, and 2028 for the DFW nine-county and HGB eight-county 1997 eight-hour ozone nonattainment areas.

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[10] Information taken from TexN User's Guide unless otherwise noted. *Eastern Research Group, Texas NONROAD (TexN) Model Version 1.0 User's Guide, Work Order No. 582-7-84003-FY-08-09, August 18, 2008.*

[11] Eastern Research Group, Deliverable 6 – Update of TexN User's Guide Addendum, Work Order No. 582-7-84003-FY09-19, July 31, 2009.

[12] Information taken from TexN User's Guide unless otherwise noted. *Eastern Research Group, Texas NONROAD (TexN) Model Version 1.0 User's Guide, Work Order No. 582-7-84003-FY-08-09, August 18, 2008.*

[13] TexN version 1.7.1

3.1 Controlled Emissions Estimates

The controlled emissions estimates reflect the following state and federal controls:

- Small Spark Ignition Rule - Phase I (Federal),
- Small Spark Ignition Rule - Phase 2 (Federal),
- Large Spark Ignition Rule (Federal),
- Small Spark Ignition/Spark Ignition Marine Rule (Federal),
- Diesel Recreation Marine Rule (Federal),
- Tier 1 Diesel Rule (Federal),
- Tier 2/3 Diesel Rule (Federal),
- Tier 4 Diesel Rule (Federal),
- Texas Low Emission Diesel Requirements (State), and
- Reformulated Gasoline Requirements (State).

The resulting controlled emission estimates for a typical ozone season weekday for multiple years for each area are summarized in Tables 8 – 13.

Table 8. NO_X Controlled Emission Estimates – DFW 4-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	7.59	7.08	5.95	4.86	4.18	3.73	3.53
Dallas	25.40	22.35	17.99	14.68	12.88	11.88	11.51
Denton	5.19	4.54	3.62	3.01	2.72	2.59	2.56
Tarrant	14.58	12.84	10.20	8.24	7.13	6.49	6.24
Grand Total	**52.75**	**46.81**	**37.77**	**30.79**	**26.91**	**24.69**	**23.84**

Table 9. VOC Controlled Emission Estimates – DFW 4-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	5.19	4.62	4.13	3.90	3.85	3.87	3.91
Dallas	18.50	15.96	14.12	13.46	13.47	13.72	13.96
Denton	3.91	3.38	2.88	2.62	2.54	2.52	2.53
Tarrant	10.06	8.63	7.47	7.00	6.94	7.02	7.13
Grand Total	**37.66**	**32.59**	**28.60**	**26.99**	**26.81**	**27.13**	**27.53**

Table 10. NOx Controlled Emission Estimates – DFW 9-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	7.59	7.08	5.95	4.86	4.18	3.73	3.53
Dallas	25.40	22.35	17.99	14.68	12.88	11.88	11.51
Denton	5.19	4.54	3.62	3.01	2.72	2.59	2.56
Ellis	2.66	2.44	1.95	1.50	1.25	1.08	1.01
Johnson	2.57	2.26	1.66	1.24	1.03	0.92	0.88
Kaufman	2.60	2.09	1.56	1.18	0.98	0.88	0.85
Parker	2.08	1.70	1.25	0.94	0.78	0.70	0.68
Rockwall	0.84	0.77	0.65	0.53	0.45	0.41	0.39
Tarrant	14.58	12.84	10.20	8.24	7.13	6.49	6.24
Grand Total	**63.50**	**56.08**	**44.82**	**36.18**	**31.40**	**28.69**	**27.64**

Table 11. VOC Controlled Emission Estimates – DFW 9-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	5.19	4.62	4.13	3.90	3.85	3.87	3.91
Dallas	18.50	15.96	14.12	13.46	13.47	13.72	13.96
Denton	3.91	3.38	2.88	2.62	2.54	2.52	2.53
Ellis	1.37	1.21	1.02	0.90	0.86	0.84	0.84
Johnson	0.79	0.69	0.60	0.56	0.55	0.55	0.56
Kaufman	0.94	0.82	0.72	0.67	0.66	0.66	0.67
Parker	0.99	0.89	0.76	0.69	0.67	0.66	0.67
Rockwall	1.03	0.90	0.76	0.66	0.60	0.57	0.56
Tarrant	10.06	8.63	7.47	7.00	6.94	7.02	7.13
Grand Total	**42.78**	**37.10**	**32.47**	**30.47**	**30.14**	**30.42**	**30.82**

Table 12. NOx Controlled Emission Estimates – HGB Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Brazoria	3.24	2.84	2.25	1.76	1.49	1.35	1.29
Chambers	0.75	0.62	0.47	0.36	0.31	0.29	0.28
Fort Bend	3.86	3.61	2.95	2.34	2.00	1.79	1.70
Galveston	2.39	2.08	1.67	1.30	1.09	0.97	0.91
Harris	36.67	32.26	25.36	20.04	17.24	15.70	15.14
Liberty	1.10	0.92	0.68	0.51	0.42	0.38	0.36
Montgomery	3.05	2.66	2.12	1.67	1.42	1.29	1.24
Waller	0.81	0.69	0.51	0.39	0.33	0.30	0.29
Grand Total	**51.88**	**45.68**	**36.01**	**28.36**	**24.30**	**22.06**	**21.21**

Table 13. VOC Controlled Emission Estimates – HGB Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Brazoria	2.67	2.34	1.94	1.69	1.56	1.49	1.46
Chambers	0.89	0.78	0.62	0.50	0.44	0.39	0.37
Fort Bend	2.07	1.86	1.68	1.61	1.61	1.64	1.67
Galveston	3.08	2.70	2.26	1.95	1.78	1.67	1.63
Harris	26.09	22.69	19.39	17.80	17.36	17.35	17.51
Liberty	0.51	0.46	0.40	0.37	0.36	0.37	0.37
Montgomery	3.69	3.29	2.82	2.52	2.38	2.32	2.30
Waller	0.38	0.34	0.30	0.27	0.26	0.26	0.26
Grand Total	**39.38**	**34.45**	**29.40**	**26.71**	**25.75**	**25.49**	**25.57**

3.2 Uncontrolled Emissions Estimates

To estimate the uncontrolled emissions using TexN, the Technology Type Year was set to 1970, essentially turning off all Federal controls. In addition, the State controls for TxLED and RFG were also turned off. The resulting emissions are presented in Tables 14-19.

Table 14. NOx Uncontrolled Emission Estimates – DFW 4-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	19.43	21.60	24.26	25.74	27.22	28.52	29.45
Dallas	60.13	65.10	71.72	74.79	77.97	80.68	82.61
Denton	12.69	13.67	15.16	16.15	17.19	18.22	18.97
Tarrant	35.90	38.85	42.32	44.17	46.09	47.78	48.94
Grand Total	**128.15**	**139.23**	**153.46**	**160.85**	**168.46**	**175.21**	**179.97**

Table 15. VOC Uncontrolled Emission Estimates – DFW 4-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	16.06	16.78	17.76	18.55	19.33	20.09	20.61
Dallas	57.82	60.50	64.29	67.35	70.44	73.44	75.47
Denton	10.82	11.27	11.91	12.44	12.96	13.48	13.83
Tarrant	30.15	31.49	33.33	34.85	36.38	37.87	38.88
Grand Total	**114.85**	**120.04**	**127.29**	**133.18**	**139.12**	**144.88**	**148.78**

Table 16. NOx Uncontrolled Emission Estimates – DFW 9-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	19.43	21.60	24.26	25.74	27.22	28.52	29.45
Dallas	60.13	65.10	71.72	74.79	77.97	80.68	82.61
Denton	12.69	13.67	15.16	16.15	17.19	18.22	18.97
Ellis	7.19	8.30	9.34	9.75	10.19	10.53	10.76
Johnson	7.64	8.38	8.90	9.19	9.50	9.82	10.03
Kaufman	7.79	7.73	8.35	8.80	9.27	9.75	10.09
Parker	6.42	6.42	6.86	7.18	7.51	7.85	8.10
Rockwall	2.11	2.33	2.62	2.80	2.99	3.17	3.31
Tarrant	35.90	38.85	42.32	44.17	46.09	47.78	48.94
Grand Total	**159.30**	**172.37**	**189.53**	**198.57**	**207.93**	**216.33**	**222.25**

Table 17. VOC Uncontrolled Emission Estimates – DFW 9-County Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Collin	16.06	16.78	17.76	18.55	19.33	20.09	20.61
Dallas	57.82	60.50	64.29	67.35	70.44	73.44	75.47
Denton	10.82	11.27	11.91	12.44	12.96	13.48	13.83
Ellis	3.55	3.78	4.03	4.19	4.35	4.50	4.60
Johnson	2.87	3.05	3.22	3.36	3.50	3.63	3.73
Kaufman	3.14	3.24	3.43	3.59	3.75	3.90	4.01
Parker	2.82	2.93	3.10	3.23	3.35	3.48	3.56
Rockwall	2.55	2.63	2.75	2.85	2.96	3.06	3.13
Tarrant	30.15	31.49	33.33	34.85	36.38	37.87	38.88
Grand Total	**129.79**	**135.67**	**143.82**	**150.40**	**157.03**	**163.46**	**167.81**

Table 18. NOx Uncontrolled Emission Estimates – HGB Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Brazoria	8.74	9.36	10.26	10.64	11.08	11.48	11.74
Chambers	2.10	2.18	2.33	2.44	2.57	2.69	2.77
Fort Bend	10.21	11.48	12.70	13.29	14.00	14.66	15.11
Galveston	6.33	6.70	7.38	7.55	7.74	7.90	8.02
Harris	93.60	102.60	112.36	116.37	121.24	125.65	128.71
Liberty	3.34	3.44	3.65	3.75	3.88	4.00	4.08
Montgomery	7.95	8.54	9.39	9.80	10.27	10.71	11.01
Waller	2.48	2.56	2.73	2.86	2.99	3.13	3.21
Grand Total	**134.74**	**146.85**	**160.80**	**166.70**	**173.76**	**180.21**	**184.67**

Table 19. VOC Uncontrolled Emission Estimates – HGB Area (Tons Per Day)

County	2012	2014	2017	2020	2023	2026	2028
Brazoria	6.81	7.07	7.43	7.69	7.95	8.21	8.38
Chambers	1.82	1.87	1.94	2.00	2.06	2.12	2.16
Fort Bend	6.97	7.36	7.85	8.22	8.61	8.98	9.24
Galveston	6.79	7.00	7.32	7.56	7.79	8.02	8.18
Harris	76.65	80.32	85.22	89.00	92.94	96.79	99.36
Liberty	1.54	1.61	1.70	1.78	1.85	1.92	1.97
Montgomery	8.99	9.32	9.80	10.18	10.56	10.92	11.16
Waller	1.20	1.25	1.32	1.37	1.43	1.48	1.52
Grand Total	**110.76**	**115.80**	**122.58**	**127.79**	**133.19**	**138.45**	**141.97**

3.3 Trends

The following figures illustrate the trends for controlled emissions in the DFW and HGB areas.

Figure 1. DFW Controlled Emissions Trends (NO_X) (Tons Per Day)

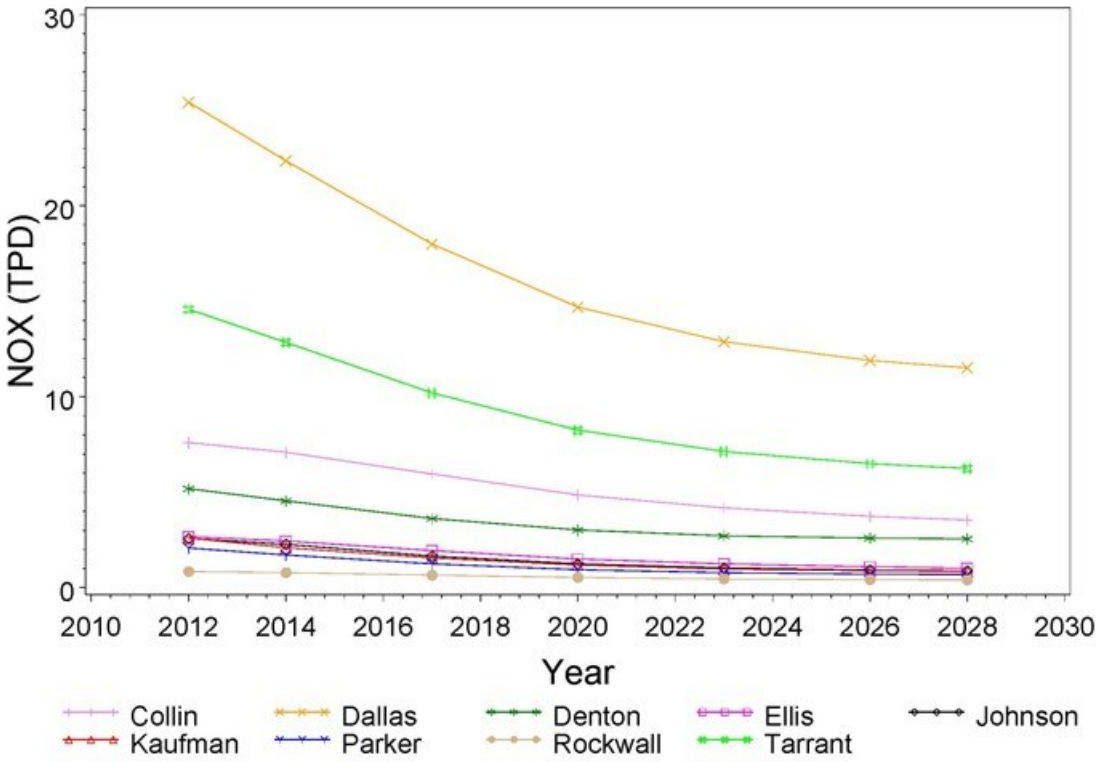

Figure 2. DFW Controlled Emissions Trends (VOC) (Tons Per Day)

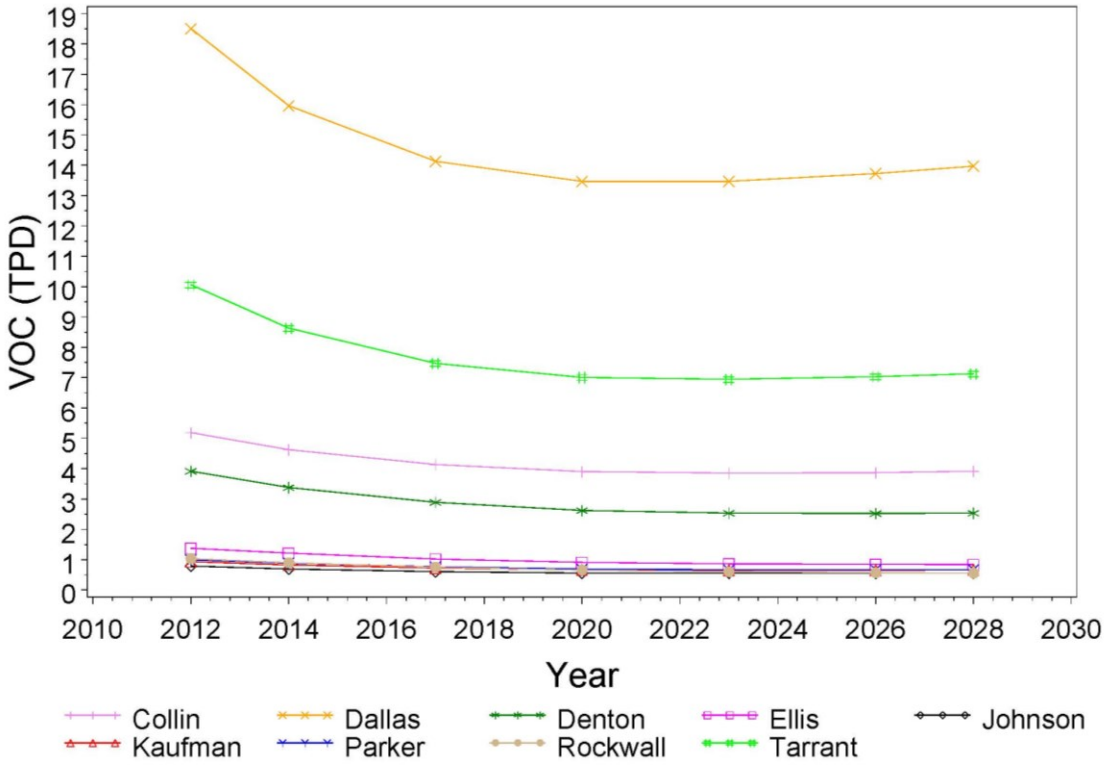

Figure 3. HGB Controlled Emissions Trends (NOx) (Tons Per Day)

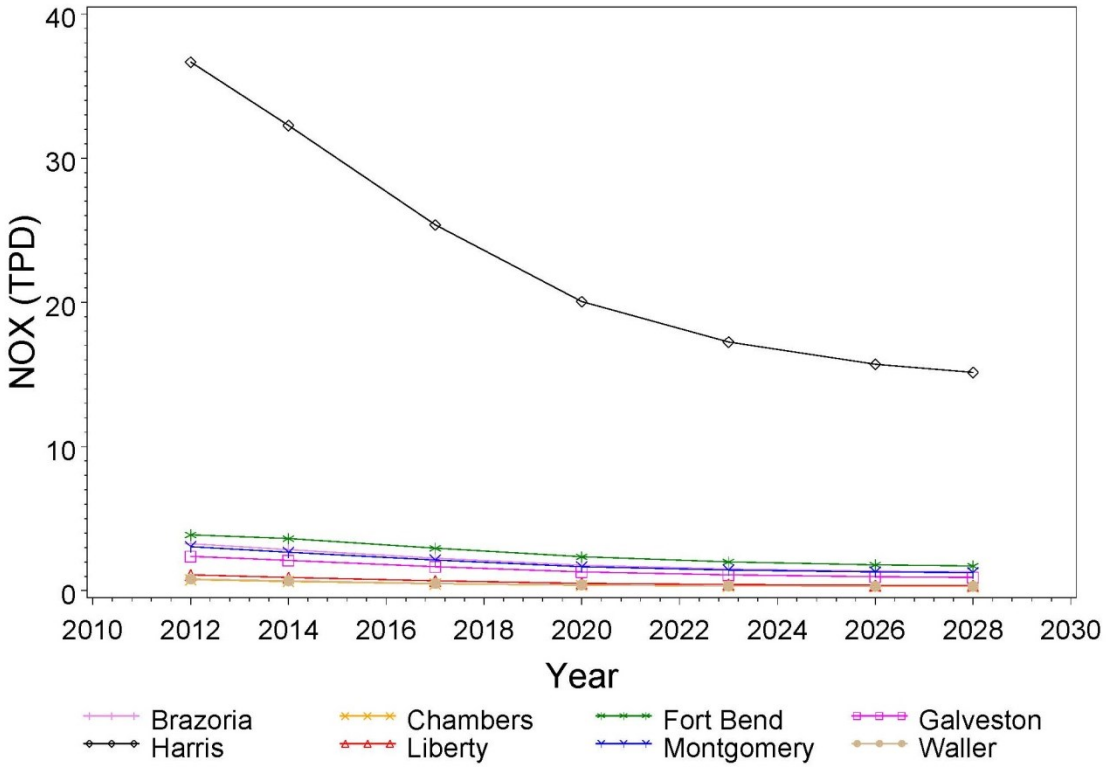
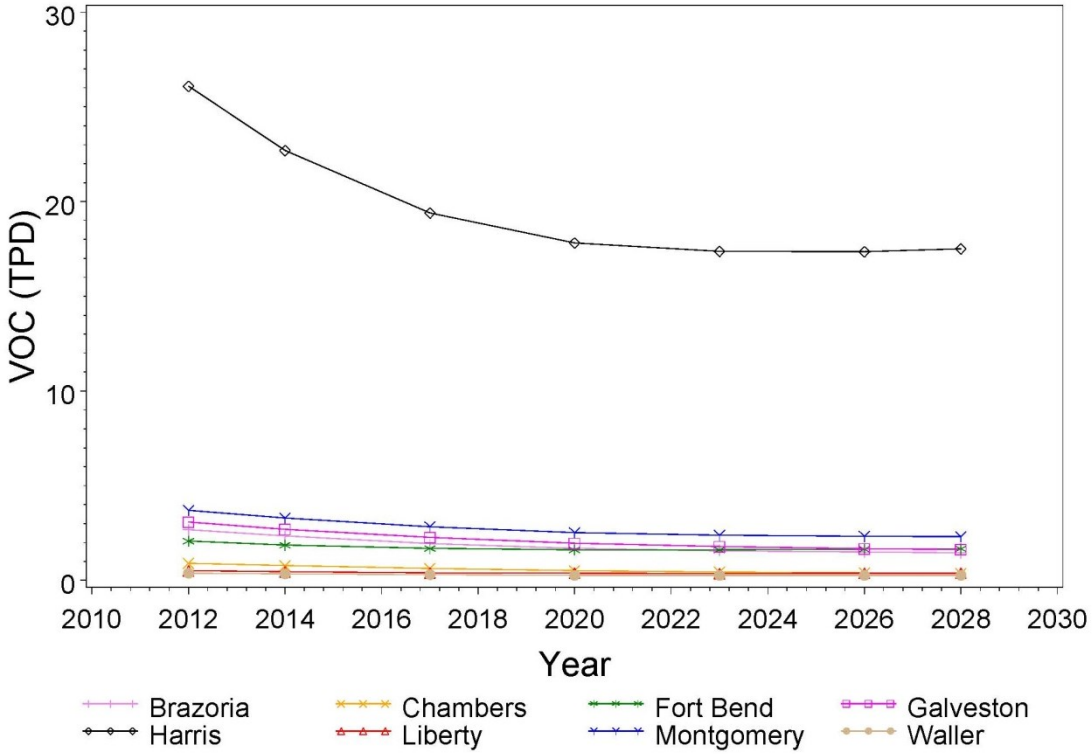
Figure 4. HGB Controlled Emissions Trends (VOC) (Tons Per Day)