Eastern Research Group, Inc.

2014 Summer Fuel Field Study (Revised)

FINAL REPORT

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Prepared by:

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2014 SUMMER FUEL FIELD STUDY
FINAL REPORT

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1.0 Project Overview

The purpose of this Work Order was to develop physical properties and speciation profiles, and to report laboratory test results for samples of gasoline and diesel fuel collected from retail stations across Texas. Testing of various properties was completed in an approved laboratory which involved speciation of volatile organic compounds (VOC) including oxygenates, determination of Reid vapor pressure (RVP), and estimation of sulfur in gasoline, and quantification of aromatics, cetane and sulfur in diesel fuel.

In order to maintain a high confidence level in the fuel parameters used in the development of on-road emission inventories, trend analysis and control strategy analysis, the TCEQ has undertaken a program to periodically collect and analyze fuel samples. The data will ensure the accuracy of local specific fuel information and also provide the best data available to be used for analysis to support Texas State Implementation Plan (SIP) and control strategy development.

Samples of regular, mid-grade, and premium gasoline, and diesel fuel were taken from 92 retail gas stations, from the 25 areas across the state. The 25 areas corresponded to the 25 Texas Department of Transportation (TxDOT) Districts.

The following summarizes the results of this study, including sample collection and lab analysis, the development of fuel parameter files for use in EPA's MOVES emission factor model, based on this data. Detailed electronic files with supporting data and analysis are provided separately on CD.

2.0 Site Selection

In this task ERG developed a fuel sampling plan to be implemented by Southwest Research Institute (SwRI) during the summer of 2014. ERG obtained background information to help assess the geographic and temporal boundaries for sampling at retail stations. This information included:

- The geographic boundaries of the 25 TxDOT districts in the state; and
- Surrogates for estimating sales volumes from readily available data, such as underground storage tank numbers and sizes, obtained from the TCEQ Petroleum Storage Tank (PST) Datasets.1

ERG used this information to develop the selections for the fuel sampling task and specify the areas within the districts and station sites. Fuel Sampling Plan and Site Selection

2.1 Fuel Sampling Plan and Site Selection

A Sampling Plan was developed to specify the number of stations per area, the total number of samples (including number of diesel and gas samples, across gas grades), and the allocation of stations across the different areas. The sampling plan specifications included the following:

- Each fuel sampling region has a minimum of three sample sites;
- Both diesel and gasoline samples are to be collected at each location;
- Regular, mid-grade, and premium gasoline grades are to be sampled; and
- Gasoline and diesel samples are to be collected separately (no compositing).

This approach required a lab test of every sample. As a result, it was more costly and limited the total number of stations that could be sampled. However, it did provide an indication of differences within areas that would not be discernible using a compositing approach. Specifically, this approach enabled the determination of minimum, maximum, and average fuel parameter values, instead of just averages for each region. This characterization is more consistent with MOVES modeling, in that it will allow the TCEQ to specify maximum and average parameter values for model inputs, such as fuel sulfur levels.

[1] Downloaded from http://www.tceq.texas.gov/adminservices/data/pst_datasets html, downloaded March 18, 2014.

Table 1 summarizes the number of stations to be initially sampled for each TxDOT Region. At each station, three gasoline samples and one diesel sample were obtained.

Table 1. Initial Sampling Plan Summary Table

TxDOT District	Number of Stations	Area Designation
Abilene	3	Attainment Area
Amarillo	3	Attainment Area
Atlanta	3	Attainment Area
Austin	5	Attainment Area (Former Early Action Compact Area)
Beaumont	5	Beaumont-Port Arthur Nonattainment Area
Brownwood	3	Attainment Area
Bryan	3	Attainment Area
Childress	3	Attainment Area
Corpus Christi	4	Corpus Christi Near Nonattainment Area
Dallas	4	Dallas-Ft. Worth Nonattainment Area
El Paso	4	Attainment Area (Maintenance)
Fort Worth	4	Dallas-Ft. Worth Nonattainment Area
Houston	7*	Houston-Galveston-Brazoria Nonattainment Area
Laredo	3	Attainment Area
Lubbock	3	Attainment Area
Lufkin	3	Attainment Area
Odessa	3	Attainment Area
Paris	3	Attainment Area
Pharr	3	Attainment Area
San Angelo	3	Attainment Area
San Antonio	5	San Antonio Early Action Compact Area
Tyler	5	Northeast Texas Early Action Compact Area
Waco	3	Attainment Area
Wichita Falls	3	Attainment Area
Yoakum	4	Victoria Near Nonattainment Area
Total	92	

* These stations were sampled a second time later in the summer, as described below.

In order to identify specific fuel stations for sampling, the latest Petroleum Storage Tank (PST) Database was obtained from the TCEQ, consisting of several large text files.[2] The following data were selected from these files.

- Owner information (name, contact, enforcement actions, etc.);
- Facility information (facility status [active or inactive], facility type [retail, aircraft, fleet, etc.], location, number of tanks);
- Tank information (tank size and status [in-use, removed, etc.]); and

[2] Data was obtained from TCEQ PST Registration Datasets obtained from http://www.tceq.texas.gov/adminservices/data/pst_datasets.html, downloaded March 18, 2014.

- Composition information (tank-specific information including fuel type).

These files were merged into one master file for site selection purposes. Next, only retail establishments were selected where the status was "active" within the PST database. It should be noted that retail service stations are only one type of facility that can have tanks; other facility types include bulk fuel terminals, state agency fleet tanks, municipal fleet tanks, etc. The next step was to include only stations that sell both gasoline and diesel. Also, to ensure that the larger service stations will be sampled – size being used as a surrogate for fuel throughput, since actual throughput data is only available at the wholesale level – the list was narrowed down by extracting only those facilities that had tank capacities greater than or equal to 10,000 gallons. Furthermore, ERG filtered out the stations with enforcement actions against them from the TCEQ. Each of the retail stations remaining on the list was then assigned to the appropriate TxDOT district based on county designation.

From this master list, ERG selected primary and alternate sampling candidates. The alternate sampling candidates were selected in the event that sampling at any primary sampling candidate was not possible (i.e., out of business, temporarily closed, or otherwise inaccessible). As indicated in the initial sampling plan presented in Table 1, three to seven primary sampling candidates were selected for each TxDOT district. In addition, another three to seven alternate sampling candidates were also selected for each TxDOT district. The primary and alternate sampling candidates were selected using a weighted random sample where weights were applied to each station that were directly proportional to the total number of gasoline plus diesel tanks listed for each station in the PST database. Random numbers between 0 and 1 were then assigned to each station, and multiplied by the weighting factor. The resulting list was then sorted by weighted random number in descending order for station selection. In a few instances, stations located in isolated rural counties were replaced with another more accessible station in the same TxDOT district, in order to reduce sample collection costs and time. Likewise, those stations with missing address information were also replaced with another station having a complete address within the dataset. The final sampling candidates are presented in Attachment 1.

In addition to the initial round of sampling, a second round of testing was conducted in an attempt to obtain a better understanding of temporal variability of fuel composition within a region. For a small subset of fueling stations (the seven located in the Houston area), SwRI conducted a second round of sampling, ensuring that enough time elapsed for complete tank turnover (at least 4 weeks). This second round of sampling is intended to make a preliminary assessment of the temporal variability of fuel parameters at the station level.

3.0 Sampling and Laboratory Analysis

3.1 Objective

The following describes the sampling protocol and laboratory test results for the study. Under this project, SwRI provided containers and packaging, gasoline and diesel sample acquisition services from retail station pumps, shipping, sample handling and testing for summer fuels in 2014. Service station locations were identified by ERG, as described above.

3.2 Retail Station and Sample Collection and Handling Procedures

Independent contractors (ICs) working with SwRI acquired the fuel samples from retail stations. Each IC received written instructions, service station sampling procedures, sample containers, shipping instructions, etc. from SwRI. All contractors were instructed on retail station sample acquisition with special emphasis on sample handling, and safe disposal of flushed gasoline.

SwRI used U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) approved fuel sample containers and shipping cartons. Boxes were assembled at SwRI by trained staff, and all appropriate shipping materials were provided to the ICs along with FedEx-approved instructions for shipment of hazardous materials.

The containers were delivered cleaned and dried to the ICs. The ICs purged three gallons of gasoline product through the pump nozzle before obtaining a sample, or purged ½ gallon of the appropriate fuel immediately after the appropriate grade was purchased by the previous customer. When possible the temperature of the flushed sample was recorded. Immediately after the fuel was flushed from the pump, the ICs attached a spacer, if needed, to the pump nozzle. The nozzle extension was inserted into the sample container. The pump nozzle was inserted into the extension with slot over the air bleed hole. The sample container was slowly filled through the nozzle extension to 70 to 85% full. The nozzle extension was removed and the seal and cap were immediately inserted into the sample container. Checks were performed for leaks and the sample was prepared for air shipment. The ICs also recorded the ground cover around the pumps at each station.

When diesel samples were acquired, the ICs filled the sample container slowly to 70 to 85% full. The seal and cap were immediately inserted into the sample container. Checks for leaks were performed and the sample was prepared for air shipment. The IC also recorded the sulfur content labeling of the diesel pump used to obtain the diesel sample.

The IC used FedEx for sample shipment return to SwRI. Members of the SwRI shipping and receiving team meet regularly with FedEx and attend IATA and International Civil Aviation Association (ICAO) hazardous materials shipping and handling training sessions to keep abreast of current regulations. All samples were chilled.

3.3 Sample Locations and Grades of Fuel

Four fuel samples were acquired at each station visited, including three grades of gasoline and one diesel sample. Sampling took place at a minimum of three retail stations for each of the 25 districts of the state, as discussed above. Attachment 2 contains the listing of all samples acquired, date of sampling, location name, brand of fuel, address, gasoline grades acquired, posted octane, temperature of flushed sample and pad cover of sampling location.

3.4 Laboratory Testing

All testing was accomplished in the PPRD laboratories of the Automotive Products and Emissions Research Division at Southwest Research Institute. The facilities are located at 6220 Culebra Road, San Antonio, Texas.

3.4.1 Gasoline Testing

Gasoline testing was performed on individual regular, mid-grade, and premium gasoline samples. There was no compositing of samples, as discussed above. Key testing methods included:

- Reid vapor pressure (ASTM D5191-13)
- Sulfur (ASTM D2622-10)
- Distillation (ASTM D86-12)
- Benzene (ASTM D3606-10)
- Total aromatics and olefins (ASTM D1319-13)
- Oxygenates (ASTM D5599-00(2010))
- Detailed Hydrocarbon Analysis (ASTM D6729-04-(2009))

Uncertainty values are listed in Table 2. Test results are provided in Attachment 2 for gasoline and Attachment 3 for diesel samples.

Table 2. Uncertainty Estimates on Composite Data Results

Property	Test Method	Level Measured	Uncertainty
Flash point	D93	118.4 F	2.6
Distillation	D86	Initial Boiling Point	2.54
Distillation	D86	10%	2.36
Distillation	D86	50%	1.96
Distillation	D86	90%	1.57
Distillation	D86	Final Boiling Point	5.11
Cetane number	D 613	38.51-55.69	2.7
API	D 287	23.71-65.6	0.2
Aromatics	D 1319	30%	0.54
Saturates	D 1319	60%	0.59
Olefins	D 1319	10%	0.64
Relative Density	D 1298	0.71876 - 0.96492	0.001308
Sulfur	D 2622	450 ppm	11.3
Sulfur	D 2622	50 ppm	4.2
Poly Aromatics	D 5186	7.49 mass %	1.55
Mono Aromatics	D 5186	26.33 mass %	0.84
Total Aromatics	D 5186	34.51 mass%	1.38
Nitrogen	D 4629	50 mg/kg	3.67
Nitrogen	D 4629	150 mg/kg	6.9
Relative Density	D 4052	1.00000	0.00003
Relative Density	D 4052	0.6884	0.00004
Benzene	D 3606	0.800 vol%	0.036
RVP	D 5191	6.400 psi	0.048
RVP	D 5191	9.960 psi	0.07
TAME	D 5599	5.790 wt%	0.062
Ethanol	D 5599	10.100 wt%	0.235
Sulfur	D 5453	250 mg/kg	15.598
Sulfur	D 5453	25 mg/kg	1.665

3.4.2 Diesel Testing

Diesel samples were acquired and tested at all retail fuel sites. Sample testing performed on each sample included:

- Cetane Number (ASTM D613-13)
- Calculated cetane index (ASTM D976-06(2011))
- API Gravity (ASTM D287-12b)
- Specific Gravity (ASTM D1298-12b)
- Sulfur (ASTM D5453-12)
- Nitrogen (ASTM D4629-12)

- Aromaticity (ASTM D1319-13)
- Total aromatic content (ASTM D5186-03(2009))
- Polycyclic aromatic content (ASTM D5186-03(2009))
- Distillation (ASTM D86-12)
- Flash point (ASTM D93-13)

Sample identification and test results for diesel fuel are listed in Attachment 3. Uncertainty results for diesel analyses are not available.[3]

[3] See the applicable ASTM test procedures for repeatability and reproducibility precision estimates.

4.0 MOVES Fuel Parameter Input Files for Texas Counties

4.1 Overview

ERG used gasoline fuel sample data collected by SwRI to develop fuel parameter input data for EPA's MOVES2010b model. Fuel parameter files were developed for each county in Texas using fuel sample data obtained from the 92 gasoline and diesel retail locations across the State in the summer of 2014. Recently, EPA released MOVES2014, which has some changes to the fuel tables. However, along with the new release of MOVES, EPA has provided a converter tool to convert many of the inputs from the MOVES2010 format to that of the MOVES2014 format.

4.1.1 Methodology

The SwRI gasoline data required significant formatting prior to development of the average MOVES parameter values. The source data was compiled in a spreadsheet with each station and gasoline grade results presented on separate worksheets. The header section of the data contained service station information, RVP, and fuel sulfur content. The body of the workbook contained chemical name, Chemical Abstracts Service (CAS) number, and percent weight by volume (mol weight was also included). ERG proceeded to extract the required parameters into one large flat file.

SwRI was first consulted as to how to interpret the results, which contained multiple entries for certain contaminants and combinations of contaminants. SwRI processed their data and the following parameters were sent to ERG:

- RVP (EPA Method)
- Sulfur (ppm)
- Aromatics
- I-Paraffins
- Naphthenes
- Olefins
- Paraffins
- Benzene
- Ethanol
- MTBE

- ETBE
- TAME

Historically, data from the detailed hydrocarbon analysis (DHA) were used to report data for specific contaminants from each sample (e.g., benzene, ETBE, MTBE, TAME, EtOH, aromatics, and olefins). However, beginning in 2011, data for these parameters were also reported using the ASTM D5599 test while aromatics and olefins were determined using the ASTM D1319 test method. In this revision of the original report, the data for the individual oxygenates as well as the aromatics and olefins are being updated to reflect the data derived from the more targeted analysis using the ASTM D5599 and ASTM D1319 test methods. In addition to test results, the data also reported summary data containing sample identification number (ID), sample date, survey area, location name, city, zip code, fuel grade, RVP, and sulfur content (ppm).

These data were processed using SAS™, a statistical analysis software. Attachment 4 provides the SAS program used for this task.

Since three grades of gasoline were sampled, regular, mid-grade, and premium blend data were extracted from the master file separately for each grade. Parameters for RVP, fuel sulfur, benzene, ethanol, MTBE, ETBE, and TAME were then averaged by geographic area. For example, benzene for gasoline was averaged for each of the 25 districts, for regular, mid-grade, and premium blends.

ERG then used the SwRI results to calculate the required MOVES fuel parameter inputs, weighting across fuel grades using the latest available sales data from the Energy Information Administration (EIA).[4] According to EIA data for Texas in 2009 (the most recent data available), regular gasoline comprised 87.8% of the market, mid-grade gasoline comprised 6.5%, and premium gasoline comprised 5.7%. These weighting factors were applied to each of the geographic areas for each parameter. Such a weighting process can be applied to any of the over 50 chemical compounds evaluated in the SwRI analysis.

The resulting weighted MOVES fuel parameter inputs for gasoline included:

- RVP (psi)
- Sulfur (ppm)

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[4] Table 39: Refiner Motor Gasoline Volumes by Grade, Sales Type, PAD District, and State from the Preliminary Petroleum Marketing Annual 2009, Energy Information Administration. http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/petroleum_marketing_annual/current/pdf/pmaall.pdf

- Olefins (% wt)
- Aromtaics (% wt)
- Benzene (% wt)
- Oxygentates (% vol)

Additional MOVES fuel input requirements include lower volatility percentage (E200) and upper volatility percentage (E300). SwRI performed distillate analysis, providing the temperatures corresponding to specific sample fractions (e.g., 5%, 10%, 20%, etc.), as shown in Attachment 2. In order to estimate E200 and E300 fractions as required by the MOVES model, ERG performed a simple interpolation of the SwRI distillation data.

ERG then used the TxDOT mappings, assigning each county in the state to a unique TxDOT district. The county assignments were identical to those developed for the 2005, 2007, 2008, and 2011 sampling studies. Figure 1 indicates the TxDOT District boundaries and major city locations.

The fuel specifications for the 2014 summer sampling results were compiled, processed, and formatted for use as an input file for the MOVES2014 model. ERG first used the MOVES County Data Manager, exporting the fuel data template as an Excel file. Next, ERG updated each tab of the template with the 2014 summer fuel sampling data to update the Fuel Formulation and Fuel Supply tables in MOVES2014. All other tables related to fuel data were left as defaults.

This process resulted in populating a master Excel file containing the 2014 summer fuel data collected for the TCEQ. This file may be edited according to user needs and imported directly into MOVES using the County Data Manager within MOVES2014.

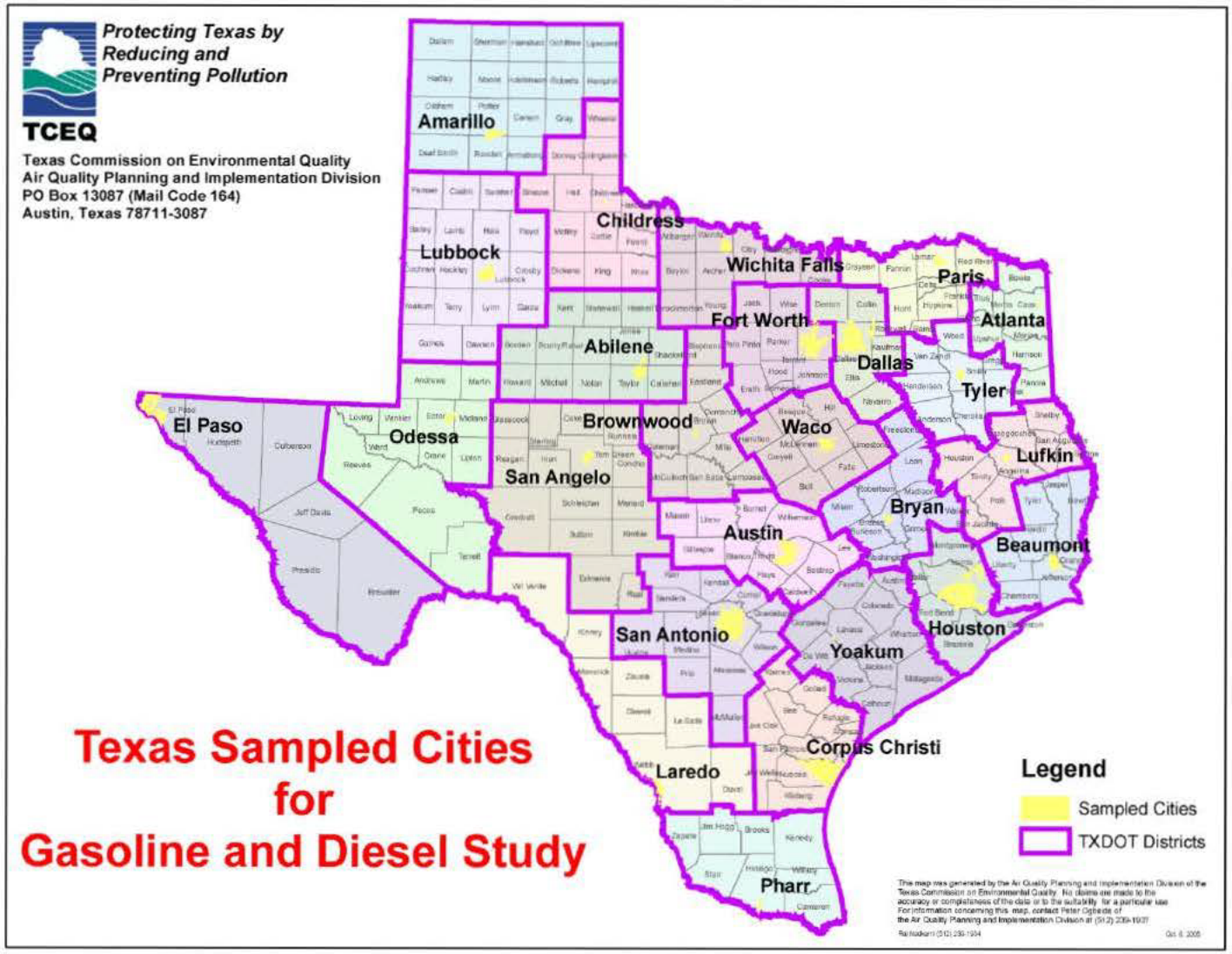


Figure 1. TxDOT Districts and Sampling Areas

4.1.2 Findings - Gasoline

The resulting MOVES fuel parameter input values are presented in Table 3 for each of the 25 sampling regions, along with selected descriptive statistics. Note that statewide average values are not weighted by fuel consumption or other activity metrics, and are used only for identifying directional trends in fuel quality.

By-county fuel parameter inputs for the summers of 2003 through 2014 can be found in Attachment 5, on the "NTI Inputs" worksheet. Fuel parameters for each sampling location, weighted across fuel grades and the specific sampling location/county assignments can be found on the "Master_output from SAS program" worksheet.

Figures 2 through 13 illustrate the trends in gasoline parameters for selected areas from 2003 through 2014. (Note that no testing was conducted in the summers of 2006, 2009, and 2010. In addition, aromatics, olefins, and benzene values are presented on a percent volume basis, as percent weights were not available for all historical years.)

Table 3. Gasoline Properties by Region (Summer 2014) (Revised)

Region	RVP	Sulfur (ppm)	Aromatics (% wt)	Olefins (% wt)	Benzene (% wt)	EtOH (% vol)	MTBE (% vol)	ETBE (% vol)	TAME (% vol)	E200 (%)	E300 (%)
ABILENE	9.57	31.5	18.275	12.286	0.564	7.87	0	0	0	52.868	83.874
AMARILLO	9.83	16.2	23.626	5.303	1.332	10.241	0	0	0	55.054	85.792
ATLANTA	7.51	32.9	29.822	10.039	0.814	9.845	0	0	0	46.879	84.701
AUSTIN	7.8	41.9	20.209	16.547	0.409	9.714	0	0	0	51.665	81.412
BEAUMONT	7.65	26.4	25.752	6.75	0.646	9.832	0	0	0	50.207	83.802
BROWNWOOD	7.67	38.8	20.291	13.523	0.415	9.612	0	0	0	52.009	82.758
BRYAN	7.45	30.2	28.189	8.059	0.518	9.894	0.003	0	0	47.311	81.649
CHILDRESS	9.5	12.1	24.487	5.319	0.861	9.909	0	0	0	53.685	86.883
CORPUS CHRISTI	7.93	21.8	13.2	17.663	0.427	9.684	0	0	0	56.155	86.738
DALLAS	7.19	32	15.085	14.649	0.43	9.621	0	0	0	49.416	83.489
EL PASO	6.83	14.8	25.788	8.391	0.399	9.774	0	0	0	47.211	87.77
FORT WORTH	7.25	30.9	16.962	12.076	0.447	9.678	0	0	0	49.767	84.441
HOUSTON	7.09	28	16.716	12.877	0.453	9.802	0	0	0	49.135	83.934
LAREDO	8.43	33.6	19.498	11.742	0.359	9.826	0	0	0	52.398	83.012
LUBBOCK	9.69	16.6	24.214	6.05	1.326	9.926	0	0	0	54.938	86.156
LUFKIN	7.57	34.1	27.344	7.251	0.682	9.977	0	0	0	48.565	82.697
ODESSA	9.85	32	17.583	11.445	0.575	9.912	0	0	0	56.441	83.953
PARIS	7.58	29.4	22.792	9.791	0.69	9.887	0	0	0	50.032	84.772
PHARR	9.18	18.4	15.894	16.305	0.591	9.767	0	0	0	57.541	86.651
SAN ANGELO	8.93	36.3	18.418	14.232	0.464	9.52	0	0	0	54.068	82.404
SAN ANTONIO	7.56	34.7	23.195	11.887	0.452	9.566	0	0	0	49.378	80.752
TYLER	7.63	24.5	25.396	12.128	0.762	9.764	0	0	0	50.021	86.165
WACO	7.51	33.9	18.021	15.62	0.441	9.742	0	0	0	51.571	84.268
WICHITA FALLS	8.85	27	19.181	10.852	0.456	9.751	0	0	0	55.474	86.554
YOAKUM	7.53	23.7	25.714	7.618	0.52	9.711	0	0	0	48.267	83.619
average	8.14	28.07	21.43	11.14	0.60	9.71	0.000	0.00	0.00	51.60	84.33

Region	RVP	Sulfur (ppm)	Aromatics (% wt)	Olefins (% wt)	Benzene (% wt)	EtOH (% vol)	MTBE (% vol)	ETBE (% vol)	TAME (% vol)	E200 (%)	E300 (%)
min	6.83	12.10	13.20	5.30	0.36	7.87	0.000	0.00	0.00	46.88	80.75
max	9.85	41.90	29.82	17.66	1.33	10.24	0.003	0.00	0.00	57.54	87.77
range	3.02	29.80	16.62	12.36	0.97	2.37	0.003	0.00	0.00	10.66	7.02
standard deviation	0.97	7.83	4.51	3.62	0.26	0.41	0.001	0.00	0.00	3.14	1.88

Figure 2. Gasoline RVP Trends for Selected Regions (Revised)

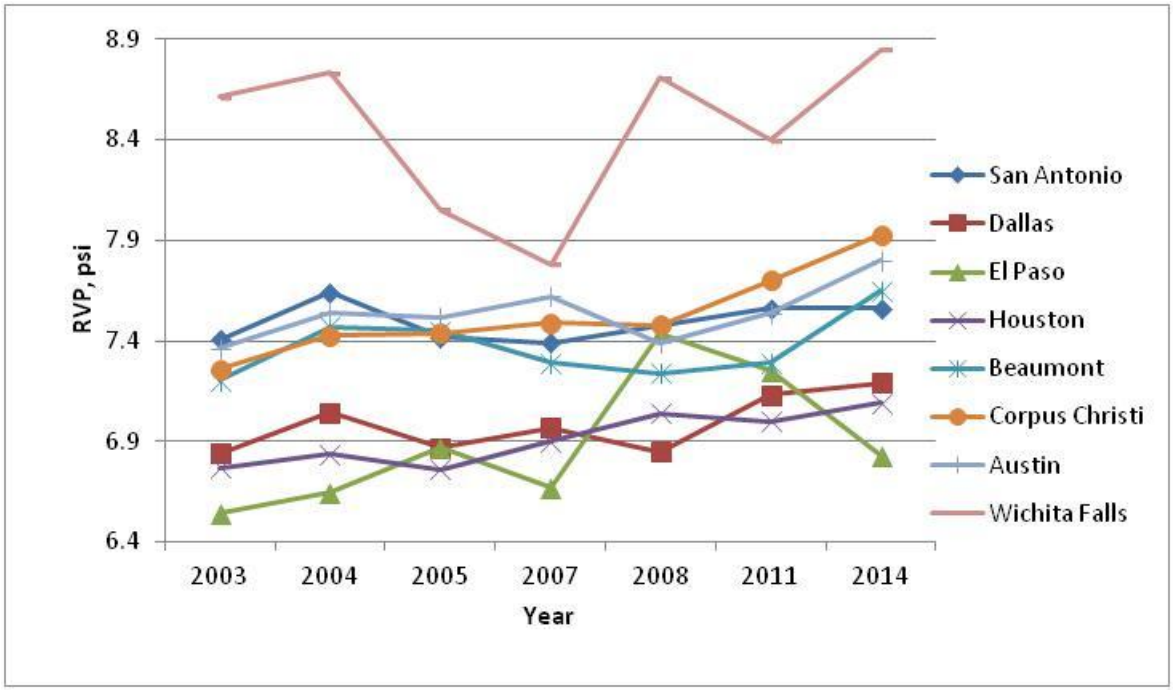


Figure 3. Gasoline Sulfur Trends for Selected Regions

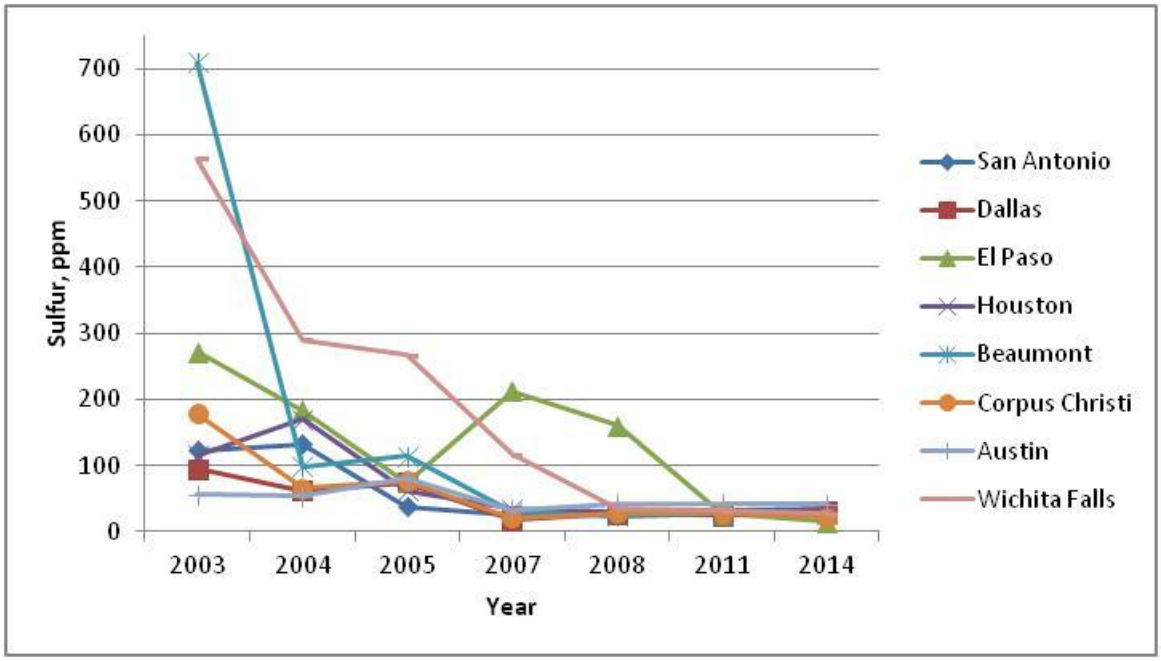


Figure 4 presents the gasoline sulfur trends for 2008 through 2014 and excludes El Paso to allow for greater resolution.

Figure 4. Gasoline Sulfur Trends for Selected Regions (2008 – 2014)

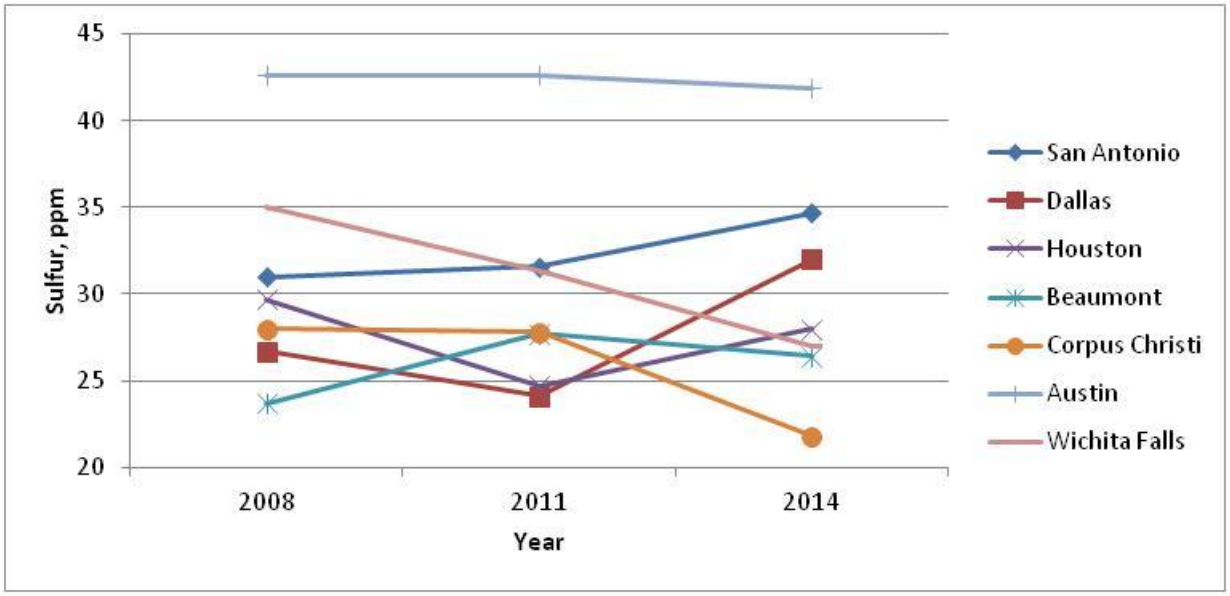


Figure 5. Gasoline Olefins Trends for Selected Regions (Revised)

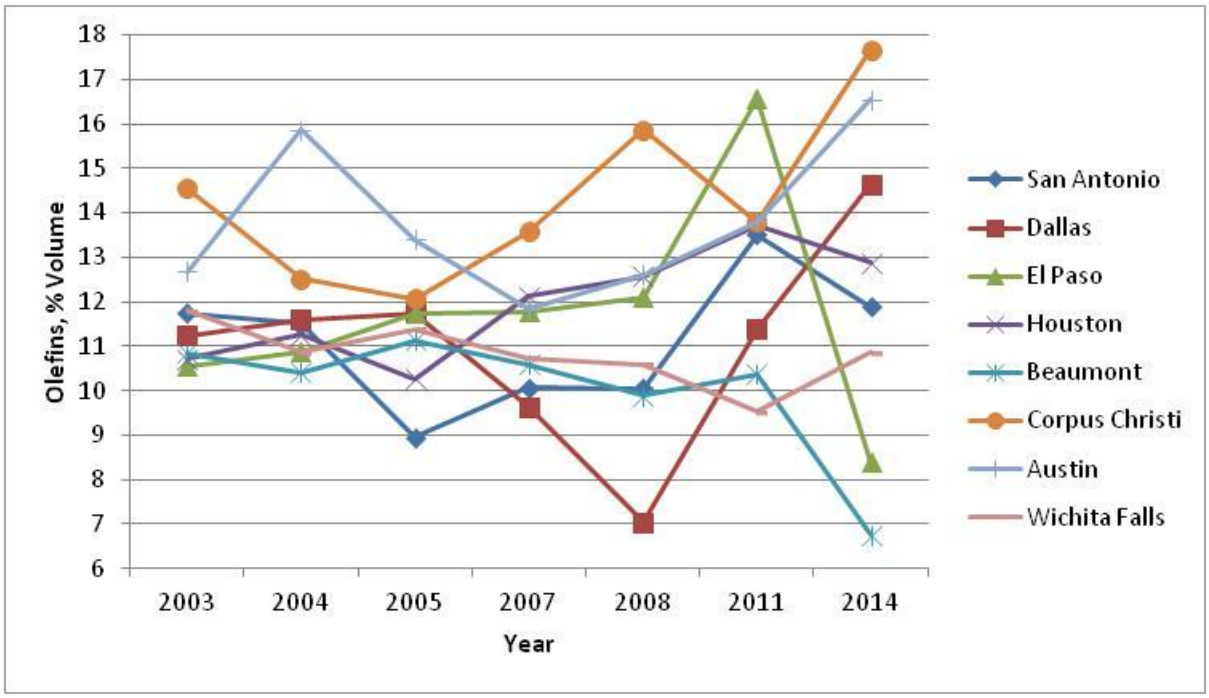


Figure 6. Gasoline Aromatics Trends for Selected Regions (Revised)

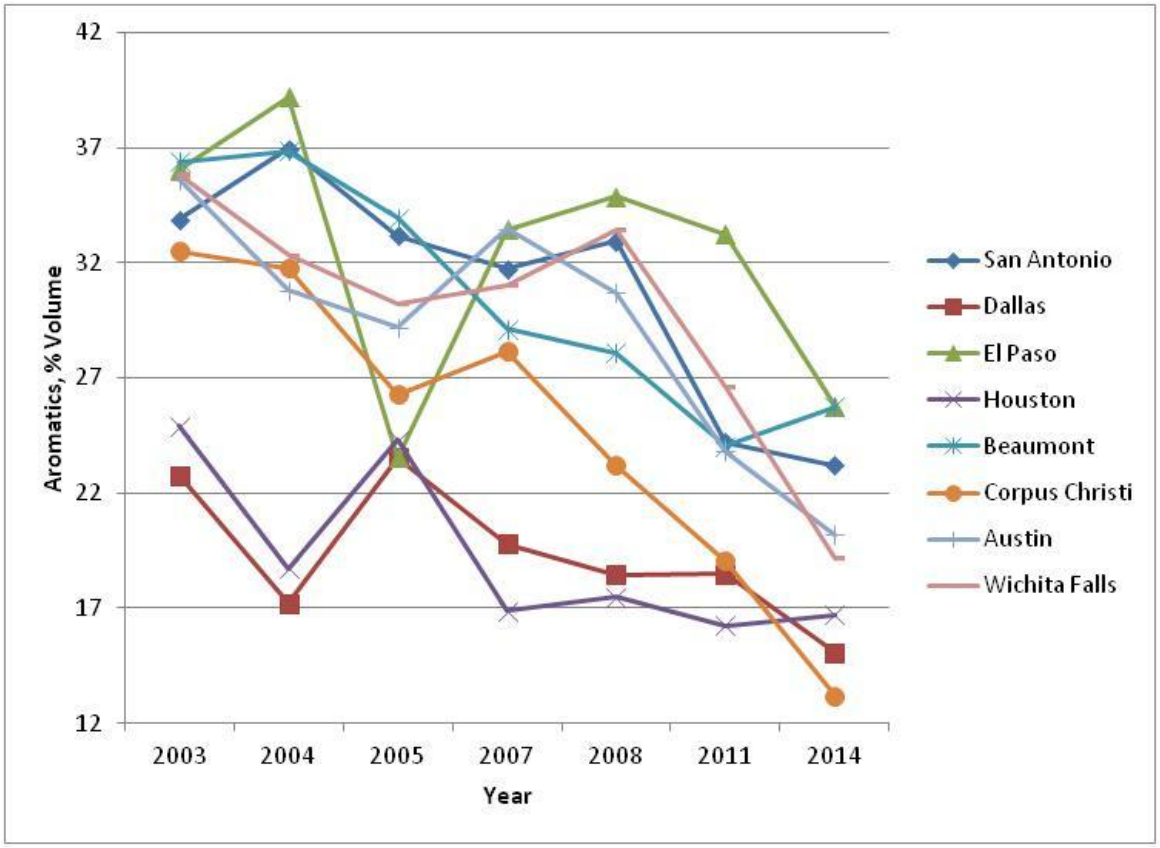


Figure 7. Gasoline Benzene Trends for Selected Regions (Revised)

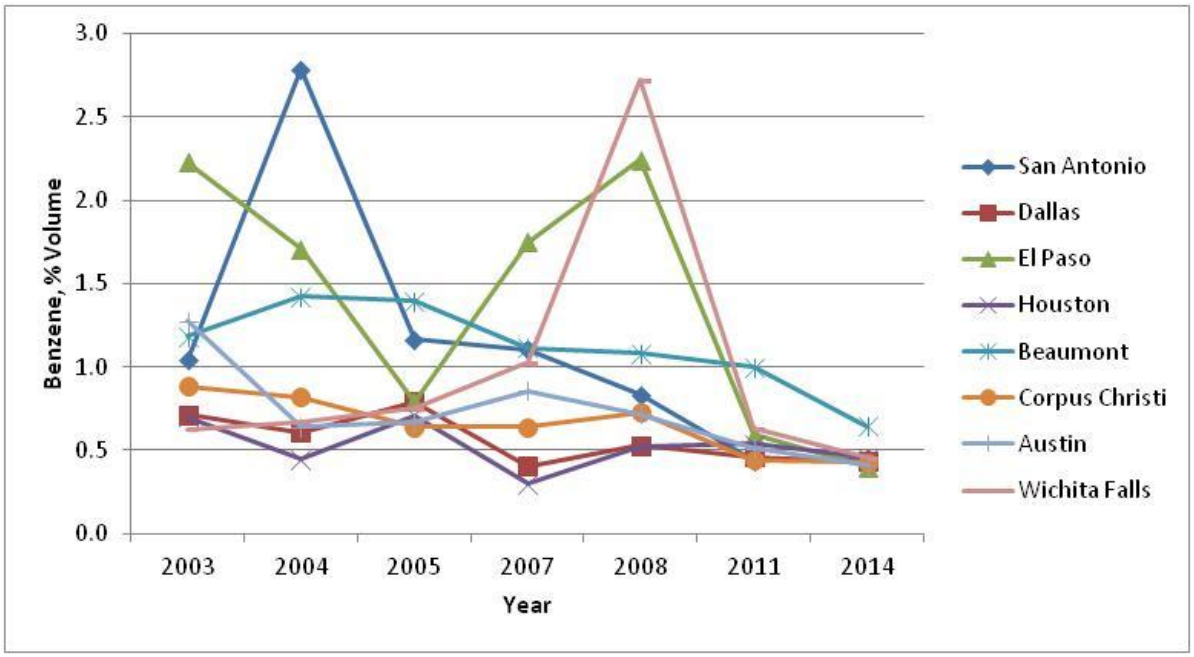


Figure 8. Gasoline MTBE Trends for Selected Regions (Revised)

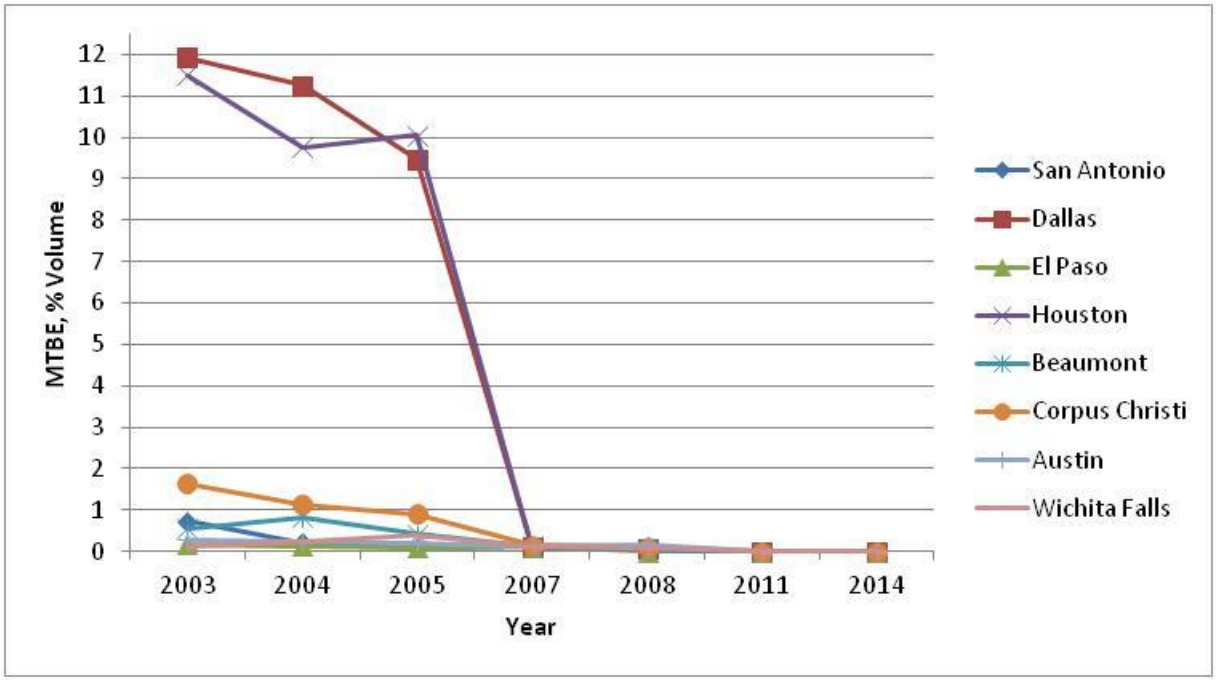


Figure 9. Gasoline ETBE Trends for Selected Regions (Revised)

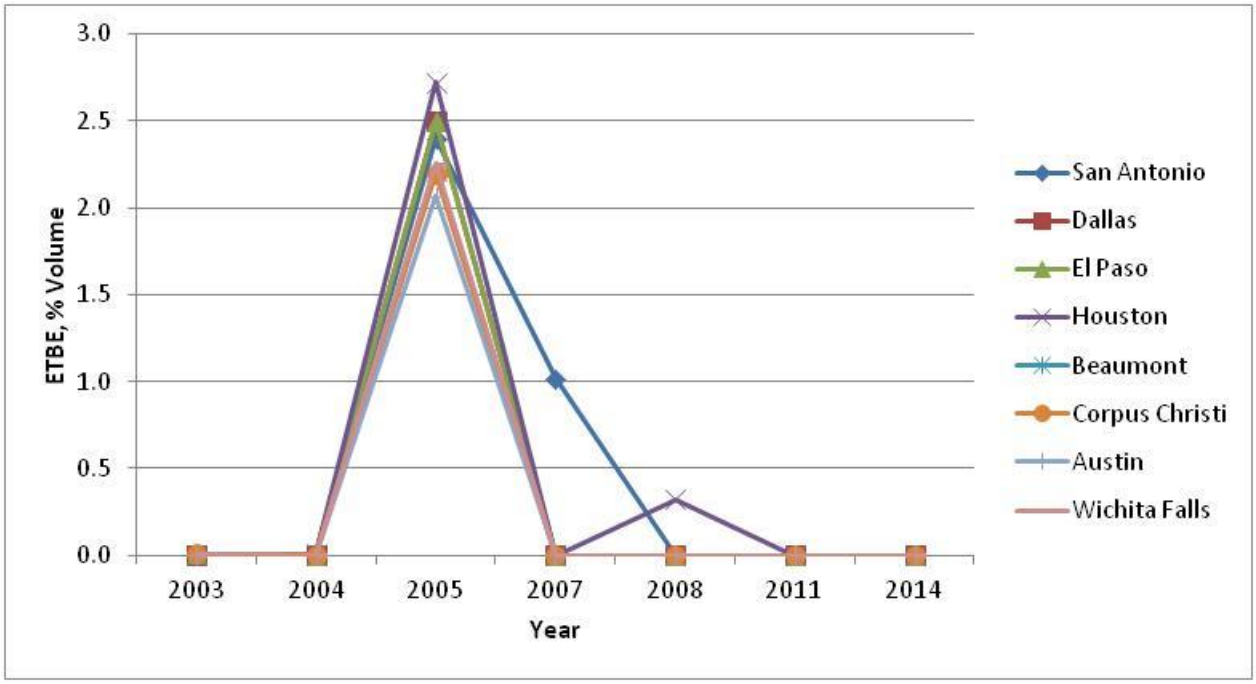
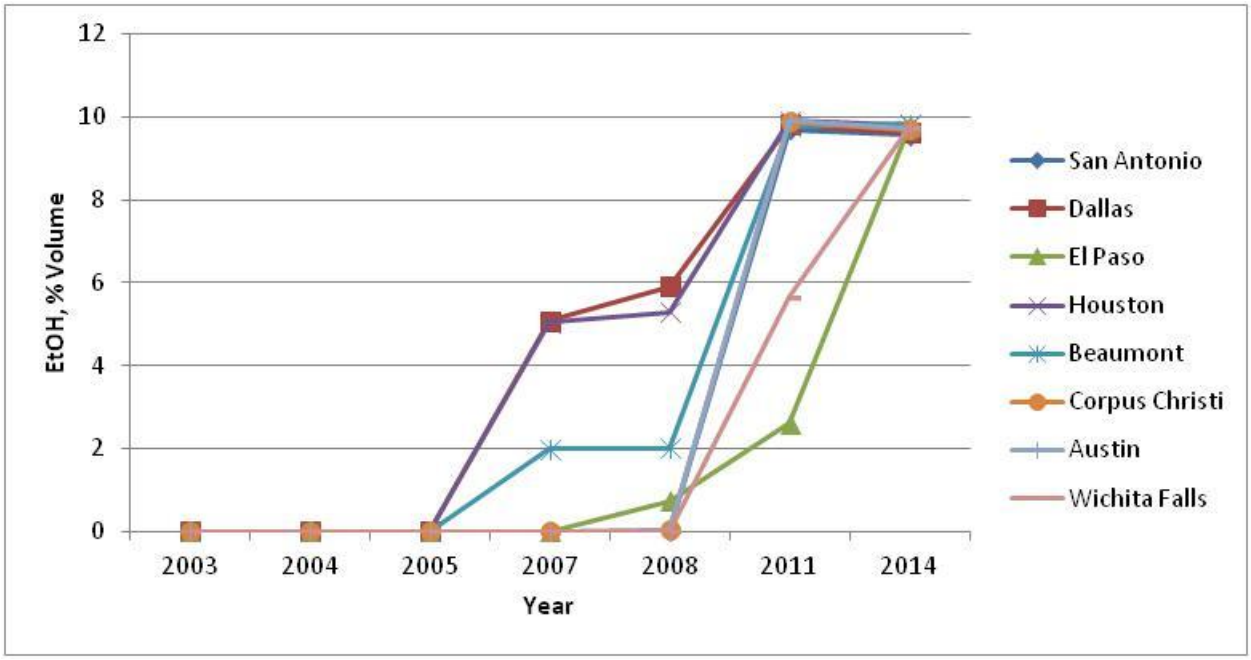


Figure 10. Gasoline Ethanol Trends for Selected Regions (Revised)



Figures 10 through 12 show trends for TAME, E200, and E300 from 2007, 2008, 2011, and 2014. (Prior years are not available for comparison.)

Figure 11. Gasoline TAME Trends for Selected Regions (Revised)

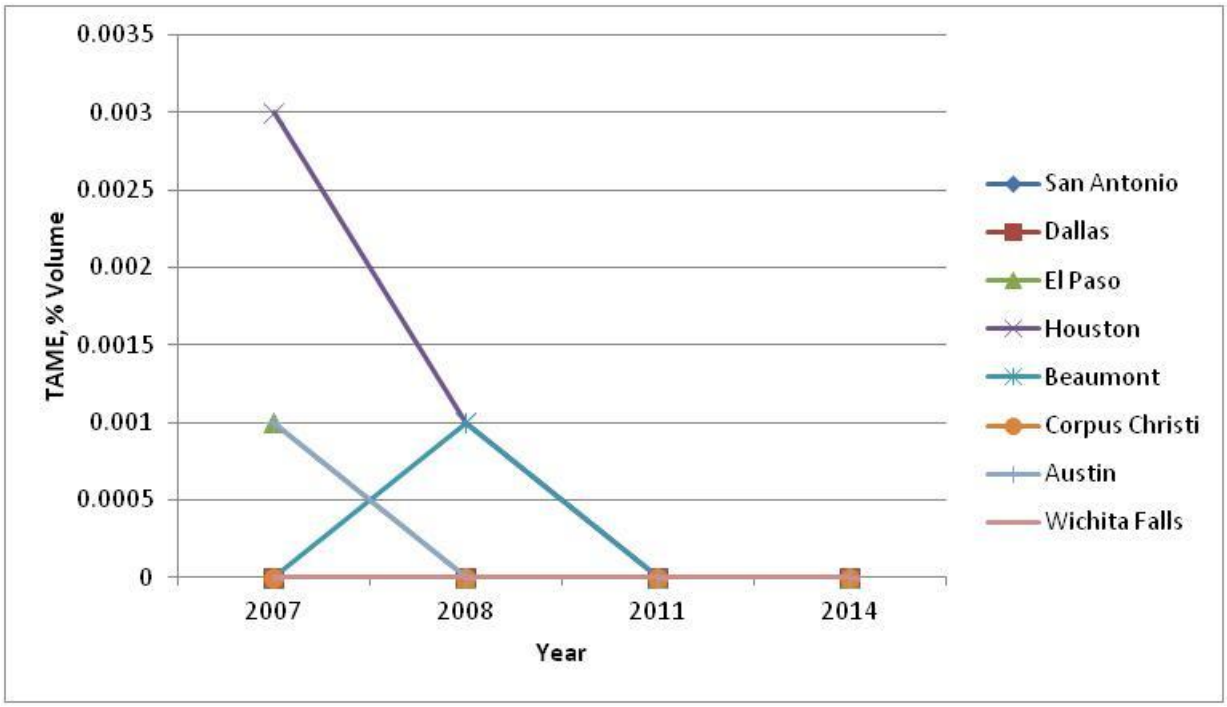


Figure 12. Gasoline E200 Trends for Selected Regions

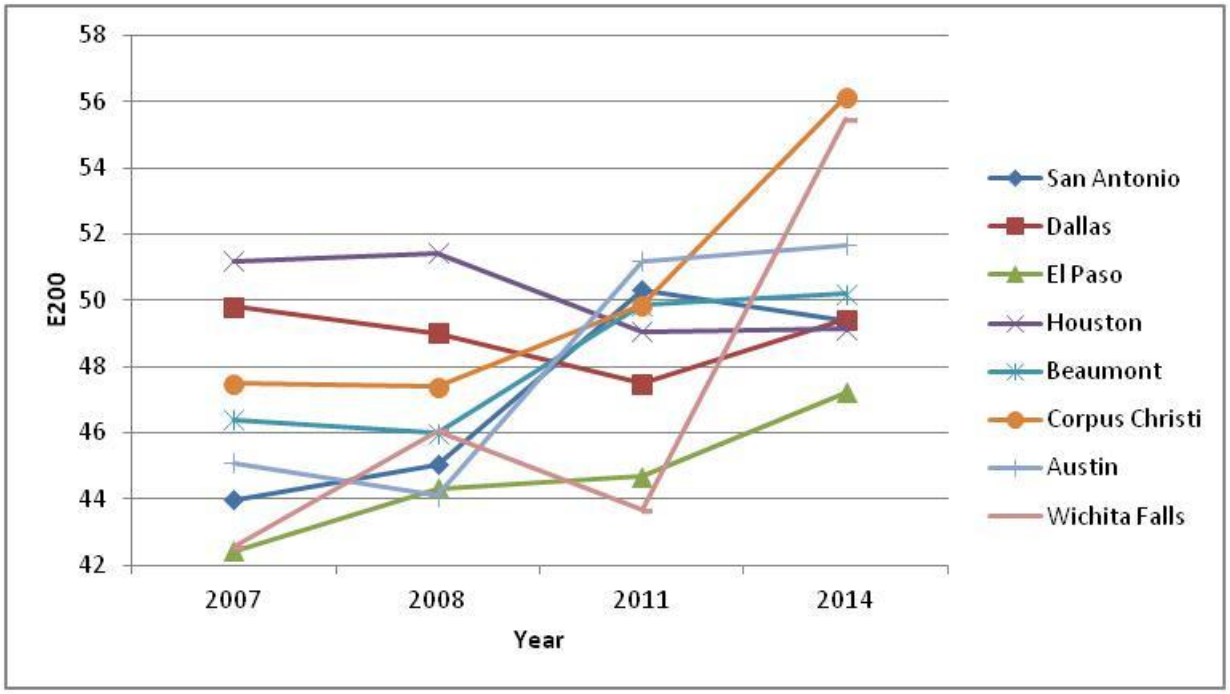
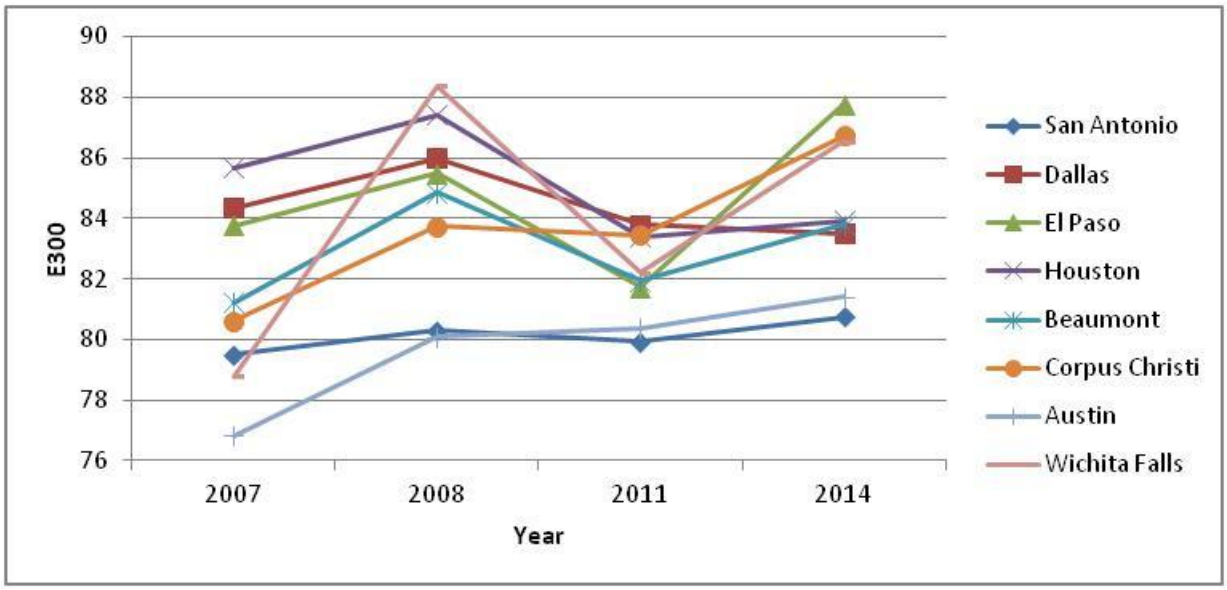


Figure 13. Gasoline E300 Trends for Selected Regions



A brief comparison of maximum differences for each fuel parameter across the selected counties is provided in Table 4. Sample sites corresponding to the maximum differentials are shown in parentheses. A table of how the regions sampled in 2011 compared to the TxDOT districts sampled in 2014 is available in Attachment 5 on the "District comp – 2014 vs. 2011" worksheet.

Table 4. Gasoline Comparison of 2014 with 2011 Findings* (Revised)

Fuel Parameter	Maximum Delta
RVP	+0.56 (Laredo)
Sulfur (ppm)	-15.50 (Pharr)
Olefins (% vol)	+7.30 (El Paso)
Aromatics (% vol)	-11.54 (Odessa)
Benzene (% vol)	-1.25 (Tyler)
Ethanol (% vol)	+7.16 (El Paso)
MTBE (% vol)	-0.00 (All regions)
ETBE (% vol)	-0.00 (All regions)
TAME (% vol)	-0.00 (All regions)
E200	+11.81 (Wichita Falls)
E300	-6.06 (El Paso)

*Changes are expressed in absolute terms. Positive values indicate increases relative to 2011, negative values indicate decreases.

The following provides some general observations regarding the gasoline sampling data.

- RVP in most regions appears relatively stable over time, although Corpus Christi appears to have risen slightly above the 7.8 limit for the 95 county East Texas region. Most values range from 6.8 to about 9.8 for all years, with the exception of areas with a 9.0 limit (e.g., Wichita Falls, which ranges from about 7.7 in 2007, to almost 8.9 in 2014. A slight upward trend may be evident for certain regions (e.g., Corpus Christi), although further statistical analysis would be required to confirm this.

- Sulfur levels are now all well below 50 ppm, as expected with the Federal sulfur fuel standards.

- There doesn't appear to be any apparent obvious trend for olefins in most regions, although aromatics may be trending downward for the majority of regions since the 2007-08 timeframe. Benzene appears to have a clear downward trend with most regions sampling below 1.0% for the first time. RFG regions Dallas and Houston appear to have generally lower aromatics values, between 15 and 25 percent, compared to other areas generally around 30 percent.

- Non-ethanol oxygenates were only observed in trace amounts, if at all.
- Ethanol averages are approaching 10% Ethanol blends in most regions, as expected as the national trend leans towards nearly 100% use of E10 gasoline blends.
- All key regions had E200 levels between 473 and 56 in 2014. Small upward trends are evident for most regions since 2011, with sharp rises seen for the Corpus Christi and Wichita Falls regions.
- All key regions had E300 levels between 80 and 88 in 2014. Most regions have risen since 2011, with notable increases for El Paso, Wichita Falls, and Corpus Christi.

4.1.3 Findings - Diesel

The diesel fuel the analysis focused on cetane, aromatics, specific gravity, T50 (°F), olefins, saturates, and fuel sulfur. Note that all diesel fuel sampled was labeled as ultra-low sulfur. The detailed data analysis performed for the diesel fuel samples is provided in Attachment 7. Summary results for 2014 are shown in Table 5, with selected descriptive statistics.

Table 5. Diesel Fuel Properties by Region (Summer 2014)

Region	Aromatics, % wt	Olefins, % wt	Saturate, % wt	Sulfur, ppm	Cetane No.	Specific Gravity	T50, deg F
ABILENE	30.83	2.8	66.3	5.43	48.37	0.84	505.43
AMARILLO	34.43	2.7	62.8	6.1	49.47	0.84	504.47
ATLANTA	30.75	2.5	66.8	8.93	46.6	0.84	501.57
AUSTIN	26.47	2.5	71.1	5.78	51.94	0.84	515.24
BEAUMONT	33.22	2.0	64.8	7.06	48.2	0.84	511.82
BROWNWOOD	32.39	2.1	65.5	6.13	51.43	0.84	519
BRYAN	33.01	2.5	64.4	5.6	46.63	0.84	494.37
CHILDRESS	33.41	1.8	64.8	5.9	49.6	0.84	503.33
CORPUS CHRISTI	32.94	2.1	65.0	4.33	51.85	0.84	521.43
DALLAS	34.12	2.0	63.9	5.78	48.28	0.84	509.15
EL PASO	28.60	2.6	68.8	5.45	48.75	0.84	505.68
FORT WORTH	28.24	1.9	69.8	5.65	51.1	0.83	509.58
HOUSTON	42.53	2.4	55.1	5.13	48.39	0.85	527.84
LAREDO	26.42	2.0	71.6	4.65	52.05	0.83	504.05
LUBBOCK	30.02	2.0	68.0	6	49.97	0.83	506.23
LUFKIN	35.59	2.0	62.4	5.77	45.8	0.84	507
ODESSA	36.76	2.1	61.2	6.4	49.9	0.84	516.5
PARIS	32.50	2.2	65.3	8.2	49.03	0.84	506.87
PHARR	25.26	2.6	72.2	3.63	52.3	0.83	495.17
SAN ANGELO	28.93	2.6	68.5	6.1	48.43	0.84	503.27
SAN ANTONIO	25.99	1.5	72.5	4.64	51.72	0.83	501

Region	Aromatics, % wt	Olefins, % wt	Saturate, % wt	Sulfur, ppm	Cetane No.	Specific Gravity	T50, deg F
TYLER	36.02	2.2	61.8	9.6	48.74	0.84	513.84
WACO	29.30	2.9	67.8	5.97	50.57	0.84	513.13
WICHITA FALLS	33.19	2.1	64.7	5.07	48.53	0.84	513.4
YOAKUM	31.66	2.8	65.5	5.07	46.17	0.84	497.27
average	*31.70*	*2.27*	*66.03*	*5.93*	*49.35*	*0.84*	*508.27*
min	*25.26*	*1.46*	*55.10*	*3.63*	*45.80*	*0.83*	*494.37*
max	*42.53*	*2.92*	*72.54*	*9.60*	*52.30*	*0.85*	*527.84*
range	*17.27*	*1.46*	*17.44*	*5.97*	*6.50*	*0.02*	*33.47*
standard deviation	*3.93*	*0.37*	*3.92*	*1.34*	*1.92*	*0.005*	*8.09*

Figures 14 through 21 illustrate the diesel composition trends from 2003 through 2014. (Note that no testing was conducted in the summers of 2006, 2009, 2010, 2012, and 2013. In addition, aromatics and olefin values are presented on a percent volume basis, as percent weights were not available for all historical years.)

Figure 14. Diesel Aromatics Trends for Selected Regions

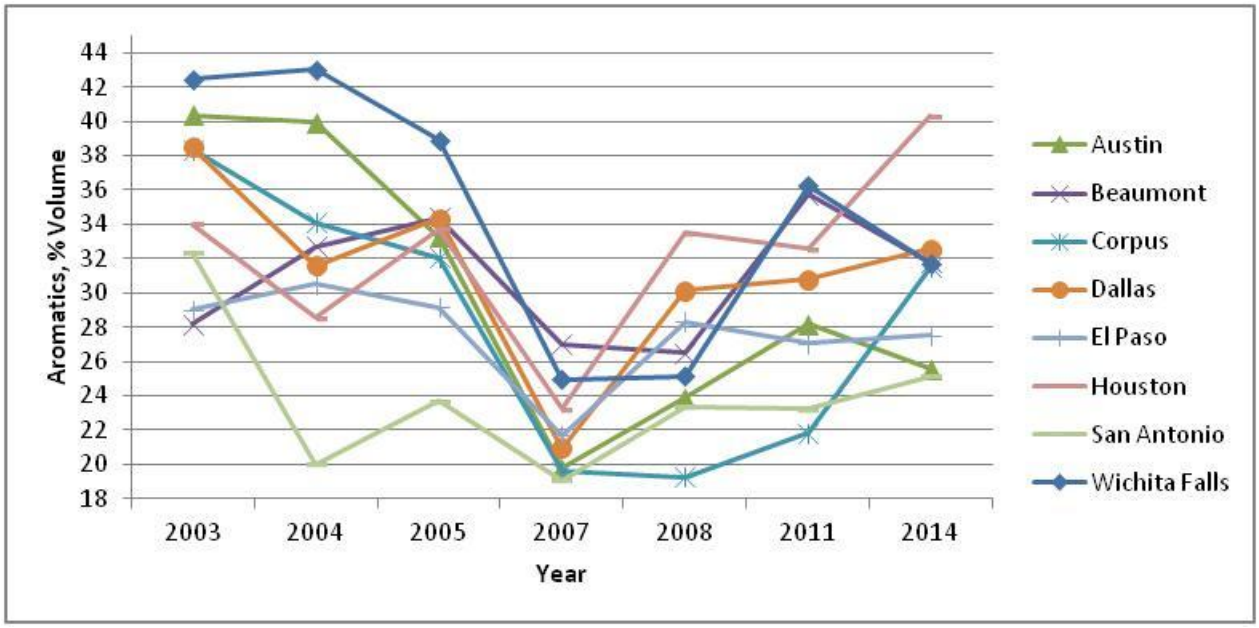


Figure 15. Diesel Olefins Trends for Selected Regions

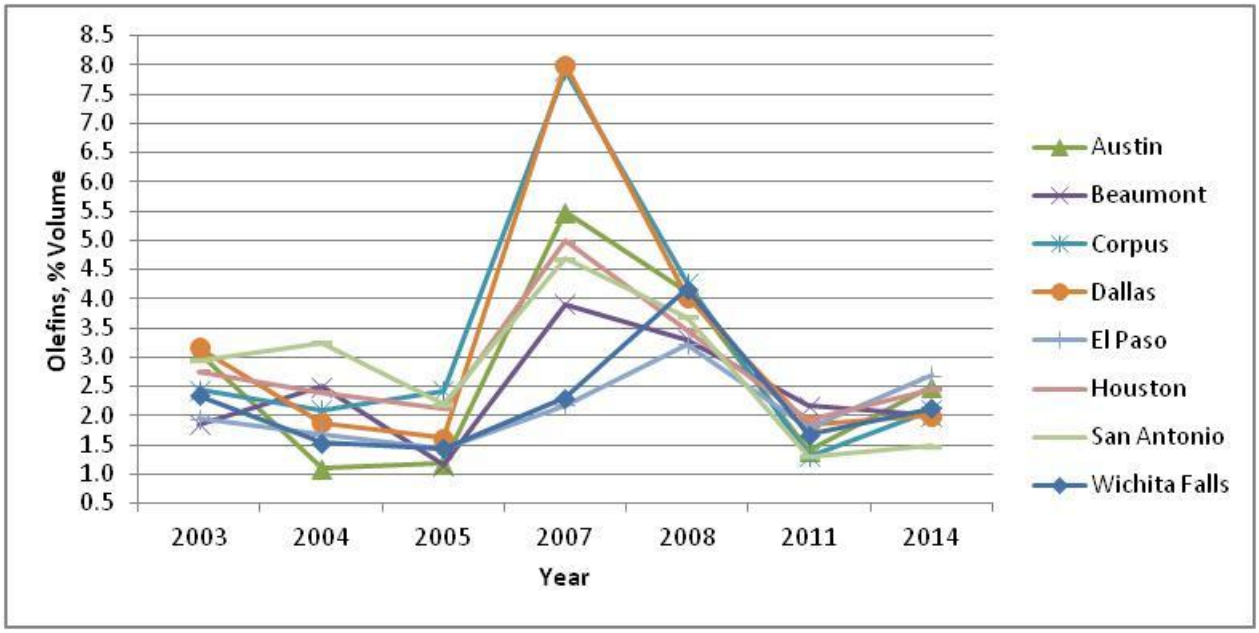


Figure 16. Diesel Saturates Trends for Selected Regions

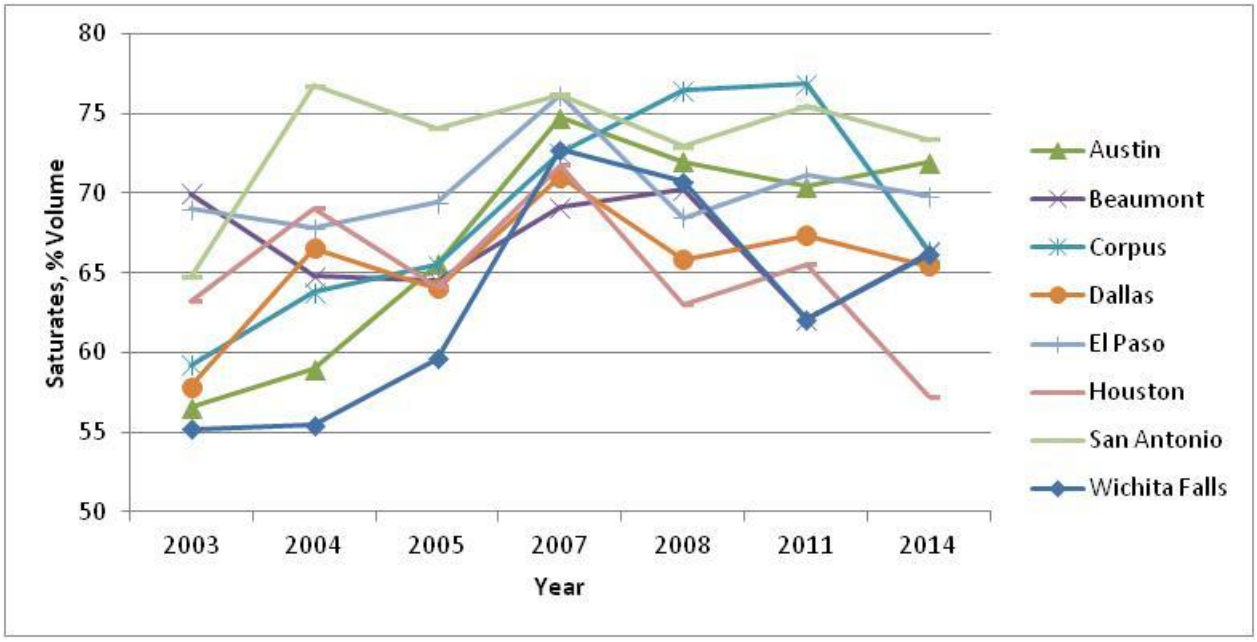


Figure 17. Diesel Sulfur Trends for Selected Regions

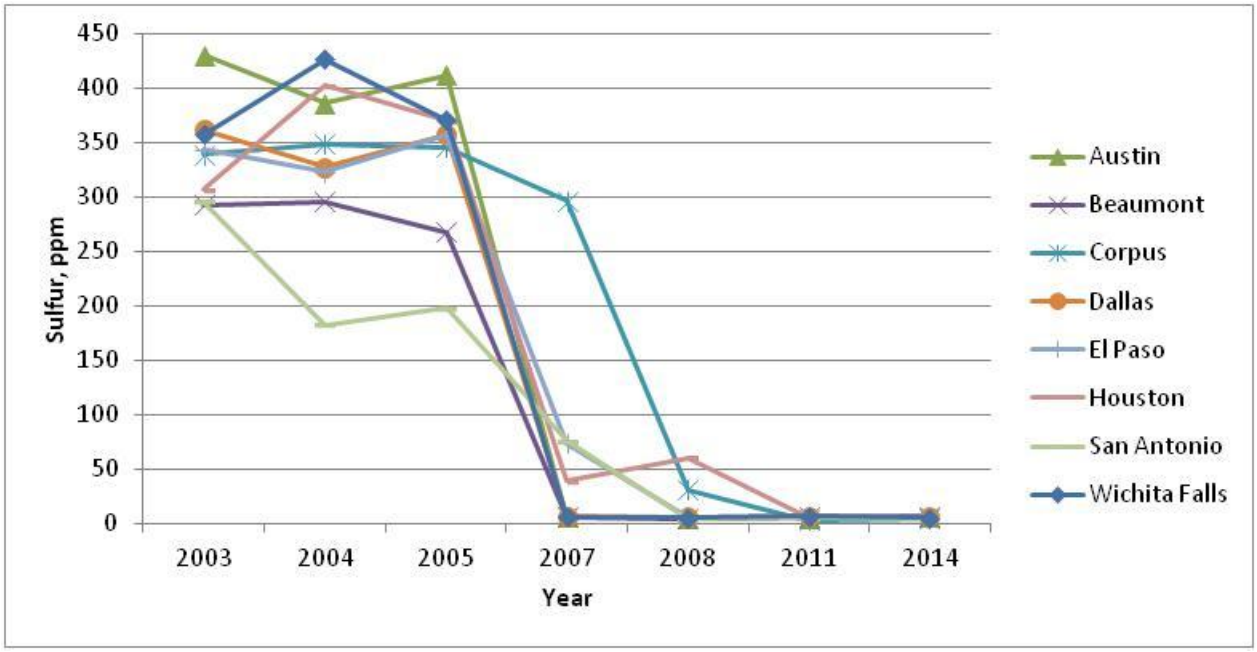


Figure 18. Diesel Sulfur Trends for Selected Regions (2008-2014)

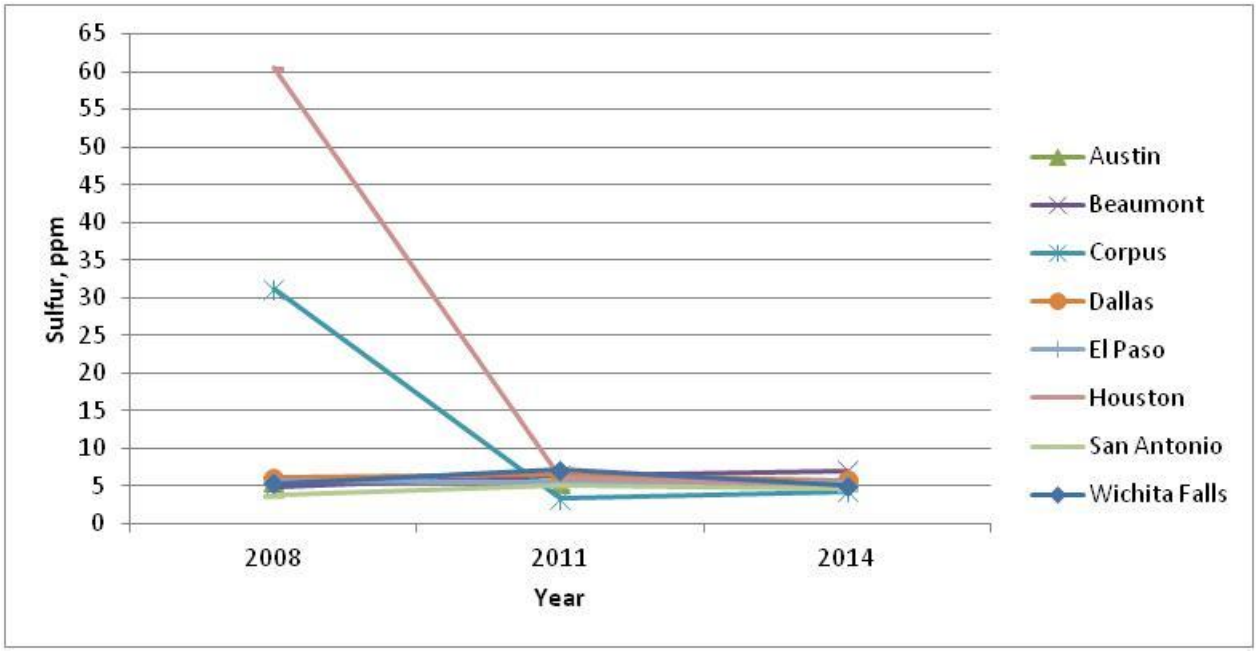


Figure 19. Diesel Cetane Trends for Selected Regions

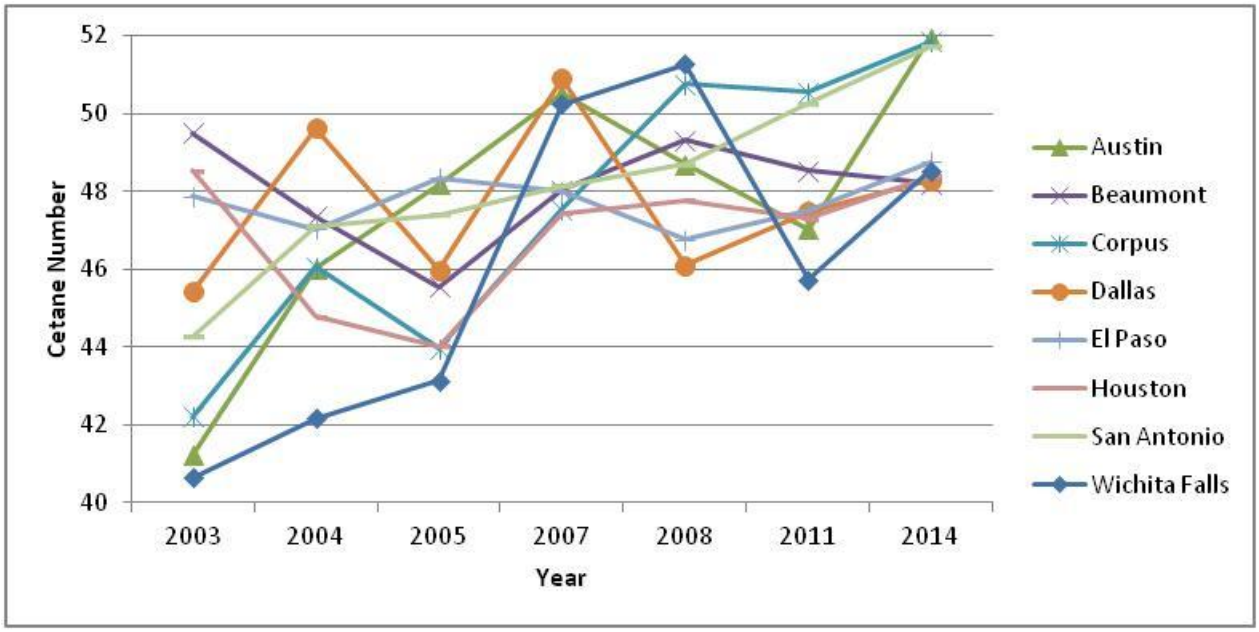


Figure 20. Diesel Specific Gravity Trends for Selected Regions

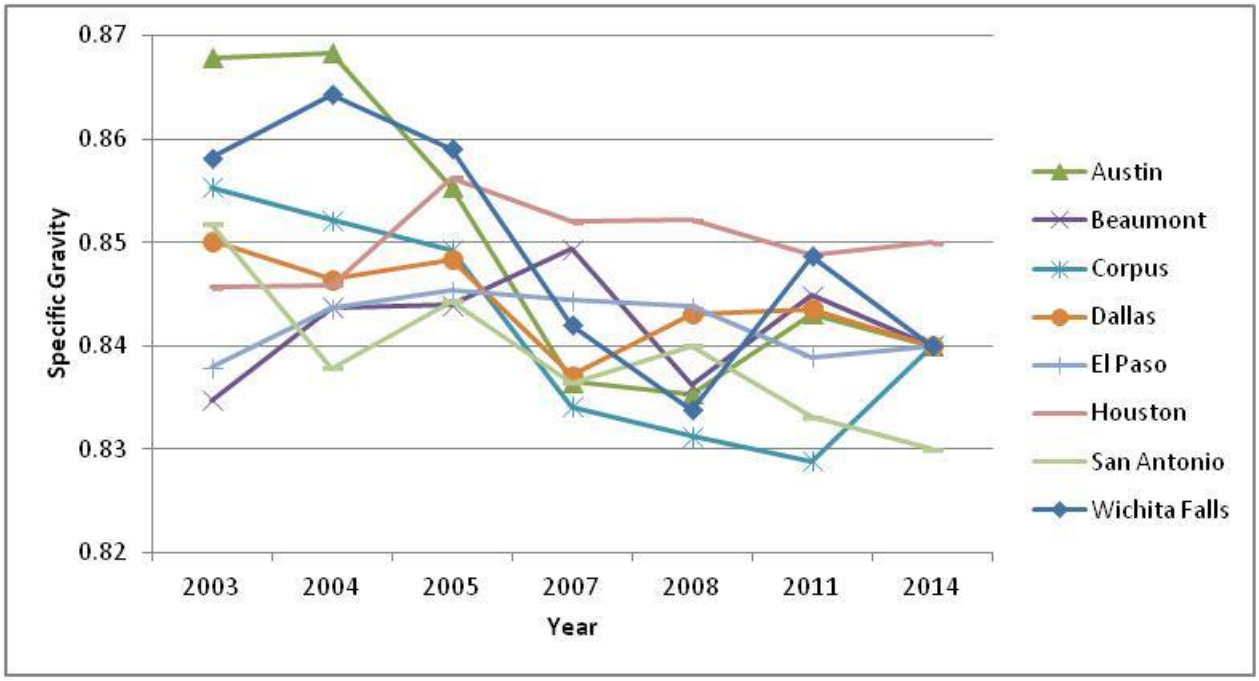
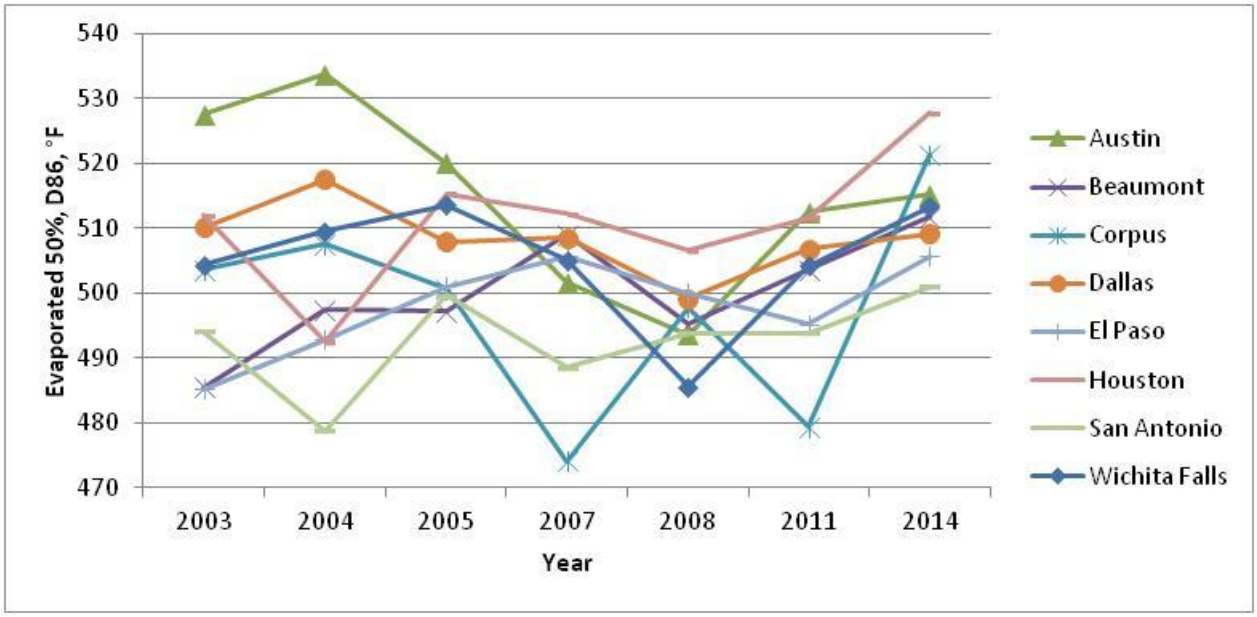


Figure 21. Diesel T50 Trends for Selected Regions



Some general observations about the diesel sampling data follow.

- All key regions have an aromatics percentage between 25 and 40 percent in 2014. Most regions show a downward trend to a minimum in 2007, with a general upward trend through 2014. There is no clear relationship between area and aromatics level;

- All key regions have olefin percentages between 1 and 8 percent since 2003. Most regions show an upward trend to a maximum in 2007, with strong downward trend from 2008 to 2011 and a slight uptick in 2014. The 2014 measurements all close to 2 – 2.5 %. There is no clear relationship between area and olefins level;

- All key regions have saturates concentrations between about 55 and 75 percent. Most regions showed a general upward trend through 2007, and leveling out since time. There is no clear relationship between area and saturates level;

- All regions show clear, sharp downward trend in sulfur levels over time, with all key regions below 10 ppm from 2011 through 2014;

- Most regions show general upward trend in cetane number over time, although this is not strong, with all key regions at or above 48 by 2014. There is no clear relationship between area and cetane number;

- Some regions show general downward trend in specific gravity through 2007, although there is no clear trend thereafter. Most key regions have

been tightly grouped between 0.83 and 0.85 from 2007 through 2014. There is no clear relationship between area and specific gravity;

- The T50 values for the key regions are tightly grouped between 500 and 530 by 2014, with a slight upward trend indicated starting in 2008. There is no clear trend or relationship between area and T50.

4.1.4 Supplemental Testing – Houston Area Stations

In addition to the testing described above, a second round of sampling and lab analysis was conducted for a subset of fueling stations (the seven located in the Houston area). This testing took place approximately one month after the first round of sampling, to ensure complete storage tank turnover. This second round of sampling was intended to make an assessment of the temporal variability of fuel parameters at the station level.

Table 6 identifies the seven stations that were sampled for gasoline and diesel in the HGB area and the Station ID assigned to each. Tables 7 and 8, for gasoline and diesel fuels, respectively, show the results of the second round of testing compared to the first round of testing for the seven stations in the HGB area. Attachment 6 provides the SAS program used to create Table 7.

Table 6. HGB Station ID Numbers

Station ID	Station Name
1	FLYING J TRAVEL PLAZA 729
2	LOVES TRAVEL STOP 401
3	BAYTOWN EXPRESS TRAVEL CENTER
4	FLYING J TRAVEL PLAZA 740
5	LOVES TRAVEL STOP 315
6	LOVES TRAVEL STOP 234
7	LOVES TRAVEL STOP 468

4.2 Gasoline Results

Table 7. Station-Specific Gasoline Sampling, Round 1 vs. Round 2 (Revised)

StationID	Component	Round 1	Round 2	Difference (Round 2 - Round 1)	% Difference
1	Aromatics, % Volume	17.11	17.36	0.25	1.47%
	Benzene, % Volume	0.39	0.39	0.00	0.52%
	E200	51.05	51.62	0.57	1.12%
	E300	84.57	85.09	0.52	0.62%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.83	9.92	0.09	0.90%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	13.44	12.57	-0.87	-6.46%
	RVP, psi	7.01	6.99	-0.02	-0.29%
	Sulfur, ppm	32.00	32.60	0.60	1.88%
	TAME, % Volume	0.00	0.00	0.00	0.00%
2	Aromatics, % Volume	15.14	16.05	0.91	6.00%
	Benzene, % Volume	0.37	0.48	0.11	29.70%
	E200	49.72	47.51	-2.22	-4.46%
	E300	82.68	81.74	-0.94	-1.14%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.88	9.94	0.06	0.60%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	15.51	14.02	-1.50	-9.66%
	RVP, psi	7.20	7.21	0.01	0.14%
	Sulfur, ppm	32.40	27.80	-4.60	-14.20%
	TAME, % Volume	0.00	0.00	0.00	0.00%
3	Aromatics, % Volume	16.47	21.08	4.61	27.98%
	Benzene, % Volume	0.52	0.53	0.02	2.90%
	E200	48.31	45.78	-2.53	-5.24%
	E300	85.34	81.82	-3.52	-4.13%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.73	9.95	0.21	2.20%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	12.37	7.99	-4.38	-35.42%
	RVP, psi	7.12	6.99	-0.13	-1.83%
	Sulfur, ppm	25.40	16.60	-8.80	-34.65%
	TAME, % Volume	0.00	0.00	0.00	0.00%

StationID	Component	Round 1	Round 2	Difference (Round 2 - Round 1)	% Difference
4	Aromatics, % Volume	17.23	16.04	-1.19	-6.89%
	Benzene, % Volume	0.38	0.37	-0.01	-2.40%
	E200	49.50	50.02	0.52	1.05%
	E300	84.04	83.89	-0.14	-0.17%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.72	9.88	0.17	1.71%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	13.18	14.95	1.77	13.39%
	RVP, psi	6.85	6.98	0.13	1.90%
	Sulfur, ppm	33.30	33.70	0.40	1.20%
	TAME, % Volume	0.00	0.00	0.00	0.00%
5	Aromatics, % Volume	16.12	14.70	-1.42	-8.82%
	Benzene, % Volume	0.46	0.48	0.02	3.70%
	E200	49.00	50.74	1.73	3.54%
	E300	83.54	84.35	0.82	0.98%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.93	10.04	0.11	1.15%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	12.40	13.55	1.15	9.27%
	RVP, psi	7.23	7.29	0.06	0.83%
	Sulfur, ppm	24.20	25.00	0.80	3.31%
	TAME, % Volume	0.00	0.00	0.00	0.00%
6	Aromatics, % Volume	17.23	16.98	-0.25	-1.47%
	Benzene, % Volume	0.47	0.41	-0.06	-12.58%
	E200	48.52	47.40	-1.12	-2.31%
	E300	84.45	81.89	-2.56	-3.04%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.61	9.71	0.09	0.96%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	12.27	13.41	1.14	9.32%
	RVP, psi	7.14	7.06	-0.08	-1.12%
	Sulfur, ppm	28.30	25.30	-3.00	-10.60%
	TAME, % Volume	0.00	0.00	0.00	0.00%
7	Aromatics, % Volume	17.72	17.79	0.07	0.40%
	Benzene, % Volume	0.58	0.54	-0.05	-8.05%
	E200	47.84	46.97	-0.88	-1.83%
	E300	82.93	82.07	-0.86	-1.03%
	ETBE, % Volume	0.00	0.00	0.00	0.00%
	EtOH, % Volume	9.91	9.93	0.02	0.22%
	MTBE, % Volume	0.00	0.00	0.00	0.00%
	Olefins, % Volume	10.97	11.60	0.63	5.70%
	RVP, psi	7.11	7.05	-0.06	-0.84%
	Sulfur, ppm	20.40	21.70	1.30	6.37%
	TAME, % Volume	0.00	0.00	0.00	0.00%

4.3 Diesel Results

Table 8. Station-Specific Diesel Sampling, Round 1 vs. Round 2

Station ID	Component	Round 1	Round 2	Difference (Round 2 - Round 1)	% Difference
1	Aromatics % vol	44.8	46.2	1.4	3.13%
	Olefins % vol	2.7	1.4	-1.3	-48.15%
	Saturate % vol	52.5	52.4	-0.1	-0.19%
	Sulfur ppm	4.5	5.6	1.1	24.44%
	Cetane Number	46.9	46.1	-0.8	-1.71%
	Specific Gravity	0.8605	0.863	0.0025	0.29%
	T50, deg F	550.4	551.9	1.5	0.27%
2	Aromatics % vol	44.2	45.3	1.1	2.49%
	Olefins % vol	2.2	1.7	-0.5	-22.73%
	Saturate % vol	53.6	53	-0.6	-1.12%
	Sulfur ppm	5.2	5.5	0.3	5.77%
	Cetane Number	52.5	46.8	-5.7	-10.86%
	Specific Gravity	0.85	0.8535	0.0035	0.41%
	T50, deg F	539.4	550.5	11.1	2.06%
3	Aromatics % vol	34.8	34.5	-0.3	-0.86%
	Olefins % vol	2.3	1.8	-0.5	-21.74%
	Saturate % vol	62.9	63.7	0.8	1.27%
	Sulfur ppm	6.9	6.7	-0.2	-2.90%
	Cetane Number	48	46.3	-1.7	-3.54%
	Specific Gravity	0.841	0.842	0.001	0.12%
	T50, deg F	499	500.6	1.6	0.32%
4	Aromatics % vol	43.4	48.1	4.7	10.83%
	Olefins % vol	2.8	2	-0.8	-28.57%
	Saturate % vol	53.8	49.9	-3.9	-7.25%
	Sulfur ppm	4.2	5.6	1.4	33.33%
	Cetane Number	45.1	48.6	3.5	7.76%
	Specific Gravity	0.86	0.861	0.001	0.12%
	T50, deg F	550.8	552.5	1.7	0.31%
5	Aromatics % vol	38.5	34.2	-4.3	-11.17%
	Olefins % vol	2.3	2.5	0.2	8.70%
	Saturate % vol	59.2	63.3	4.1	6.93%
	Sulfur ppm	5	5.3	0.3	6.00%
	Cetane Number	51	48.6	-2.4	-4.71%
	Specific Gravity	0.8455	0.842	-0.0035	-0.41%
	T50, deg F	520.1	527.1	7	1.35%
6	Aromatics % vol	36.2	40	3.8	10.50%
	Olefins % vol	3	1.4	-1.6	-53.33%
	Saturate % vol	60.8	58.6	-2.2	-3.62%
	Sulfur ppm	5.5	5.4	-0.1	-1.82%
	Cetane Number	48	47.6	-0.4	-0.83%
	Specific Gravity	0.8405	0.8485	0.008	0.95%
	T50, deg F	506.8	529	22.2	4.38%

Station ID	Component	Round 1	Round 2	Difference (Round 2 - Round 1)	% Difference
7	Aromatics % vol	40.1	39.6	-0.5	-1.25%
	Olefins % vol	1.9	2.1	0.2	10.53%
	Saturate % vol	58	58.3	0.3	0.52%
	Sulfur ppm	4.6	4.8	0.2	4.35%
	Cetane Number	47.2	47.2	0	0.00%
	Specific Gravity	0.8505	0.848	-0.0025	-0.29%
	T50, deg F	528.4	532.6	4.2	0.79%

Some general observations about the second round of test results are discussed below.

- Even though there is substantial variation between stations, gasoline testing shows little variability for the same station between Round 1 and Round 2, with most parameters within the statewide standard deviation values shown in Table 3.

- Unlike the gasoline samples, several diesel parameters showed relatively large changes between Round 1 and 2, with all but one station having at least one measurement vary by more than a standard deviation between rounds one and two (see Table 5). The source of this variation is not known.

5.0 Quality Assurance

ERG performed a review of the lab analysis results for all gasoline and diesel samples, looking for possible outliers or unusual data distributions. ERG evaluated the minimum, maximum, average, and standard deviation for lab testing results, by TxDOT district. The values were then plotted against previous years and other districts to highlight possible outliers. Notably, the Beaumont district is the only district with TAME values greater than zero. After checking the original test results provided by SwRI, Beaumont does indeed have measurable amounts of TAME in the gasoline samples. However, the amount is small enough that it is not considered an outlier. Trend lines also aid in identifying outliers created during post-processing the lab results. One set of trend lines helped to identify a county mapping error created during the processing of the data, allowing the error to be corrected before being finalized.

Prior to ERG receiving the lab test results, SwRI performs rigorous QA/QC checks of both the samples received and the equipment used during testing. These QA/QC procedures are described in detail here.

5.1 Calibrations and Quality Control Checks

5.1.1 Instrument/Equipment Calibration and Frequency

5.1.1.1 Detailed Hydrocarbon Analysis, ASTM 6729-04(2009)

The instrument is calibrated by running the calibration standard containing the 400 plus components and verifying their identification using the provided chromatogram.

5.1.1.2 Reid Vapor Pressure, ASTM D 5191-13

All instruments for this test are calibrated by the SwRI Calibration Laboratory every 6 months.

5.1.1.3 Sulfur, ASTM D 2622-10

The x-ray instruments for this test are calibrated annually with drift correction and calibration verification performed daily.

5.1.1.4 Distillation, ASTM D 86-12

An in-house maintenance group calibrates each distillation rig every three months. Each temperature probe is calibrated every 6 months using 100% toluene.

5.1.1.5 Gravity, ASTM D4052-11

Samples are analyzed on an Anton Paar Model DMA48 Density/Specific Gravity Meter. Instrument is checked daily using solutions with known densities. Repairs and maintenance for these instruments are provided through a service contract with the manufacturer, set for an annual inspection and preventive maintenance.

5.1.1.6 Cetane Number, ASTM D 613-13

The rating units are calibrated daily to the range of each sample.

5.1.1.7 Aromaticity, ASTM D 1319-13

The electronic caliper used for rod measurements is calibrated every 6 months. The pressure gauges used in the rod set-ups are calibrated annually. The black lights used in the procedure are also calibrated annually.

5.1.1.8 Sulfur, ASTM D 5453-12

Samples are analyzed using ultraviolet fluorescence. The instrument is calibrated every three months.

5.1.1.9 API Gravity, ASTM D 1298-12b

New calibrated hydrometers are acquired every twelve months to cover the range of gasoline and diesel samples.

5.1.1.10 Flash point, ASTM 93-13

The in-house maintenance group calibrates the temperature probe and stirrer rotation every 12 months.

5.1.1.11 Nitrogen, ASTM D 4629-12

The instruments are calibrated every three months.

5.1.1.12 Polycyclic and Total Aromatic, ASTM 5186-03(2009)

The systems performance is set to meet ASTM D 5186-03.

5.1.1.13 Benzene, ASTM D 3606-10

Each instrument is calibrated daily using a curve with a series of calibration standards containing benzene form 0 to 5% and toluene from 0.5 to 20%. Every tenth sample and at the end of the tray a QA sample containing benzene and ethanol is run, to

ensure instrument stability and performance. Purchased standards are also used for verification. Flow and valve timing is checked on a minimum of once a month and at any other time that non-routine maintenance is performed. Control charts are maintained and monitored daily for process stability for each instrument.

5.1.1.14 Oxygenates, ASTM D 5599-00(2010)

Each chromatograph is calibrated with a standard set at regular intervals, and the calibration is verified daily before any sample run. The verification includes measurement of a set of QA/QC standards with internal standards. Several external standards are used which include varied concentrations of TAME, ethanol, and MTBE. A blank and one of the instrument calibration standards containing approximately 0.5% of each component are also included at the beginning of each tray to determine if proper resolution is being achieved on each column. Each sample contains an internal standard to correct for any variation in injection volume.

A QA/QC sample is placed every 10 samples and at the end of each tray. A sample is run in duplicate every 10 samples. Regular instrument maintenance, multiple daily calibration checks, column performance checks and review of the gas chromatograph traces for excessive noise, drift, or other operational problems provide assurance that a system is in place that will generate quality data. Control charts are maintained and monitored daily for process stability for major oxygenate components for each instrument.

5.1.2 Quality Control

5.1.2.1 4.1.2.1 Detailed Hydrocarbon Analysis, ASTM D 6729-04 (2009)

The laboratory will routinely monitor the repeatability and reproducibility of its analysis. The repeatability will be monitored through the use of laboratory replicates at the rate of one per batch or at least one per 10

samples whichever is more frequent. Reproducibility will be monitored

through the use of a QC sample analyzed at the rate of one per batch or at least one per 15 samples whichever is more frequent.

The range (R) for the duplicate samples should be less than the following limits:

Benzene	0.047*
C MTBE	0.032*C
2,2,4 Trimethyl pentane	0.034*C

Where:

$C = (C_o+C_d)/2$

C_o = Concentration of the original sample

C_d = Concentration of the duplicate sample

R = Range, $| C_o - C_d |$

The QC sample will be plotted on an individual control chart and the Upper and Lower control limits are to be determined in accordance with OAE Standard Operating Procedure 4.20 – Revision 0 *Statistical Methods*.

5.1.2.2 Reid Vapor Pressure, ASTM D 5191-13

RVP systems are verified daily with 2,2 dimethylbutane, in the range 9.82 to 10.10 psi. Because the RVP values covered, a second verification material is used. This material, 3-methyl pentane, with an RVP around 7 psi, is recommended in 40 CFR Part 80, Appendix E. The material is used as a routine verification material. Verification are performed at the start of the day and again at the end of the day.

5.1.2.3 Sulfur, ASTM D 2622-10

Sulfur is analyzed using the multi-point calibration curves specified in Method D 2622, which are stored in the system computer. At the beginning of each shift the instrument is standardized by running a setting up standard (SUS), according to the manufacturer's instructions, followed by verification using a purchased QA standard. Control charts are maintained on the sulfur procedure. NIST standards are available for periodic monitoring of the system. This test is included in many regional and ASTM crosscheck programs in which we participate.

5.1.2.4 Distillation, ASTM D 86-12

Full instrument verification is conducted on each unit on an annual basis and daily system verification is completed prior to running any sample at the start of each day. Control charts are maintained on each instrument and a verified barometer is used for barometric correction of the data. Electronic parts are checked as specified in the lab calibration and recall schedule and at any time that non-routine maintenance is performed. This test is included in many of the regional and ASTM crosscheck programs in which we participate.

5.1.2.5 Gravity, ASTM D 4052-11

Full instrument verification is conducted on each unit on an annual basis. Density testing is performed on a Paar Model DDMA 48 density meter, which is monitored daily by running heptanes and distilled water samples with known densities.

Control charts are maintained on each instrument. This test is included in many regional and ASTM crosscheck programs in which we participate.

5.1.2.6 Cetane Number, ASTM D 613-13

The rating units are calibrated daily to the range of each sample.

5.1.2.7 Aromaticity (FIA), ASTM D 1319-13

The FIA results are monitored with a daily QA sample. The current QA material is a surrogate fuel blended to reflect RFG aromatic concentrations. This test is run on a new column every day in the same manner as the sample testing is performed. Each analyzer column is checked for internal and external dimensions, and silica gel parameters are monitored as per the ASTM procedure.

5.1.2.8 Sulfur, ASTM D 5453-12

The instrument is monitor monitored daily by running a quality control sample with known sulfur content. Control charts are maintained on each instrument. This test is included in many regional and ASTM crosscheck programs in which SwRI participates.

5.1.2.9 Flash Point, ASTM D 93-13

The flash point results are monitored through daily verification with an anisole reference material and an annual verification using decane certified reference material. The instrument under goes an annual instrument calibration by internal calibration

5.1.2.10 Nitrogen, ASTM D 4629-12

The Antek instruments are monitor monitored daily by running a quality control sample with known nitrogen content. Control charts are maintained on each instrument. This test is included in many regional and ASTM crosscheck programs in which SwRI participates.

5.1.2.11 Polycyclic and Total Aromatics, ASTM D 5186-03(2009)

The Selerity Technology instrument is monitor monitored daily by running a quality control sample with known aromatic content. Control charts are maintained for the instrument. This test is included in many regional and ASTM crosscheck programs in which SwRI participates.

5.1.2.12 Benzene, ASTM D 3606-10

Each instrument is calibrated daily using a curve with a series of calibration standards containing benzene form 0 to 5% and toluene from 0.5 to 20%. Every tenth sample and at the end of the tray a QA sample containing benzene and ethanol is run, to ensure instrument stability and performance. Control charts are maintained for each instrument. This test is included in many regional and ASTM crosscheck programs in which SwRI participates.

5.1.2.13 Oxygenate, ASTM D 5599-00(2010)

Each chromatograph is calibrated with a standard set at regular intervals, and the calibration is verified daily before any sample run. The verification includes measurement of a set of QA/QC standards with internal standards. Several external standards are used which include varied concentrations of TAME, ethanol, and MTBE. A blank and one of the instrument calibration standards containing approximately 0.5% of each component are also included at the beginning of each tray to determine if proper resolution is being achieved on each column. Each sample contains an internal standard to correct for any variation in injection volume. Control charts are maintained for each instrument. This test is included in many regional and ASTM crosscheck programs in which SwRI participates.

A QA/QC sample is placed every 10 samples and at the end of each tray. A sample is run in duplicate every 10 samples. Regular instrument maintenance, multiple daily calibration checks, column performance checks and review of the gas chromatograph traces for excessive noise, drift, or other operational problems provide assurance that a system is in place that will generate quality data. Control charts are maintained and monitored daily for process stability for major oxygenate components for each instrument.

5.2 Calibrations and Quality Control Acceptance Criteria

The SwRI laboratory staff will conduct the initial Data verification. They will accept or reject the data based upon the QC samples and, if applicable, chromatography and laboratory replicates.

The SwRI Program Manager will review data. The data will be reviewed for apparent accuracy, completeness and reasonableness. The SwRI Program Manager will decide whether to validate, rerun or invalidate the data.

A Non-conformance Report (NCR) will be issued to document the investigation into any discrepancies noted during the technical assessments. The NCR will be issued in accordance

with OAE Standard Operating Procedure 4.13 – Revision 1 *Nonconformance, Preventive and Corrective Action, Customer Complaints.*

5.2.1 Detailed Hydrocarbon Analysis, ASTM D 6729-04(2009)

Since a typical gasoline is a mixture of over 400 components, it would be impractical if not impossible to impose data quality indicators on each analyte of interest. Therefore, one component from each of the functional groups will be tracked to assess the overall quality of the analytical performance.

Data Quality Indicators – Detailed Hydrocarbon Analysis (ASTM D 6729-04(2009))

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	The difference between replicate results, in the normal and correct operation of the method, should not exceed the following values expressed as percentages of the average of the two values: 4.7 % Benzene 3.2 % MTBE 3.4 % 2,2,4 Trimethyl pentane
Bias	The bias of this test method cannot be determined since an appropriate standard reference material is not available. It is impossible to account for every potential co-elution and quantify the magnitude of the interference.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Since a suitable reference material is not available, Accuracy will be maintained by a QC sample	The 95 CI limits for the QC sample should be as follows expressed as percentages of the average of the two values: 9.9 % Benzene 8.9 % MTBE 9.5 % 2,2,4 Trimethyl pentane
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data set is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions if the measurement technique. And in the case of petroleum chemistry are generally not quantifiable. The data set should give a reasonable estimate of the component distribution in the fuel supply but it may not be directly comparable to other methods	N/A

DQI	Definition/Discussion	Measurement Performance Criteria
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Upper and lower concentration limits are defined in table A1.2 of ASTM D 6729. For a list of predominate compounds and identified co-eluting compounds see table 4 of ASTM D 6729.	See ASTM D 672904(2009)-

5.2.2 Reid Vapor Pressure, D 5191-13

Data Quality Indicators – RVP (ASTM D 5191-13)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 5191-13
Bias	There is no accepted reference material suitable for determining the bias for the procedures in this test method. Bias cannot be determined.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 5191-13
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Upper and lower vapor pressure limits are defined in table 1.1 of ASTM D 5191-07	See ASTM D 5191-13

5.2.3 Sulfur, ASTM D2622-10

Data Quality Indicators – Sulfur (ASTM D 2622-10)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 2622-10.
Bias	Sulfur bias is detailed in D 2622-07.	See ASTM D 2622-10

DQI	Definition/Discussion	Measurement Performance Criteria
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 2622-10.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	N/A	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Test method covers the determination of total sulfur in gasoline and diesel fuel.	See ASTM D 2622-10.

5.2.4 Distillation, ASTM D 86-12

Data Quality Indicators – Distillation (ASTM D 86-12)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 86-12.
Bias	Due to the use of total immersion thermometers, the distillation temperatures in this test method are somewhat lower than the true temperatures. The amount of bias depends on the product being distilled and the thermometer used. The bias due to the emergent stem has been determined for toluene and is shown in ASTM D 86-07b.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 86-12
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement	100%
Sensitivity	The method is designed for the analysis of distillate fuels; it is not applicable to products containing appreciable quantities of residual material.	See ASTM D 86-12

5.2.5 Gravity, ASTM D 4052-11

Data Quality Indicators – Gravity (ASTM D 4052-11)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short-term)	See ASTM D 4052-11 Range 0.68-0.97 g/ml Repeatability 0.0001
Bias	Bias study is documented in ASTM Research Report RR-D02-1387.	Results can be biased by as much as 0.6kg/m3 (0.0006 g/ml)
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 4052-11 Range 0.68-0.97 g/ml Reproducibility 0.0005
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	N/A	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Test method covers the determination of the density or relative density of petroleum distillates and viscous oils that can be handled as liquids at test temperatures between 15 and 35 C. Liquids must have a vapor pressure below 80 kPa and viscosity below 15 cSt.	See ASTM D 4052-11

5.2.6 Cetane Number, ASTM D 613-13

Data Quality Indicators – Cetane Number (ASTM D 613-13)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 613-13..
Bias	The procedure in this test method for cetane number of diesel fuel oil has no bias because the value of cetane number can be defined only in terms of the test method.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 613-13.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG. `	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A

DQI	Definition/Discussion	Measurement Performance Criteria
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	The cetane number scale range from zero to 100 but typical testing is in the range of 30 to 65 cetane number.	See ASTM D 613-13.

5.2.7 Aromatics and Olefins, ASTM D 1319-13

Data Quality Indicators – Aromatics and Olefins (ASTM D 1319-13)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 1319-13.
Bias	Bias cannot be determined because there are no acceptable reference materials suitable for determining the bias for the procedure in this test method.	See ASTM D 1319-13.
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 1319-13.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	This test method covers the determination of hydrocarbon types over the concentration ranges from 5 to 99 volume % aromatics, 0.3 to 55 volume % olefins, and 1 to 95 volume % saturates in petroleum fraction that distill below 315 C.	See ASTM D 1319-13.

5.2.8 Sulfur, ASTM D 5453-12

Data Quality Indicators – Sulfur (ASTM D 5453-12)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability.	See ASTM D 5453-12.
Bias	Bias study is documented in ASTM Research Report RR-D02-1307 (1992). The report indicated that the bias is within repeatability of the test method.	See ASTM D 5453-12.
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 5453-12.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	This method covers the determination of total sulfur in liquid hydrocarbons, boiling in the range of 25 to 400 °C with viscosities of 0.2 and 20 cSt at room temperature.	See ASTM D 5453-12.

5.2.9 Flash Point, ASTM D 93-13

Data Quality Indicators – Flash point, ASTM D 93-13

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability.	See ASTM D 93-13.
Bias	There is no accepted reference material suitable for determining the bias for the procedure in these test methods, bias has not been determined.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term)	See ASTM D 93-13.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A

DQI	Definition/Discussion	Measurement Performance Criteria
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	This test method covers the determination of flash point of petroleum products in the temperature range 40 to 360 °C by manual Pensky-Martens closed cup apparatus or an automated Pensky-Marten closed cup apparatus.	See ASTM D 93-13.

5.2.10 Nitrogen, ASTM D 4629-12

Data Quality Indicators – Nitrogen, ASTM D 4629-12

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability.	See ASTM D 4629-12.
Bias	The bias cannot be determined since an appropriate standard reference material containing a known trace level of nitrogen in a liquid petroleum hydrocarbon is not available to form the basis of a bias study	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term)	See ASTM D 4629-12.
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	This test method covers the determination of the trace total nitrogen naturally found in liquid hydrocarbons boiling in the range of 50 to 400 °C with viscosities between 0.2 and 10 cSt at room temperature.	See ASTM D 4629-12.

5.2.11 Polycyclic and Total Aromatics, ASTM D 5186-03(2009)

Data Quality Indicators – Polycyclic and Total Aromatics, ASTM D 5186-03(2009)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability.	See ASTM D 5186-03(2009).
Bias	Reference materials for this test method are in development through ASTM. The bias cannot be determined at this time.	N/A
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term)	See ASTM 5186-03(2009).
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	The resulting data is defined only in terms of the method. Various analytical techniques that purport to report the same property have systematic biases that are functions of the measurement technique.	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	This test method covers the determination of the total amounts of monoaromatic and polynuclear aromatic hydrocarbon compounds in motor diesel fuel by SFC. The range of aromatics concentration to which this test method is applicable is from 1 to 75 mass %. The range of polynuclear aromatic hydrocarbon concentrations to which this test method is applicable is from 0.5 to 50 mass %.	See ASTM 5186-03(2009).

5.2.11.1 Benzene, ASTM 3606-10

Data Quality Indicators – Benzene (ASTM D 3606-10)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 3606-10.
Bias	Benzene bias is detailed in D 3606-06e1.	See ASTM D 3606-10
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 3606-10.

DQI	Definition/Discussion	Measurement Performance Criteria
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	N/A	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Benzene can be determined between the levels of 0.1 and 5 volume %	See ASTM D 3606-10.

5.2.12 Oxygenates, ASTM D 5599-00(2010)

Data Quality Indicators – Oxygenates, ASTM D 5599-00(2010)

DQI	Definition/Discussion	Measurement Performance Criteria
Precision	Precision in analytical petroleum chemistry is generally given in terms of repeatability. (Short term)	See ASTM D 5599-00(2010).
Bias	Oxygenate bias is detailed in D 5599-00.	See ASTM D 5599-00(2010).
Accuracy	Accuracy in analytical petroleum chemistry is generally defined in terms of reproducibility (long term). Accuracy will be maintained by a QC sample	See ASTM D 5599-00(2010).
Representative	Fuel samples are to be collected by field contractors at locations defined by ERG.	N/A
Comparability	N/A	N/A
Completeness	All samples received by SwRI will be analyzed according to the protocol. Should any sample be compromised, SwRI will supply a replacement sample.	100%
Sensitivity	Test method covers a gas chromatographic procedure for the quantitative determination of organic oxygenated compounds in gasoline having a boiling point limit of 220°C and oxygenates having a boiling point limit of 130°C. It is applicable when oxygenates are present in the 0.1 to 20% by mass range.	See ASTM D 5599-00(2010).

5.3 Data Auditing

SwRI will review the sample collection receipts for all samples collected to ensure the proper grade was acquired and samples were obtained from designated retail outlets. SwRI will also audit the steps of analysis for 30 of the samples taken (> 10%), as required by Category III projects.

6.0 Conclusions

Evaluating the most recent four years of data a few points can be made:

1. The results of the 2014 data collection found no areas with gasoline sulfur values above the 80 ppm federal limit. The data set average was 28.1 ppm, with a maximum value of 41.9 ppm.

2. The results also found no districts with average diesel sulfur values above the 15 ppm limit. The data set average was 5.93 ppm, with a maximum value of 9.60 ppm.

3. The analysis of temporal variability at the station level, as evidenced in the second round test results for the Houston area, appear to indicate low variability for gasoline fuel parameters. Significant, unexplained temporal variability was identified in the diesel samples, however, for the second straight sampling year. The source of this variability is not known.

Attachment 1

Station Selection List

TXDOT District	Facility Name	Address	City	Zip Code
Abilene	Chillerz 10	1433 S Willis St	Abilene	79605
Abilene	Pilot Travel Center	706 E I 20	Big Spring	79720
Abilene	Big Country Truck St	9232 Interstate 20	Merkel	79536
Amarillo	Loves Country Store	6930 E Interstate 40	Amarillo	79118
Amarillo	Loes Country Store #	8615 Canyon Dr	Amarillo	79110
Amarillo	Flying J Travel Plaz	9601 Ih 40 E	Amarillo	79111
Atlanta	Marshall I20e Truck	304 Interstate 20 E	Marshall	75672
Atlanta	Total Stop Southlake	4020 S Lake Dr	Texarkana	75501
Atlanta	Step In #2	4526 W 7th Street	Wake Village	75561
Austin	7-Eleven Store 36600	1625 E Parmer Ln	Austin	78753
Austin	M & S Food Mart	5511 Cameron Rd	Austin	78723
Austin	Discover Food Mart 1	7200 N Ih 35	Austin	78752
Austin	Stripes 2432	2501 S Water St	Burnet	78611
Austin	Jeks West	528 W Main St	Fredericksburg	78624
Beaumont	Express Mart 323	910 S Major Drive	Beaumont	77707
Beaumont	Hwy 190 Fuel Stop	850 E Gibson St	Jasper	75951
Beaumont	Texas Country Store	7411 Ih 10 E	Orange	77630
Beaumont	Flying J Travel Plaz	7112 Ih 10 W	Orange	77632
Beaumont	Rudys 26	705 S Magnolia St	Woodville	75979
Brownwood	Country Store	3706 Highway 377 S	Brownwood	76801
Brownwood	Stripes #2422	1003 W Central Ave	Commanche	76442
Brownwood	Loves Country Store	1600 W Loop 254	Ranger	76470
Bryan	Brenham Food Stop 2	1312 Prairie Lea St	Brenham	77833
Bryan	Crossroads Corner St	1900 S Market St	Brenham	77833
Bryan	Navasota Express	17694 Highway 6	Navasota	77868
Childress	Murphy Usa 7382	2709 Avenue F Nw	Childress	79201
Childress	Allsups #102	105 S Central Ave	Knox City	79529
Childress	Garrison Food Mart	1627 N Main St	Shamrock	79079
Corpus Christi	Pilot Travel Center	4066 Highway 59	George West	78022
Corpus Christi	Loves Travel Stop 32	1451 N Us Highway 77 Byp	Kingsville	78363
Corpus Christi	Corner Store 0979	1402 Wildcat Dr	Portland	78374
Corpus Christi	Stripes 2288	108 N Alamo St	Refugio	78377
Dallas	Quik Trip 970	5909 W Davis St	Dallas	75211
Dallas	I-30 Truck Stop	801 E Interstate 30	Garland	75043
Dallas	Loves Travel Stop 33	2500 S I-45 Service Rd	Hutchins	75141
Dallas	Terrell Travelcenter	1700 Wilson Rd	Terrell	75161
El Paso	Loves Travel Stop 44	3000 Mountain Pass Blvd	Anthony	79821
El Paso	Flying J Travel Plaz	1301 Horizon Blvd	El Paso	79928
El Paso	Coleman Secure Inves	6631 Montana Ave	El Paso	79925
El Paso	Petro Stopping Cente	1295 Horizon Blvd	El Paso	79927
Fort Worth	Golden Express Truck	8417 N Us Highway 287	Alvord	76225
Fort Worth	Pilot Travel Center	2400 Alliance Gateway Fwy	Fort Worth	76177
Fort Worth	Loves Country Store	2605 E Bankhead Hwy	Weatherford	76087
Fort Worth	Pilot Travel Center	1201 W Interstate 20	Weatherford	76087
Houston	Loves Travel Stop 40	1703 East Fwy	Baytown	77521
Houston	Baytown Express Trav	1901 Interstate 10 E	Baytown	77521
Houston	Flying J Travel Plaz	204 Waller Ave	Brookshire	77423
Houston	Loves Travel Stop 31	3940 N Mccarty St	Houston	77013
Houston	Flying J Travel Plaz	15919 North Fwy	Houston	77090
Houston	Loves Travel Stop 23	612 Pederson Rd	Katy	77494
Houston	Loves Travel Stop 46	9600 Longstreet Rd	Willis	77318

TXDOT District	Facility Name	Address	City	Zip Code
Laredo	Loves Country Store	1509 Rose St	Edna	77957
Laredo	Stripes 2409	14118 Fm 1472	Laredo	78045
Laredo	Flying J Travel Plaz	1011 Beltway Pkwy	Laredo	78045
Laredo	7-Eleven Store 36548	900 Espejo Molina Rd	Laredo	78046
Lubbock	Kendrick Oil Co	824 Main St	Friona	79035
Lubbock	Corner Store #1449	2815 Slide Rd	Lubbock	79407
Lubbock	Fast Stop #29	2510 West 5th Street	Plainview	79072
Lufkin	O Lucky Truck Stop	11960 U S Highway 59 N	Livingston	77351
Lufkin	Depot Chevron	428 W Main St	Nacogdoches	75961
Lufkin	South Side Chevron	3325 South St	Nacogdoches	75964
Odessa	Pilot Travel Center	4015 S Fm 1788	Midland	79706
Odessa	Kent Kwik 262	2113 S Stockton Ave	Monahans	79756
Odessa	Loves Travel Stop 49	5202 S Cedar St	Pecos	79772
Paris	Wag A Bag 2 (Shell F	186 Us Highway 271 S	Deport	75435
Paris	Loves Country Store	215 E I 30 North Service Rd	Mt Vernon	75457
Paris	Pilot Travel Center	1200 S Hillcrest Dr	Sulphur Springs	75482
Pharr	Stripes 2404	2202 W Monte Cristo Rd	Edinburg	78541
Pharr	Stripes 2196	702 E Us Highway 281	Los Indios	78567
Pharr	Murphy Usa 5808	215 E Expy 83	Weslaco	78599
San Angelo	Stripes 261	1802 S Bryant Blvd	San Angelo	76903
San Angelo	Stripes #199	3002 Knickerbocker Rd	San Angelo	76904
San Angelo	Stripes 267	1105 N Crockett Ave	Sonora	76950
San Antonio	Trainer Hale Truck S	14462 Ih 10 East	Marion	78124
San Antonio	Pit Stop Food Mart 2	3201 Ih 35 S	New Braunfels	78132
San Antonio	New Braunfels Travel	4817 N Ih 35	New Braunfels	78130
San Antonio	Tex Best Travel Cent	4463 E State Highway 97	Pleasanton	78064
San Antonio	Petro Stopping Cente	1112 Ackerman Rd	San Antonio	78219
Tyler	Super C South	411 Us Highway 79 S	Henderson	75654
Tyler	Henderson Depot	1609 Kilgore Dr	Henderson	75652
Tyler	Murphy Usa 6620	1315 S Jackson St	Jacksonville	75766
Tyler	Green Top 2	5909 W Marshall Ave	Longview	75604
Tyler	Pilot Travel Center	12881 Fm 14	Tyler	75706
Waco	Stripes 2427	603 S Valley Mills Dr	Beverly Hills	76711
Waco	Big Bs Truck Stop	1205 E Main St	Itasca	76055
Waco	End Zone Mini Mart	402 S Memorial St	Riesel	76682
Wichita Falls	Murphy Usa 6693	1525 N Grand Ave	Gainesville	76240
Wichita Falls	7-Eleven Store 57218	19765 Us Highway 287 E	Harrold	76364
Wichita Falls	Loves Country Store	1124 Central Fwy E	Wichita Falls	76301
Yoakum	Hwy 71 Shell	1003 Walnut St	Columbus	78934
Yoakum	Rattlers Country Sto	2409 W State Highway 71	La Grange	78945
Yoakum	Sealy Shell	2010 Highway 36 S	Sealy	77474

Attachment 2

SwRI Testing Results for Gasoline – provided electronically

Attachment 3

SwRI Testing Results for Diesel – provided electronically

Attachment 4

SAS Program for Processing Round 1 Gasoline Data – provided electronically

Attachment 5

Data Analysis for Gasoline – provided electronically

Attachment 6

SAS Program for Round 1 vs Round 2 Gasoline Comparison – provided electronically

Attachment 7

Data Analysis for Diesel Samples – provided electronically