Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study

FINAL REPORT

Prepared for:

Texas Commission on Environmental Quality

Prepared by:

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Cambridge Systematics, Inc.

Alliance Transportation Group, Inc.

August 31, 2004

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Executive Summary

The Texas Commission on Environmental Quality (TCEQ) contracted with Eastern Research Group (ERG) to develop a statewide On-Road Heavy-Duty Vehicle (HDV) Extended Idling Activity Database and Emissions Inventory for all counties in Texas. Specifically ERG was tasked with characterizing NOx emissions from heavy-duty trucks idling for more than 15 consecutive minutes at a time, for the following source generator categories:

- Truck Stops and Travel Plazas (hereafter referred to collectively as Truck Stops)
- State-maintained Rest Areas and Travel Centers (referred to collectively as Rest Areas)
- Commercial Marine Ports
- Airports
- Intermodal Rail Yards

Extended truck idle emissions from these and other source categories have not been developed in a bottom-up fashion before, and are not included in current emission inventory efforts. The Texas Transportation Institute (TTI) first developed an "order of magnitude" estimate of emissions from these sources in "Heavy-Duty Diesel Vehicle Idling Activity and Emissions Study: Phase 1 – Study Design and Estimation of Magnitude of the Problem" (August 2003). The current study constitutes Phase II of this effort, refining activity and emissions estimates for the above source categories.

For this analysis data from these source categories was collected in sufficient detail to characterize truck idling activity at several different time scales, including ozone-season daily, ozone-season hourly, and seasonal/annual. Annual emissions are also projected from the base year 2004 through 2030. In this way the final emissions model can be used for a number of different purposes, including SIP development, photochemical modeling, and for EPA's Consolidated Emissions Reporting Rule requirements.

The HDV idle study consisted of three main components. One element focused on identifying and characterizing the source generator categories across the state (mainly truck stops). The goal was to identify the universe of truck stops, rest areas, and intermodal locations, obtaining reliable information as to location and number of parking spaces. This information could then be used to identify sites for data collection, as well as for extrapolating activity and emissions to non-surveyed sites.

The second component of the study involved actual field observations of truck occupancies and idling rates, following the specifications laid out in the Data Collection Plan. A range of observational variables were also recorded (including time of visit, truck class, truck stop amenities, etc.) in order to refine the predictive models if necessary.

The third component of the study involved analysis of the field data and development of the idling and emissions model. First, correlation analyses were performed to identify statistically significant factors affecting the fraction of idling trucks expected per parking space. Based on these finding, separate relationships were developed to predict idle rates for different geographic regions and time periods, for both truck stops and rest areas. Combining the appropriate expansion factors from this analysis with estimates of total parking spaces from the master truck stop and rest area tables, values for the number of idling trucks per hour/day/year were developed for each county. Combining these figures with appropriate gram per hour emission factors provides the final county-level emission inventory. Growth factors are then applied in the model to estimate activity and emissions levels through 2030.

Estimation of intermodal idle activity and emissions did not involve the development of a formal model. Given the relatively small number of sites involved, these data were evaluated in a stand-alone manner, using upper-bound activity estimates derived from field observations.

Results – Truck Stops and Rest Areas

The final idle activity and emissions model achieves excellent geographic coverage, with at least one truck stop or rest area identified in 162 Texas counties. The field observations used to build the model exceeded the target number of site visits set in the Data Collection Plan, and established reliable temporal profiles for all time periods and regions of the state.

In an attempt to compile a comprehensive list of truck stops across the state, ERG conducted an extensive Internet search. Adding to the initial TTI Phase I list of 153 sites, ERG identified an additional 352 locations verifiable as operating truck stops. An additional 40 sites were eventually identified by staff in the field, from manager or trucker interviews, or simply by sight while on the road, for a final total of 563 truck stops statewide. 93 active Rest Areas were also identified through TxDOT.

The final estimate of statewide truck stop and rest area emissions is approximately twice that estimated by TTI for the Phase 1 study, again due to the greater number of truck stops identified for this effort. Emissions estimates for large metro areas such as Houston were more

similar. Emission results for the 2004 base year are summarized for key regions of the state below.

Table ES-1. Truck Stop and Rest Area Extended Idle NOx Emissions (2004)

Region*	Tons Per Day
Houston/Galveston/Brazoria	4.35
Dallas/Fort Worth	4.67
Beaumont/Port Arthur	0.86
El Paso	1.39
Austin	0.32
San Antonio	0.93
Tyler/Longview	0.38
Statewide	29.61

*Corresponding to current/pending 8-hour ozone non-attainment area.

Several recommendations have been identified for potentially improving the accuracy and precision of the idle activity and emissions inventory model in the future.

- Adjust parking space estimates to account for future penetration of idle reduction technologies. As use of idle reduction techniques become more widespread, site-specific adjustments can be applied to the master truck stop list to account for reduced idling.
- Adjust the baseline MOBILE6 emission inventory for extended idle emissions. The MOBILE model uses in-use fuel economy estimates from the 1992 Truck Inventory and Use Survey (TIUS) to calculate heavy truck gram per mile emission rates. These fuel economy data implicitly include fuel consumed during extended idling events. As such, MOBILE model output includes some amount of extended idle emissions. Therefore we recommend that the extended idle emissions estimated in this study should be netted out of the current heavy-duty diesel on-road inventory, to avoid double-counting. EPA currently estimates extended idle emissions should account for no more than 3.4% of total on-road emissions (7). The extended idle emission estimates developed here should be compared with the on-road inventories for each region of the state to confirm that they are below the 3.4% cap before proceeding with this recommendation.
- Contact TxDOT Districts to identify and characterize the roughly 740 state picnic and parking areas across the state. This can be incorporated under a future study to estimate emissions at these distinctly different source generators.
- Conduct a brief follow-up study during the fall, winter, and spring seasons to characterize idle expansion factors for these periods. This will address remaining doubts concerning the accuracy of interview responses and resulting annual expansion factors.

- Work with TxDOT Maintenance Division to refine Rest Area growth factors. In this way plans for expansion of rest area parking capacity can be made county-specific.
- Develop means of allocating truck stops without GPS coordinates. As noted in the report, approximately 50% of the sites identified in the master truck stop list do not have GPS coordinates. In order to facilitate preparation of photochemical modeling inputs, a methodology should be developed to allocate these emissions spatially within a given county. In those cases where GPS coordinates cannot be determined via available locator information, emissions could be allocated evenly along the primary access highway identified on the list. Unfortunately even access highway information is missing for certain sites. For these, emissions could be allocated evenly across all major interstates and highways in a county.
- Develop a truck stop allocation model using data from this project. This may be the most important recommendation regarding future idle characterization activities. Based on our experience, we believe it will be very time consuming to keep the current master truck stop list up to date. Doing so would require frequent review of the Internet for new truck stops, and calling existing locations to determine if they have recently closed or modified their parking capacity. An alternative would be to build a truck stop allocation model using regression analyses to identify pertinent factors influencing the number of parking spaces in a county, and subsequently developing the required predictive algorithms. Independent variables in such a model would most likely include region of state, associated Interstate/State Highway, and proximity to key metro areas. Such a model could be periodically validated and refined through a relatively low-cost survey of representative counties (e.g., one urban, one suburban, one rural), simply by driving the major interstates and state highways in the area.

Results -- Intermodal Facilities

Initial findings indicated that intermodal facilities did not experience significant extended truck idling during typical operations. Accordingly, these facilities were not observed as intensively as truck stops and rest areas. However, even under the “worst-case” conditions assumed in our analysis, extended idle emissions at these locations total less than 0.1 tons per day of NOx statewide.

Nevertheless, certain facilities have the potential to become significant sources of NOx under conditions of strained capacity. Therefore periodic monitoring of terminal capacity may be warranted to identify emerging queue problems in the future.

1.0 Introduction

The Texas Commission on Environmental Quality (TCEQ) contracted with Eastern Research Group (ERG) to develop a statewide On-Road Heavy-Duty Vehicle (HDV) Extended Idling Activity Database and Emissions Inventory for all counties in Texas. This work was authorized through TCEQ Contract 582-4-65564, under Work Orders 01 and 08.

Under these work orders ERG was tasked with characterizing NOx emissions from heavy-duty trucks idling for more than 15 consecutive minutes at a time, for the following source generator categories:

- Truck Stops and Travel Plazas (hereafter referred to collectively as Truck Stops)
- State-maintained Rest Areas and Travel Centers (referred to collectively as Rest Areas)
- Commercial Marine Ports
- Airports
- Intermodal Rail Yards[1]

Extended truck idle emissions from these and other source categories have not been developed in a bottom-up fashion before, and are not included in current emission inventory efforts. The Texas Transportation Institute (TTI) first developed an "order of magnitude" estimate of emissions from these sources in "Heavy-Duty Diesel Vehicle Idling Activity and Emissions Study: Phase 1 – Study Design and Estimation of Magnitude of the Problem" (August 2003). The current study constitutes Phase II of this effort, refining activity and emissions estimates for the above source categories. Phase III of this effort may investigate idling at more diffuse, and more numerous sources such as commercial warehouses, industry, construction sites, package distribution facilities, and other parking areas (e.g., picnic and parking areas along the highway, but without amenities.)

For this analysis data from these source categories was collected in sufficient detail to characterize truck idling activity at several different time scales, including ozone-season daily, ozone-season hourly, and seasonal/annual. Annual emissions are also projected from the base year (2004) through 2030. In this way the final emissions model can be used for a number of different purposes, including SIP development, photochemical modeling, and for EPA's Consolidated Emissions Reporting Rule requirements.

[1] Ports, airports, and intermodal rail yards are often collectively referred to as "intermodal" locations or facilities throughout this report, as cargo is transferred from one mode of transportation to another (trucks) at all of these sites.

For this effort ERG served as the overall technical lead, responsible for preparation and approval of all deliverables to TCEQ. ERG also led the effort to compile the master truck stop and rest area lists. ERG also employed several expert subcontractors to provide support for other tasks. Cambridge Systematics led the tasks to develop the data collection plans, as well as the data analysis and model development tasks. Alliance Transportation Group (ATG) conducted all field data collection involving truck stops and rest areas, while Starcrest Consulting Group (SCG) collected data at the intermodal locations (ports, airports, and rail yards).

The following presents the methodology used to identify and characterize the different source generator categories, collect field data on truck occupancies and idling rates, analyze the data, and develop the emissions estimation model.

2.0 Overview

The HDV idle study consisted of three main components. One element focused on identifying and characterizing the source generator categories across the state (mainly truck stops). The goal here was to identify the universe of truck stops, rest areas, and intermodal locations, obtaining reliable information as to location and number of parking spaces. This information could then be used to identify sites for data collection, as well as for extrapolating activity and emissions to non-surveyed sites.

The second component of the study involved actual field observations of truck occupancies and idling rates, following the specifications laid out in the Data Collection Plan. A range of observational variables were also recorded (e.g., time of visit, truck class, truck stop amenities, etc.) in order to refine the predictive models if necessary.

Different strategies were followed, depending on the nature of the source generator category. Truck stop observations were weighted toward the larger locations, although ATG field staff had the discretion to visit other nearby locations as convenient in order to maximize the total number of sites visited. ATG travel schedules were arranged to cover each of the 23 regions of the state (as defined for the purposes of this analysis), as well as a representative sample across time of day and day of week. Rest areas were surveyed whenever they were seen during ATG's travels from one truck stop to the next. Intermodal rail yards, commercial marine ports, and commercial (cargo) airports were targeted based on anticipated truck volumes within each category.

The third component of the study involved analysis of the field data and development of the idling and emissions model. First, correlation analyses were performed to identify statistically significant factors affecting the fraction of idling trucks expected per parking space. Based on these finding, separate relationships were developed to predict idle rates for different geographic regions and time periods, for both truck stops and rest areas. Combining the appropriate expansion factors from this analysis with estimates of total parking spaces from the master truck stop and rest area tables, values for the number of idling trucks per hour/day/year were developed for each county. Combining these figures with appropriate gram per hour emission factors provides the final county-level emission inventory. Growth factors are then applied in the model to estimate activity and emissions levels through 2030.

Estimation of intermodal idle activity and emissions did not involve the development of a formal model. Given the relatively small number of sites involved, these data were evaluated in a stand-alone manner, using upper-bound activity estimates derived from field observations.

3.0 Source Identification AND Characterization

Identifying the sources for most of the generator categories in this study was relatively straightforward. Reliable listings were readily available from the following:

- Rest areas – TxDOT Maintenance Division Website
  http://www.dot.state.tx.us/mnt/sra/map.htm
- Commercial cargo airports – USDOT Bureau of Transportation Statistics
- Intermodal rail yards – Rail Intermodal Terminal Directory
- Commercial Marine Ports – American Association of Port Authorities

A list of each of the intermodal source categories is provided in the Data Collection Plan (see Appendix B). The complete list of Rest Areas are provided in Appendix D.

Unfortunately there is no single comprehensive list of truck stops available for Texas. For example, the industry trade association, the National Association of Truck Stop Operators (NATSO) website only lists 74 sites, primarily from large chain operations. Other "trucker-oriented" websites typically list between 50 and 300 locations across the state. In fact, it is likely that a complete list cannot be compiled from public sources such as the Internet, as certain sites may not advertise at all using standard media methods.

In an attempt to compile a relatively comprehensive list of truck stops across the state, ERG conducted an exhausting (if not exhaustive) Internet search. Adding to the initial TTI Phase I list of 153 sites, ERG identified an additional 352 locations verifiable as operating truck stops. (An additional 40 sites were eventually identified by ATG staff in the field, from manager or trucker interviews, or simply by sight while on the road.) In this case "verifiable" means that both the location and an estimate of the number of parking spaces were obtainable through site visit, phone interview, or recent website entry. Phone numbers for interviews, if not available from the primary Internet listing, were obtained from listings in the current TCEQ Petroleum Storage Tank Database (PSTDB), or an active listing in Internet Yellow pages (Verizon or Yahoo).

Internet sources consulted for this effort included the following:

General websites –

- dieselboss.com
- gocomcheck.com

- natsn.com
- otrprotrucker.com
- roadstaronline.com
- trucker.com
- truckerslink.com
- truckingnetwork.com
- truckrealm.com
- Yahoo Yellow pages (search for “Truck Stops”)

Specific Chains –

- ripgriffin.com (Rip Griffin)
- tcfs.com (Town and Country Food Stores)
- flyingj.com (Flying J)
- loves.com (Love’s)
- petrotruckstops.com (Petro Stopping Centers)
- tatravelcenters.com (Travel Centers of America)
- pilotcorp.com (Pilot Travel Centers)

Determining if a listed site was not an active truck stop proved to be somewhat difficult. In certain instances phone numbers or site names may have been changed since the time of the listing, making confirmation of status difficult. To be conservative, sites were only removed from the master list if: 1) a site visit directly verified a closure or duplication; 2) a phone interview confirmed closure or status as “not a truck stop” (i.e., no overnight truck parking allowed); 3) the site was not found in the field, the phone number was either absent (not listed in Internet Yellow pages) or not working, and site name/listed phone did not appear in the current TCEQ PSTDB. (A complete list of truck stops removed from the master list is provided in the electronic data to TCEQ).

For surveyed locations, the number of spaces counted/estimated by ATG were used in the master site list. If an estimate of number of spaces was provided through a website, that figure was used in the absence of a site visit. If an estimate of spaces was not available from either of these options, then a phone interview was attempted to determine the size of the facility. However, an analysis of the manager interviews indicated that truck stop personnel fairly consistently overestimate the number of spaces, by about 12% (see Data Analysis section

below). Therefore a 12% adjustment was applied to all parking space estimates obtained through phone interviews to compensate for the observed bias.

In a few instances (23), it was not possible to verify the number of spaces for certain sites identified through the Internet, nor was it possible to confirm the site was not a working trucking stop. In these cases ERG estimated the number of spaces according to the following decision rule. If the site was part of a recognized chain, the average value for other members of the same chain was used. If the site was not part of a chain, ERG assigned the average value of all other "non-chain" sites identified in the same county. For the three counties with no other identified truck stops, ERG used average size estimates from an adjacent county (Hall County = Childress County; Houston County = Leon County; Dimmit County = Maverick County).

The final truck stop master list was provided to TCEQ in electronic format. An abbreviated version (without all fields) is provided in Appendix C. The full electronic listing contains numerous fields, including:

- Unique Identifier*
- Region of State*
- Truck Stop Name*
- City
- County* (determined via Internet resources and Texas maps)
- Address
- Phone
- Directions - primary access, exit number, cross street (for locating in field)
- GPS coordinates (if visited/geocoded by ATG)
- Status in PSTDB (used only for difficult matches)
- Identification Source (Internet or Site Visit)
- ATG result (site found, not surveyed, etc)
- Parking spaces*
- Basis*
- Adjusted spaces* (phone interview only)

Note that those fields with an asterisk are mandatory for data analysis and model development and are complete; other fields may be incomplete due to data or other limitations.

Table 3-1 provides a summary of the number of truck stops and spaces estimated for each of the 23 regions of the state.

Table 3-1. Truck Stop Summary by Region of State

Region	# Spaces	# Sites	Avg. # spaces/site	Avg. Size Rank
Abilene	1,032	15	69	3
Amarillo	1,727	37	47	10
Austin	257	12	21	22
Beaumont/Port Arthur	561	9	62	4
Bryan-College Station	258	11	23	21
Corpus Christi	530	14	39	12
Dallas/Fort Worth	4,470	90	50	7
El Paso	1,898	21	90	1
Houston/Galveston	4,080	109	37	13
Killeen/Temple	595	15	40	11
Laredo	872	12	73	2
Lubbock	401	12	33	14
McAllen	777	13	60	5
Midland/Odessa	957	18	53	6
Nacogdoches	306	10	31	17
San Angelo	453	15	30	19
San Antonio	2,153	45	48	9
Sherman/Denison	59	4	15	23
Texarkana	662	23	29	20
Tyler/Longview	850	26	33	14
Victoria	396	12	33	14
Waco	1,021	21	49	8
Wichita Falls	597	19	31	17
Total	24,912	563	44	

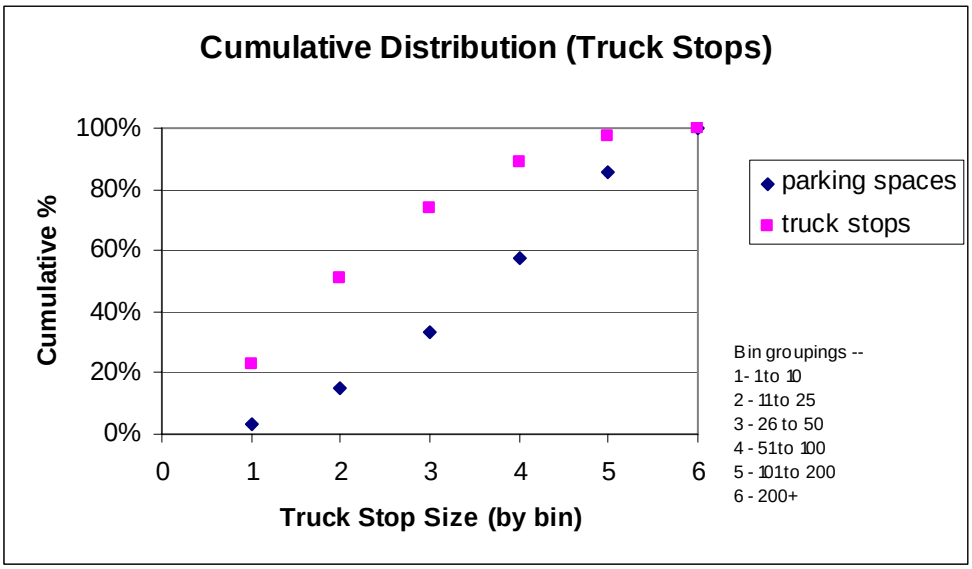
As seen from the table, the large metro areas contain the highest number of truck stops and parking spaces, with the exception of the Austin area. Truck stops appear to be clustered on either side of Williamson/Travis/Hays Counties along I-45, either in the San Antonio or Waco and Killeen/Temple regions.

The table also shows the average number of parking spaces per truck stop, by region. Interestingly, while most regions average between 30 and 60 spaces per site, the two border towns of El Paso and Laredo exhibit the highest average truck stop size, at 90 and 73, respectively.

Our findings also indicate there is a relatively flat distribution of truck stops and parking spaces across all sizes of facilities, although the smallest truck stops (with 10 or fewer spaces)

contribute a disproportionately small amount to total spaces. Figure 3-1 presents the cumulative distribution of both truck stops and parking spaces by facility size bin.

Figure 3-1. Cumulative Distribution of Truck Stops



ERG is confident that this is the most comprehensive list of truck stops currently available for the State of Texas. At 563 listings, it contains approximately twice as many listings as the 284 sites estimated for Texas in the 2002 FHWA "Study of Adequacy of Commercial Truck Parking Facilities" (FHWA-RD-01-158). But as stated above, there is no way to verify the degree of completeness of the list with certitude. On the other hand, there is good anecdotal evidence that ERG's search at least comes close to exhausting the Internet as a source of new information. For example, the last Internet source identified by ERG, dieselboss.com, listed approximately 440 "truck stops" in Texas. Once reviewed for duplicates and integrated into the master list, these sites only added a total of ~800 spaces to the entire list – an increase of only about 3%. While not definitive, we believe this finding reflects very well on the comprehensiveness of the list as it stands.

4.0 Data Collection: Truck Stops and Rest Areas

In addition to identifying source generator locations, this study focused heavily on collection of real world truck idling data. ERG and Cambridge Systematics developed Data Collection Plans for Truck Stops and Rest Areas, as well as targeted Intermodal locations. These plans were approved by TCEQ and are provided in Appendix A. The plans were designed to collect two types of data. The first type of data included quantifiable information, directly observable to field staff such as the number of spaces with idling trucks for truck stops and rest areas, and length of queue and idle duration for intermodal facilities. Additional qualitative data was also collected from facility managers and truckers via interviews, for use in validating direct observations and extrapolating results across non-summer seasons.

4.1 Data Collection Strategy

The observable data collected at truck stops and rest areas included:

- Site ID number
- Descriptive location (adjacent highway and mile marker)
- GPS points
- MOBILE6 Functional Class of adjacent roadway
- Time of day and day of week of observation
- Number of parking spaces, and basis (count or estimate)[2]
- Occupancy and idling fractions
- Total number of trucks
- Number of diesels
- Number of long-haul trucks
- Amenity characterization (truck stops only)
- Lot status (paved or unpaved)
- Surveyor comments (e.g., problems with access, presence of IdleAire systems, reliability of interviews)

These parameters were selected for observation to identify factors that might have a demonstrable influence on the final activity model's dependent variable, average number of idling trucks per parking space. If a correlation analysis found a strong relationship between any

[2] For lots with unmarked spaces, number of spaces was estimated by ATG field staff.

of these parameters and average idling rates, separate activity models would be developed for the different parameter categories (see Data Analysis and Model Development section below).

Since this study was restricted to summer time data collection, additional data was necessary to help extrapolate findings for annual activity and emissions estimation. Therefore the facility manager and trucker interview questions focused on characterizing seasonal variations in truck and idle activity. In the Manager Interview, additional questions were asked for validation purposes regarding number of spaces at the site, and typical occupancy and idle rates. Truck stop managers and staff were also asked to identify any nearby truck stop locations, in order to enhance the master location list. Trucker interviews also asked drivers to characterize average duration of idle events at different times, as well as descriptive information such as truck manufacturer and commodity type.

Finally, targets were set for the number of site visits for truck stops and rest areas, considering available time and budget. Based on the master truck stop list available at that time, it was shown that the expected results would be ± 5% at the 95% confidence level.[3]

4.2 Field Data Collection Activities

The following summarizes ATG's data collection effort for truck stops and rest areas.

An initial listing of truck stops with address and phone numbers was provided by ERG, ranked by number of parking spaces. The list was reviewed to ensure that a complete address was available to facilitate geographic location. Missing or incomplete address information was first subjected to Internet searches at www.switchboard.com and yp.yahoo.com, both of which are Internet based yellow page directories. The remaining truck stops without address information were called when possible to determine location in reference to major highways and cross streets.

The majority of the rest area locations were listed on the Texas Department of Transportation web site by county with approximate locations based on either a highway mile marker or location in reference to a nearby city.

Using the address and other location information, the truck stops and rest areas were geographically located. A geographic information system (GIS) was used to translate the

[3] The master truck stop list provided to ATG at the beginning of data collection was eventually updated to include ~100 additional locations found on the Internet, as well as the 40 sites identified by ATG in the field.

location information into map points. Each data point included a unique site number and other information associated with that site.

Through consultation between ERG and TCEQ, a list of the data elements that would be captured was forwarded to ATG. Upon reviewing the data elements and questionnaires for capturing those elements, ATG made several recommendations to ensure successful field use (see above).

Once the final questionnaires were determined, a master database was created for use during field data collection. Within the database, three forms were created to capture the three separate data elements:

- Observation Form – used to capture observational data by the field personnel at truck stops and rest areas.
- Manager Interview Form – used to capture interview information from truck stop managers.
- Trucker Interview Form – used to capture interview information from individual truck drivers.

The database and forms were transferred to four tablet personal computers for use in field data collection. A screen capture of each of the three forms is found in Appendix A. In addition, a GIS program and global positioning system (GPS) unit were provided to each data collection person.

Prior to entering the field, supervisors obtained generalized parking space requirements for a tractor-trailer rig. Several sites were surveyed north of Austin to determine average measurements. The average parking space from left edge of strip to left edge of strip was 11 feet wide and from back of curb to end of stripped area was 70 feet in length. Survey personnel were given these measurements and instructed to view several stripped areas before estimating parking for those areas without stripes.

Surveyors were instructed to indicate in the comments field when the truck parking spaces was an estimate. As stated above, after the first week of data collection, an ‘estimate’ check box was added to the data collection database form.

As would be expected, estimates improved as data collection progressed. The confidence level for all estimates after week one of data collection should be higher. Confidence levels for estimates on paved parking lots should also be higher than for unpaved lots.

Data Collection Schedule

The data collection schedule included three phases and covered a nine-week period beginning June 28, 2004 and ending August 27, 2004. The following summarizes the schedule:

Phase 1 – Daytime data collection.

- Week 1: Texarkana, Tyler/Longview, Laredo, McAllen, Corpus Christi, Victoria, Killeen/Temple, Lubbock, and Amarillo.
- Week 2: San Antonio, Dallas/Fort Worth, and Wichita Falls.
- Week 3: El Paso, San Angelo, Odessa/Midland, Abilene, and Houston.
- Week 4: Houston.
- Week 5: Data review and submission to ERG

Phase 2 – "Continuous" twenty-four hour observational data collection.

- Week 6: Houston and Dallas
- Phase 3 – Nighttime observational data collection.
- Week 7: Abilene, Lubbock, and Amarillo.
- Week 8: Midland/Odessa, Laredo, Texarkana, Austin, and Tyler/Longview.
- Week 9: San Antonio and Beaumont/Port Arthur.

Weekend data was also captured during the data collection effort in El Paso, Houston, San Antonio, and Amarillo. Weekday observations were also made in the Beaumont/Port Arthur area to supplement the Phase 1 data.

Phase 1

As stated earlier, there were three main data elements collected during Phase 1: 1) observational, 2) manager interview, and 3) trucker interviews. Phase 1 data collection was done during the daylight hours to facilitate manager and truck driver interviews.

The observational data collection was an effort to establish a baseline for number of parking spaces at truck stops and rest areas. Data collection personnel counted the number of truck parking spaces, the number that were filled, and the number of those vehicles present that were idling (other data collected is listed on the forms found in Appendix A).

Additionally, data collection personnel used the GPS unit and GIS program to place a point on the map for each site observation. That point was labeled with the truck stop or rest area unique identifier. The unique ID was tied to all data collected for an individual site.

Many of the sites on the original list were either duplicates, out of business, or not found. Data collection personnel made note of these with the final list of truck stops and rest areas and their individual status. (A complete list of those sites removed from the master truck stop list are provided in the electronic files provided to TCEQ.) Also included are those truck stops and rest areas that were added to the list during field observations.

The observational data was followed up by an attempt to interview the manager or assistant manager at each of the truck stops. Several of the questions asked of truck stop managers were intended to corroborate the observational data, such as the number of truck parking spaces. The majority of truck stop personnel agreed to be interviewed, although some refused for various reasons (e.g., “too busy”, “call owner”, etc.)

Truck driver interviews were obtained on a random basis. Field data collection personnel attempted to obtain one to two truck driver interviews at each truck stop or rest area. These interviews were designed to determine idling characteristics of the individual drivers. The truck driver interviews were the most problematic, as many drivers were reluctant to answer questions.

Phase 2

During Phase 2 of the data collection, semi-continuous observations were made for 24-hour periods at several locations in the Dallas and Houston areas in order to help improve the understanding of temporal variability in idling. Observations were made at 6 sites in the Dallas area on 8/4 and 8/5. These sites included 2 rest areas and 4 truck stops of varying size. The sites were selected to be close together, facilitating quick travel to the next location, but situated on different thoroughfares (including I-35E, I-45, and US 175 south of Dallas). 10 full sets of observations were made at these sites, approximately every 2 hours.

Observations were also made at 4 sites in the Houston area on 8/3 and 8/4. These sites included 4 truck stops of various sizes, all located west of Houston in Waller and Fort Bend Counties, along the I-10 corridor. These sites were selected to be relative far from the ship channel, to minimize unusual idling patterns possibly seen around the Port. 13 full sets of observations were made at these sites, about every 2 hours.

Phase 3

Additional field data was collected at sites already sampled during the day under Phase 1, at 85 sites across the state, including 47 truck stops and 38 rest areas. Some of these sites were visited multiple times for a total of 250 new observations. Observations were made between August 10 and August 25.

Observations were primarily made during late evening and night-time, to enhance temporal profiling, since most observations under Phase 1 were made during the day. Most of these observations were made between 9 pm and 5 am.

Additional weekend sampling (41 observations on Saturday and 41 at the same sites on Sunday) also occurred to determine any potential variation with weekday rates (for the expansion factor analysis). These data were collected during the daytime.

Finally, since the Beaumont-Port Arthur region was not included in Phase 1, 4 additional truck stops and 3 rest areas were visited during the day on 8/12/04.

Again, for all these observations data collection personnel counted the number of trucks in each parking lot, those idling, those that were diesel vehicles, and those that were long-haul vehicles.

4.3 Data Collection Results

Overall, the data collection effort was a success. The initial targets for site visits were far exceeded for both truck stops and rest areas (initial target of 190 unique truck stops and 20 rest areas). Data were well distributed across time periods and the nighttime observations completed the overnight idling profile. Samples were collected on both Saturday and Sunday for the same locations to give a snapshot with which expansions of the other sites could be formulated.

During the data collection effort, several issues arose:

- Managers' lack of knowledge about truck patterns on site
- Managers unavailable for survey
- Managers refusing interview
- Access to site denied by management
- New facilities not yet exposed to all seasons
- Truckers refusing to give interviews

- Missing TxDOT picnic area and truck parking area locations list

Most of these were unavoidable and where possible, additional contact information was collected so reluctant managers could be contacted later. As TxDOT picnic and truck parking area locations were encountered in the field, they were added to the Rest Area database and observation data were recorded.

It should also be noted that there were areas where existing truck stop locations were closed for remodeling and new truck stop locations were in the early stages of construction. Due to the dynamic nature of the trucking and trucking services industry, the database compiled during the course of this study should not be considered a "final" documentation of truck stops in Texas. It does, however, provide a comprehensive snapshot of truck stops at this point in time which can be used as a baseline for future data collection efforts.

Table 4-1 depicts the total data collection effort.

Table 4-1. Data Collection Summary

Observation Types	Number
Unique Truck Stops Surveyed[4]	245
Unique Rest Areas Surveyed	84
Total Weekend Truck Stops Surveyed	46
Total Weekend Rest Areas Surveyed	8
Total Truck Stop Nighttime Observations	151
Total Rest Area Nighttime Observations	52
Total Truck Stop 24-Hour Observations	8
Total Rest Area 24-Hour Observations	2
Total Manager Interviews	209
Total Truck Driver Interviews	62

Appendix E contains maps showing the observed sites, multiple observation sites, and sites observed during a weekend.

Quality Assurance/Quality Control

Quality assurance and control was of paramount importance during this project. Field personnel were all full time ATG staff members and, therefore, familiar with field data collection techniques. Nevertheless, each member of the crew was trained in the use of the data collection instrument and the technology used to collect the data.

[4] An additional 7 sites were visited and geocoded, but not surveyed due to manager refusal or other reasons.

As with any field data collection effort, controls were put in place to ensure data quality and integrity. During creation of the database, flow control was implemented to ensure that field data collection personnel entered a proper value during each data collection event. All data collected was tied to the unique identifier for each site.

At the conclusion of the first week of data collection, all results were reviewed for consistency and validity. One change was added to the observation form after week one. A check box was added next to the number of observed parking spaces to indicate whether the number was an estimate. Data collection personnel had accounted for this in the comments field during week one and requested that the change be made to the form.

After each phase of the data collection effort, GPS points and database entries were reviewed by the individual field personnel and then by the ATG Project Manager or Assistant Manager. Once individual databases and GPS point layers were reviewed, they were then merged with the master database and point layer.

5.0 Data Collection: Intermodal Facilities

Data was also collected on heavy-duty truck idling at intermodal facilities such as marine ports, airports, and rail terminals. As a facility reaches its capacity, it is constrained by (a) the acreage of the cargo loading marshalling area, and (b) the number of gates serving the facility. It was therefore anticipated that most of idling would occur at the entry gate where manifests are checked, with the facilities at or near capacity having the highest idling levels.

Overall, it was concluded that the likelihood of extended truck idling was directly related to facilities handling intermodal containers, which include:

- Marine containers (20- and 40-foot corrugated steel boxes)
- Rail Containers (similar to marine container but may be in different sizes)
- Truck-rail operations (loading a truck trailer directly onto a railcar)

Extended queues are more likely to develop when transferring intermodal containers for a few reasons. First, although many can be stacked, containers take up a lot of room in the marshalling area. In addition, except for some limited on-site storage and management of empty containers, containerized units are mainly high-dollar, "just-in-time" deliveries requiring a very fast turnover. This conclusion was verified in an interview with Dana Blume of the Houston Port Authority, which is responsible for about 50 percent of the cargo terminals in the Houston area.

For these reasons intermodal marine and rail facilities specializing in bulk goods, general and palletized goods, automobiles, and petroleum products were not included in this survey.

Considering these priorities, Starcrest Consulting Group LLC made observations at 16 intermodal facilities at locations in San Antonio (1), Houston (8), and Dallas (7). Some of these locations had multiple gates or loading docks where observations were performed. At these locations terminal operations managers were interviewed to determine whether extended idling occurred at the loading areas and/or exit gates, and the peak periods of activity. A complete list of sites visited is provided in Table 5-1.

Table 5-1. Intermodal Survey Locations

Houston Area	Dallas Area	San Antonio Area
Bush Intercontinental Airport	UP Mesquite	UP Railyard
Galveston Harbor	UP Miller	
Barbour's Cut Terminal	KCS Arlington	
BNSF Container Terminal	BNSF Alliance	
BNSF Car/rail Terminal	Alliance Airport	
UP Wallisville	DFW Airport - UPS	
Port of Houston Authority Turning Basin	DFW Airport – General Cargo	
UP Kirkpatrick		

Due to Department of Homeland Security measures and time constraints, it was difficult to inspect the onsite load-out areas of every terminal, and in many cases records were only collected at the entry gate. Detailed records for several facilities noted the time when a truck entered the queue and then when the same truck proceeded through the terminal gate. (Electronic files with the actual field data results have been provided to TCEQ).

In summary:

- All surveys were conducted in the morning period to capture the morning and noon peak, with the exception of airports, which were contacted during the day but surveyed at night;
- All terminal managers indicated they had no on-site extended idling on their properties;
- The Port of Houston Authority confirmed that their 5-minute idling rule was being enforced on their property;
- Some terminal operators did not allow entry onto their sites but allowed gate queues to be observed.

Field observation notes for the intermodal site observations are provided in Appendix F.

6.0 Data Analysis and Model Development: Truck Stops and Rest Areas

The methodology for estimating idling rates was developed to analyze the truck stop and rest area data collected by ATG. First, several statistical tests were used to determine which of over a dozen independent variables were statistically significant in terms of correlation with idling rates. Then, the idling data collected in the field were expanded to estimate the idling under annual, daily and hourly scenarios.

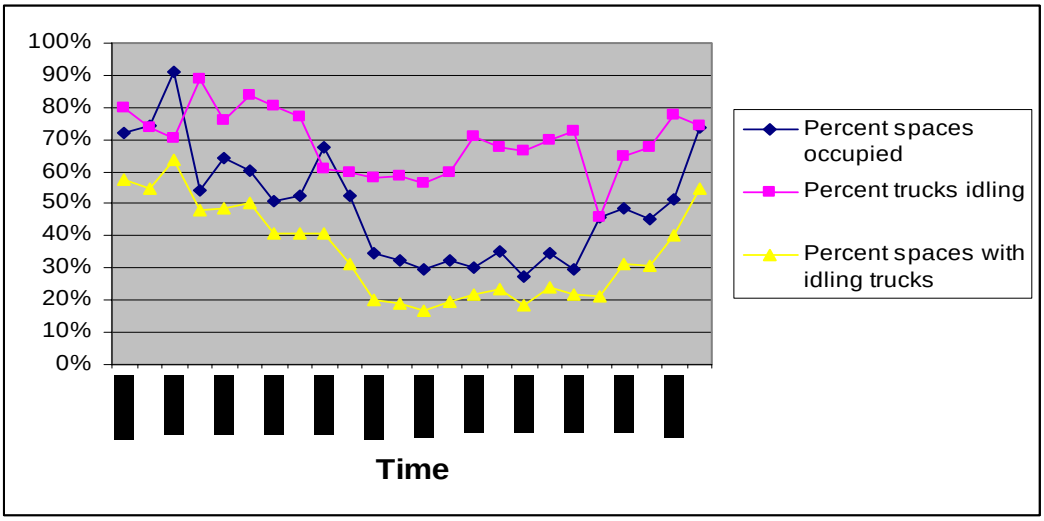
6.1 Descriptive Statistics

ATG collected data at truck stops and rest areas using three different methods: 1) observing total and idling trucks in parking lots, 2) interviews of truck stop manager, and 3) interviews of truck drivers. Each data collection method captured different types of data. The observed data at the parking lots were used to develop snapshots of the idling activity at each facility. The following provides an overview of the findings from each of the data collection methods.

Time of Day Patterns

Figure 6-1 shows a summary of the field data collected for this project. These data show occupancy rates for parking spaces are highest in the late night and lowest during the middle of the day. The percentage of trucks idling per parking space is approximately 60 percent and this percentage is roughly flat throughout the day. However, the high occupancy rates of the evening and late night periods results in higher idling rates per parking space during these time periods. It should be noted that the terminology “idling rates” used throughout this report refers to idling rates per parking space. Idling rates per truck will be specified when used in this report.

Figure 6-1. Occupancy, Truck Idling Rates and Parking Space Idling Rates by Hour



Geographic Coverage

ERG categorized the state into 23 regions to facilitate development of the Data Collection Plan. Assignment of any particular site to a region was informal, based on ERG's judgment of proximity to metro areas. A summary of survey coverage by region is provided in Table 6-1.

In most cases about one half to two three quarters of the estimated number of parking spaces were observed during the field survey. Regions with substantially less than 50% coverage of spaces included Bryan/College Station, Killeen/Temple, Sherman/Denison, Texarkana, and Wichita Falls. These areas received relatively less attention due to their relatively low truck stop populations and their "out of the way" location. Therefore, for the purposes of characterizing total statewide emissions, we conclude that very good survey coverage was obtained across the state.

Coverage by Facility Size

While the Data Collection Plan was weighted toward observations at larger facilities, it was a goal of the project to obtain an informative cross section of surveys for all sizes of truck stops. The following Figures clearly indicate substantial coverage for all facility sizes, with the exception of the smallest truck stops (with 10 or fewer spaces).

Table 6-1. Geographic Coverage by Region (Truck Stops)

	Spaces		Sites	
Region	**# Observed**	**% Coverage**	**# Observed**	**% Coverage**
Abilene	508	49%	7	47%
Amarillo	970	56%	10	27%
Austin	204	79%	7	58%
Beaumont/Port Arthur	518	92%	5	56%
Bryan-College Station	33	13%	1	9%
Corpus Christi	249	47%	6	43%
Dallas/Fort Worth	3,342	75%	54	60%
El Paso	1,448	76%	13	62%
Houston/Galveston	2,513	62%	44	40%
Killeen/Temple	189	32%	7	47%
Laredo	680	78%	4	33%
Lubbock	219	55%	5	42%
McAllen	722	93%	7	54%
Midland/Odessa	652	68%	7	39%
Nacogdoches	145	47%	4	40%
San Angelo	266	59%	5	33%
San Antonio	1,449	67%	21	47%
Sherman/Denison	6	10%	1	25%
Texarkana	202	31%	8	35%
Tyler/Longview	400	47%	8	31%
Victoria	239	60%	5	42%
Waco	637	62%	11	52%
Wichita Falls	220	37%	5	26%
Total	15,811	63%	245	44%

Figure 6-2. Site Coverage by Location Size

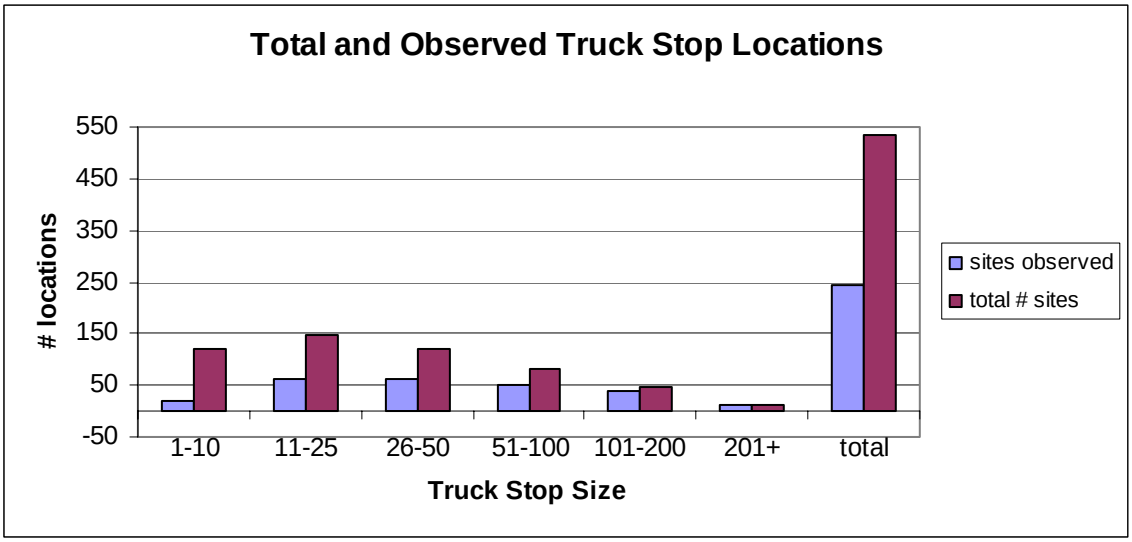
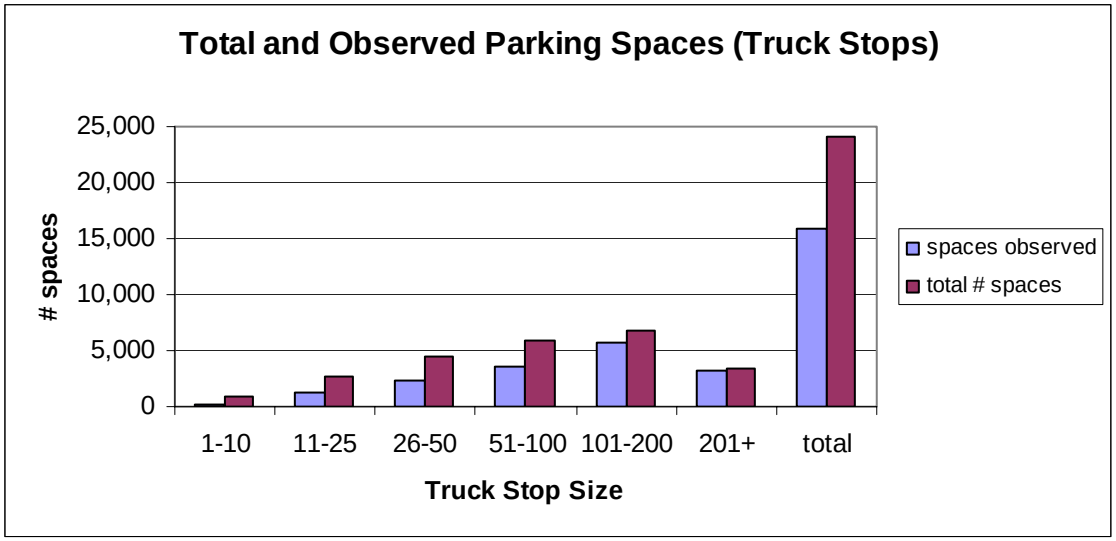


Figure 6-3. Parking Space Coverage by Location Size



Other Observational Information

The following briefly summarizes other results of interest.

Weekday vs. Weekend Coverage – A total of 631 weekday observations (87%) were made, compared to 94 weekend observations (13%). The relative number of observations corresponds closely to the typical weekday vs. weekend VMT ratios for HDVs (e.g., weekday combination truck VMT estimated at 85% of total by Washington State Transportation Center).[5] As such, the relative emphasis given to weekend coverage was appropriate for this effort.

Long vs. Short Haul Trucks – Of the 12,117 heavy trucks observed at truck stops and rest areas, only 110 (<1%) were short-haul trucks. As such, adjustments for long vs. short haul idling and emission rates were not included in the final activity and emissions model.

Diesel vs. Gas Trucks – Of the 12,117 heavy trucks observed in the field, only 2 were gasoline powered.

Paved vs. Unpaved Facilities – Field observations found that fully 89% of truck stop parking was either fully or partially paved.

Presence of IdleAire Systems – Field observations identified 4 facilities offering the IdleAire system. These systems were all located at large facilities, in Baytown, El Paso (2

[5] Vehicle Volume Distributions by Classification, Washington State Transportation Center (TRAC) and Chaparral Systems Corporation, July 1997.

locations), and San Antonio.[6] Observations were too few to determine if idling rates at these locations were statistically significantly different than elsewhere, however.

Availability of GPS Coordinates – ATG provided GPS points for all locations visited. They also provided points for a number of other locations based on the street addresses from the initial truck stop list (33) using a software package. However, there were a large number of sites without adequate address or other locater information, for which GPS points could not be determined. In addition, sites identified by ERG after the initial submittal list to ATG were not decoded. As a result, 50% of the sites identified in the master truck stop list do not have their GPS coordinates identified.

Interview Findings

62 trucker and 209 manager interviews were completed. The following summarizes some of the results of interest from the responses. Responses regarding time of day and seasonal idle rates are discussed separately in the Statistical Analysis section below.

Manufacturer – Six manufacturers were observed: Freightliner; International; Kenworth; Peterbilt; Volvo; and Western Star.

Number of Units/Axles – 56 trucks were single unit, while 6 had two units. 60 had 5 axles, while 2 had 6 axles. All trucks were Class 8b.

Short vs. Long-Haul – All but two trucks were long-haul.

Commodity Type – 14 different commodities were reported, as shown below:

- Farm Products (4)
- Metals/Minerals (6)
- Food, Health, Beauty (11)
- Wood Products (3)
- Printed Material (1)
- Chemical (1)
- Refined Petroleum/Coal (2)
- Rubber, Plastic, Styrofoam (2)
- Manufactured Goods/Equipment (10)

[6] ERG ID #s 119, 176, 243, and 311.

- Miscellaneous (12)
- Transportation (2)
- Unclassified Cargo (4)
- Driver refused to answer (3)
- Unknown to driver (1)

6.2 Statistical Analysis

Statistical analyses were performed to identify those factors significantly influencing average idle rates per parking space. The two methods utilized for performing the statistical analyses are tests of means and regression analysis. Tests of means were performed under scenarios where multiple independent variables were being tested, or for categorical attributes (e.g. amenities at truck stops). Regression analysis was used when there was a singular and quantitative independent variable to test. For tests of the means, two independent variables were considered to have effectively the same means (i.e., no statistically significant difference) if the 95% confidence interval for the means were found to overlap.

Both tests were performed by importing the raw data from Access files into Excel and using the statistical analytical package that is standard with Excel 6.0. The Excel statistical package includes a function that creates descriptive statistics of a set of numbers which includes mean, mode, standard deviation, sample variance, and a user-specified confidence interval for the mean. For regression analysis, the statistical package includes calculation of the R-square variable, estimation of the regression coefficients, intercept and a residual analysis.

Testing the Relationship between Idling and Functional Class

The first variable tested for correlation with idling rates was functional class of the adjacent roadway. Three functional classes were considered: 1) freeway, 2) arterial and 3) local roads. Functional class data were collected based on observation during the truck stop data collection process. The rationale for testing this variable is that truck stops closer to high truck volumes may have different idling patterns than truck stops closer to low volume roads. Table 6-2 shows descriptive statistics of idling percentages for each functional class. The 95% confidence intervals of the means of each functional class overlap. Therefore, there is not a statistically significant difference between average idling for each of the functional classes.

Table 6-2. Idling Percentages by Functional Class

	Freeway	Arterial	Local
Lower Bounds of Mean	17.8%	16.2%	-11.3%
Mean	19.7%	21.2%	24.2%
Upper Bounds of Mean	21.6%	26.2%	59.7%
Standard Deviation	17.6%	17.0%	22.3%
Count	332	47	4
Confidence Level (95.0%)	1.9%	5.0%	35.5%

Testing the Relationship between Idling and Truck AADT

The next variable tested for correlation with average idling rates was average annual daily traffic (AADT) for the roadway adjacent to the truck stop. AADT was determined by using the Texas Department of Transportation (TxDOT) Highway Performance Monitoring System (HPMS) truck data, using roadway name and mile marker data collected by ATG. (It should be noted that truck volume data were not available for local roads and many of the arterials.) Figure 6-4 shows a scatter plot of the idling rate and AADT for each truck stop/rest area in the data sample. Visual observation of the scatterplot does not reveal any relationship between the two variables. This is confirmed statistically through the regression analysis shown in Table 6-3. The R-square of this regression was only 4%, showing the lack of correlation between Idling and AADT.

Figure 6-4. Idling vs. AADT

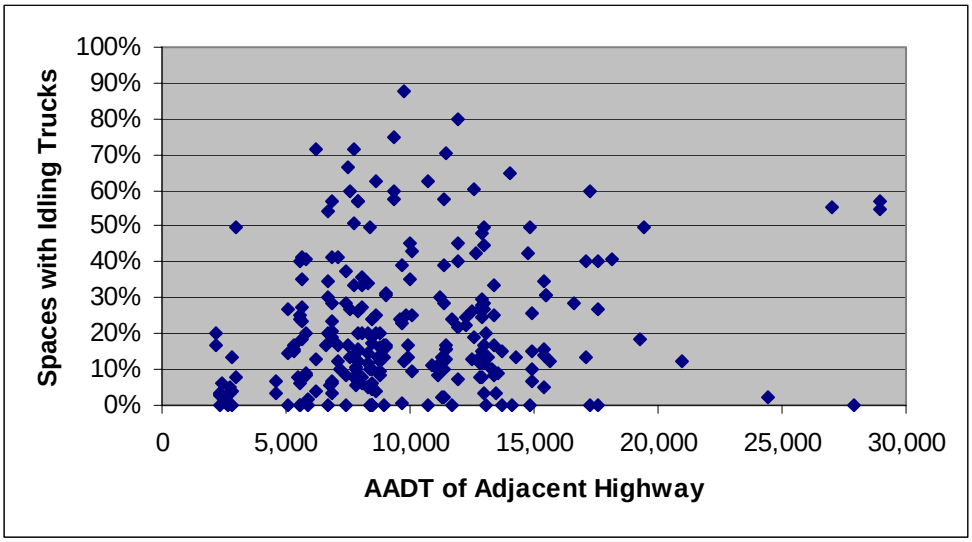


Table 6-3. Regression Analysis Statistics: Idling vs. AADT

Regression Statistics	
Multiple R	19%
R-Square	4%
Adjusted R- Square	3%
Standard Error	18%
Observations	250

Testing the Relationship between Idling by Size of Parking Lot

The next variable tested for correlation with idling rates was parking lot size. This variable was tested because of the possibility that parking lots of different size may induce different types of truck trips or different truck driver behavior. Figure 6-5 shows a scatterplot of idling rates and number of parking spaces for each truck stop/rest area. Visual observation shows that there is little correlation between the two variables. The regression analysis summarized in Table 6-4 reveals an extremely low R-square (0%) as is expected for this wide scatter. However, it does appear that that only the smallest truck stops have the highest idling rates, and the largest parking spaces have relatively low idling rates. In addition, there are no large truck stops with high idling percentages.

Therefore, based on the slight parabolic shape of the scatter, it is possible for there to be different average idling rates for truck stops in different size bins, regardless of the R-square value. To investigate this possibility, a test of means was performed for 3 different parking lot sizes: 1) less than 50 spaces, 2) 50-200 spaces, and 3) over 200 spaces. The descriptive statistics shown in Table 6-5 reveal that there is not a statistically significant difference between the means for each of these truck stop sizes based on the overlap of the confidence intervals for each of the three means.

Figure 6-5. Idling Rates vs. Number of Parking Spaces

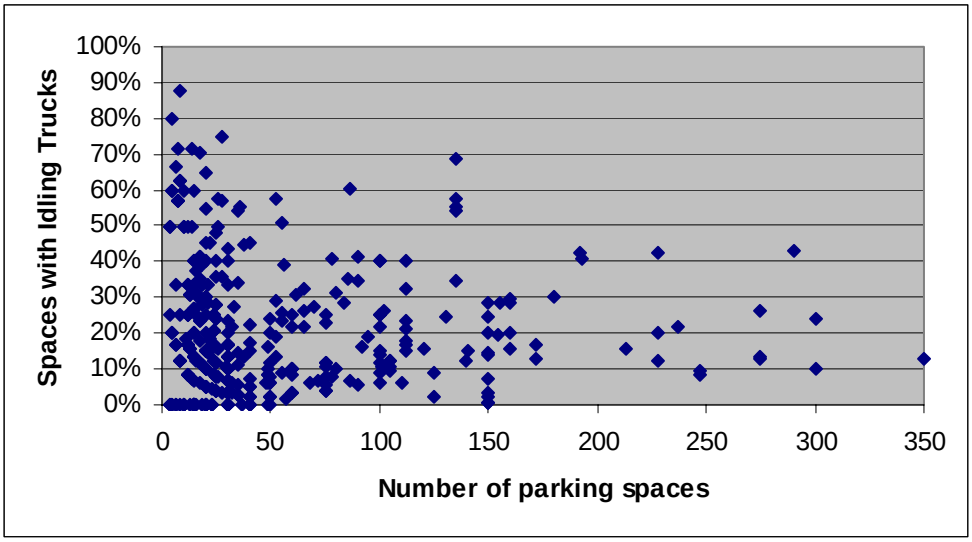


Table 6-4. Idling vs. Number of Parking Spaces

Regression Statistics	
Multiple R	0.011128
R-Square	0.000124
Adjusted R -Square	-0.0025
Standard Error	58.84692
Observations	383

Table 6-5. Idling Percentages by Size of Parking Lot

	Medium (< 50)	Large (50-200)	Very Large (>200)
Low	17.3%	18.1%	13.0%
Mean	19.5%	21.0%	19.5%
High	21.8%	23.9%	26.0%
Standard Deviation	18.8%	14.9%	11.3%
Count	266	103	14
Confidence Level (95.0%)	2.3%	2.9%	6.5%

Testing the Relationship between Idling by Size of Metropolitan Area

The next variable tested for correlation with idling rates was the size of the closest metropolitan area. This variable was tested because of the possibility that truck activity and associated idle patterns may be different in different sized metropolitan areas. For example, larger metropolitan areas generally have a higher percentage of trucks serving the local population through the service sector. Smaller metropolitan areas generally have a higher percentage of trucks serving the manufacturing sector.

For this analysis, the size of metropolitan areas was estimated based on population of the Census Bureau Metropolitan Statistical Area associated with each of the regions where data were collected. Idling rates are average percentages of all of the truck stops where data was collected in a give region. Figure 6-6 shows a scatterplot of population and average idling rates for each metropolitan area. Visual observation shows that there is little correlation between the two variables. The regression analysis summarized in Table 6-6 reveals an extremely low R-square (3%).

The three largest metropolitan areas exhibited average occupancy rates at or above 20 percent. To investigate potential differences in idle rates at this level of aggregation, a test of means was done between these three regions and the remaining areas. Table 6-7 shows descriptive statistics of these two metropolitan size groupings. There is no statistically significant difference between the average idling rates based on the overlap of the means of these two samples.

Figure 6-6. Idling vs. Population by Metropolitan Area

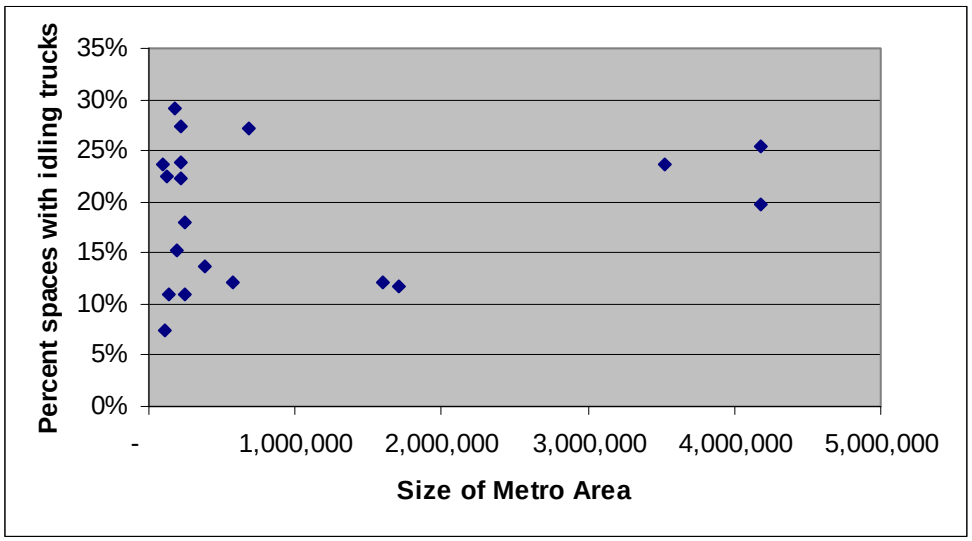


Table 6-6. Idling and Size of Metropolitan Area

Regression Statistics	
Multiple R	16%
R Square	3%
Adjusted R Square	-3%
Standard Error	7%
Observations	19

Table 6-7. Idling Rates by Two Metropolitan Sizes

	Small	Large
Mean	18.0%	23.0%
Standard Deviation	7.1%	3.0%
Count	16	3
Confidence Level (95.0%)	3.8%	7.4%

Testing the Relationship between Idling and Truck Stop Amenities

There are several different combinations of amenities offered at truck stops. This type of variable was tested because one might expect truck stops with different types of amenities to attract truck trips of different types, or encourage different types of truck driver idling behavior. Ten of these variables were tested independently to determine if there was a correlation between each amenity and idling rates. Table 6-8 shows descriptive statistics for idling rates for stops with and without each of the amenities. The means of each of the couplings overlap, showing that there is no statistically significant difference between idling rates with or without the amenities.

Table 6-8. Idling Rates v. Amenity

	Restaurant		Fast Food		Vending Machines		Showers	
	No	Yes	No	Yes	No	Yes	No	Yes
Low	17.1%	19.2%	20.0%	17.4%	18.0%	15.7%	19.8%	17.4%
Mean	19.2%	22.6%	24.4%	19.3%	19.9%	22.8%	25.1%	19.3%
High	21.3%	26.0%	28.8%	21.3%	21.7%	29.9%	30.4%	21.2%
Standard Deviation	17.9%	16.8%	16.4%	17.8%	17.8%	15.6%	18.6%	17.4%
Count	280	97	55	322	356	21	49	328
Confidence Level (95.0%)	2.1%	3.4%	4.4%	2.0%	1.9%	7.1%	5.3%	1.9%

	Motel Rooms		Computers		TV Entertainment		Laundry	
	No	Yes	No	Yes	No	Yes	No	Yes
Low	18.2%	-1.4%	17.8%	17.9%	18.0%	16.4%	18.4%	17.4%
Mean	20.0%	21.8%	19.7%	22.4%	19.9%	20.8%	22.0%	19.4%
High	21.8%	45.0%	21.7%	26.8%	21.9%	25.1%	25.7%	21.5%
Standard Deviation	17.6%	22.1%	18.0%	15.4%	18.0%	15.8%	17.4%	17.7%
Count	371	6	329	48	324	53	90	287
Confidence Level (95.0%)	1.8%	23.2%	1.9%	4.5%	2.0%	4.4%	3.6%	2.1%

	Convenience Store		Other	
	No	**Yes**	**No**	**Yes**
Low	-292.7%	18.2%	20.6%	16.6%
Mean	25.0%	20.0%	23.9%	18.7%
High	342.7%	21.8%	27.2%	20.8%
Standard Deviation	35.4%	17.6%	16.4%	17.9%
Count	2	375	96	281
Confidence Level (95.0%)	317.7%	1.8%	3.3%	2.1%

Testing the Relationship between Idling and Day-of-Week (Weekdays only)

The next variable tested for correlation with idling rates was day of the week. This variable was tested because of the possibility that truck activity differs on different days of the week. Table 6-9 shows descriptive statistics for each day of the week. The table shows that there is no statistically significant difference between the average idling rates based on the overlap of the means of these five days.

Table 6-9. Idling by Day of Week

	Monday	Tuesday	Wednesday	Thursday	Friday
Low	10.9%	15.3%	18.5%	18.2%	9.4%
Mean	16.7%	17.9%	22.2%	21.9%	25.2%
High	22.5%	20.6%	26.0%	25.7%	41.1%
Standard Deviation	17.2%	16.9%	18.4%	17.6%	19.0%
Count	36	157	95	87	8
Confidence Level (95.0%)	5.8%	2.7%	3.8%	3.8%	15.9%

Testing the Relationship between Idling Rates and Location Type

The next variable which was tested for a correlation with idling rates was location type. This variable was tested because locations of different types could attract truck trips of different types, or promote truck driver behavior of different types accompanied by different idling activity. Table 9 shows descriptive statistics for idling rates for three different location types. The three different types of locations tested were: 1) truck stops, 2) rest areas, and 3) other areas. Truck stops are defined as privately-owned for-profit facilities that offer parking for trucks. Rest areas are defined as facilities operated and maintained by TxDOT that offer parking for trucks. Other stops include all other facilities that offer truck parking including facilities such as picnic areas.

The descriptive statistics in Table 6-10 show that truck stops and rest areas have means that overlap and therefore can not be considered statistically significantly different. However, the 19 other stop types were found to have a significantly lower mean than the other locations. Therefore, when modeling idling activity, different estimation factors must be used for these other stops as opposed to the truck stops and rest areas.

Table 6-10. Idling Rate by Stop Type

	Truck	Rest	Other
Low	17.7%	18.9%	3.3%
Mean	20%	24%	11%
High	21.4%	29.0%	18.3%
Standard Deviation	16%	22%	16%
Count	291	73	19
Confidence Level (95.0%)	2%	5%	8%

Testing the Relationship between Idling and Region

The last variable that was tested for a correlation with idling rates is region of the state. Each of the state regions was recorded during the data collection phase of this project. These data were used to develop average idling rates for each region that were compared. Table 6-11 shows the average idling rates, the lower bounds and upper bounds for each region. The confidence intervals for the means of idling rates for each of the regions overlap with the mean for all stops, except for the San Antonio region. The mean for the San Antonio area was found to be 12.2 percent compared to 19.9 percent for all of the data. Although the San Antonio region does not have the lowest average idling rate of all regions, the high number of observations around San Antonio decreased the size of the confidence interval for the idling rate so that it is statistically significantly different from that of the other data collected. Therefore, in the model used to estimate idling for the entire state, separate factors must be used to account for activity in the San Antonio area.

Summary of Results of Analysis

Eight types of independent variables were tested for correlation with idling rates for the collected data. Six of these variable types (functional class, AADT, size of parking lot, size of metropolitan area, amenities offered, and day-of-week) were found not to be statistically correlated to average idling rates. Two of the variables, location type and region of the state, were found to be correlated with idling rates. Therefore, these two variables can be used as factors to predict the idling activity. Separate expansion factors must be used for locations with

these characteristics relative to the other truck stops. Table 6-12 shows a summary of the tests that were performed, the variables tested and the result of the test.

Table 6-11. Means, Lower and Upper Bounds for Idling Rates by Region

Region	Low	Mean	High
All Regions	18.2%	19.9%	21.7%
Wichita Falls	-1.6%	10.9%	23.3%
Lubbock	-5.1%	10.9%	26.9%
Ft. Stockton	0.0%	11.7%	23.3%
Odessa/Midland	5.2%	12.0%	18.8%
San Antonio	8.9%	12.2%	15.5%
Corpus Christi	5.0%	13.6%	22.2%
Laredo	0.0%	15.3%	30.5%
Abilene/San Angelo	7.4%	16.2%	25.0%
McAllen	9.8%	17.9%	26.0%
Houston/Galveston	16.0%	19.7%	23.3%
Austin	9.9%	22.3%	34.8%
Dallas/Fort Worth	20.0%	23.7%	27.5%
Texarkana	-1.4%	23.8%	48.9%
Amarillo	14.2%	23.9%	33.6%
Killeen/Temple	11.6%	25.5%	39.4%
El Paso	17.2%	27.1%	37.0%
Waco	11.8%	27.3%	42.8%
Tyler/Longview	17.8%	29.1%	40.4%

Table 6-12. Statistical Tests of Collected Data

Independent Variable	Statistical Test	Correlation with Idling Rates
Functional class of adjacent roadway	Means	No correlation
AADT of adjacent roadway	Regression	No correlation
Size of Parking Lot	Regression and Means	No correlation
Size of Metropolitan Area	Regression and Means	No correlation
Amenities (10 separate amenities tested)	Means	No correlation
Day of Week	Means	No correlation
Stop Type	Means	‘Other’ stops found to be lower than truck stops and rest areas
Region of State	Means	San Antonio found to be lower than statewide average

6.3 Expansion of Data

There was a significant amount of data collected for this project. However, the data collected were a combination of snapshots of actual idling activity and interview data for other time periods that were not observed. Additionally, not all stops were included in the survey. Therefore, expansion factors must be developed from these data to estimate idling activity for all locations, for different time periods.

The weekend data were collected after the analysis in the previous section were performed. However, it is reasonable to assume that there may be separate expansion factors required for weekend relative to weekday data. Also, while Figure 6-1 shows clear differences between idling rates in different time periods, the extent of these changes across each of the other variables of significance needs to be tested as well. Table 6-13 shows descriptive statistics for each of these variables as included in the larger data set. First, the "other" stop data were separated from the truck stop/rest areas. The remaining data were then divided into San Antonio and non-San Antonio data. Each of the two categories was then divided into weekday and weekend data. Finally, within each of these day types, the data were divided into time periods falling into one of the following four categories:

- Daytime, 10AM – 10 PM
- Late Evening, 10 PM – 1 AM
- Late Night, 1 AM – 5 AM
- Morning, 5 AM – 10 AM

These four time periods were developed based on visual observation of the idling per parking space percentages shown in Figure 6-1. The descriptive statistics shown in Table 6-13 reveal the following primary conclusions about the data:

- For non-San Antonio area data, there is no statistical difference between evening and night periods. These time periods can be combined into one time period for the final model.
- For non-San Antonio area data, there is a statistical difference between morning, evening/night and daytime periods. These can be the three time periods used for non-San Antonio data.
- For non-San Antonio area data, there is no statistical difference between daytime data on the week relative to daytime data on the weekend. These time periods can be combined into a single time period.

- For non-San Antonio area data, there is no statistical difference between morning data on the week vs. morning data on the weekend. These can be combined into a single morning period
- For non-San Antonio area data, there are not sufficient data to test for a statistically significant difference between evening/night data on the week and the weekend. Therefore, these data will be combined into a single evening/night period
- For San Antonio area data, there is no statistical difference between daytime data on the week and daytime data on the weekend. These can be combined into a single daytime period.
- There is not a statistical difference between non-daytime data in San Antonio and non-San Antonio locations. These can be combined into a single daytime period.
- In future modeling efforts, "Other stop" data should have two time periods: daytime and night. There are not sufficient data to disaggregate other stop data into finer time periods.

Table 6-13. Idling by Location, Day Type, and Time Period

	General Data					
	Weekday				**Weekend**	
	Daytime	**Evening**	**Night**	**Morn**	**Daytime**	**Morn**
Low	20.4%	44.6%	43.3%	28.4%	18%	26%
Mean	22%	52%	68%	33%	25%	33%
High	24.2%	59.5%	92.2%	37.9%	31%	41%
Standard Deviation	18%	36%	74%	18%	17%	16%
Count	344	93	38	58	26	20
Confidence Level (95.0%)	2%	7%	24%	5%	7%	8%

	San Antonio Data			**Other Stop Data**	
	Weekday		**Weekend**	**Weekday**	
	Daytime	**Eve/Night**	**Daytime**	**Daytime**	**Non-Day**
Low	10%	35%	12%	5%	-2%
Mean	14%	64%	20%	12%	36%
High	17%	93%	27%	19%	74%
Standard Deviation	13%	51%	26%	16%	59%
Count	49	14	48	23	12
Confidence Level (95.0%)	4%	29%	8%	7%	38%

The conclusions of this statistical analysis lead to the following six time/location/stop type bins for development of the final model:

- Non-San Antonio, Daytime Data
- San Antonio, Daytime Data
- Truck stop/rest area, Morning Data
- Truck stop/rest area, Evening/Night Data
- Other stops, Daytime Data
- Other stops, Nighttime Data

These categories can be used in the development of the final model for estimating emissions at truck stops and rest areas in the state.

Accuracy of manager interview data

Interviews of truck stop managers were used to estimate occupancy rates during different seasons. Therefore, an analysis of the accuracy of the manager responses will give an indication of the accuracy of the seasonal expansion data developed from these interviews. Two data elements were evaluated, both based on observed data and from manager interview responses. These include the number of truck parking spaces at the site, and the occupancy for truck stops. Figure 6-7 shows a scatterplot of observed and stated data for the number of parking spaces. The scatterplot shows a strong positive correlation between the stated and observed data. This relationship is confirmed by a 90 percent R-square value, as shown in the regression statistics shown in Table 6-14.

Figure 6-7. Stated vs. Observed Parking Spaces

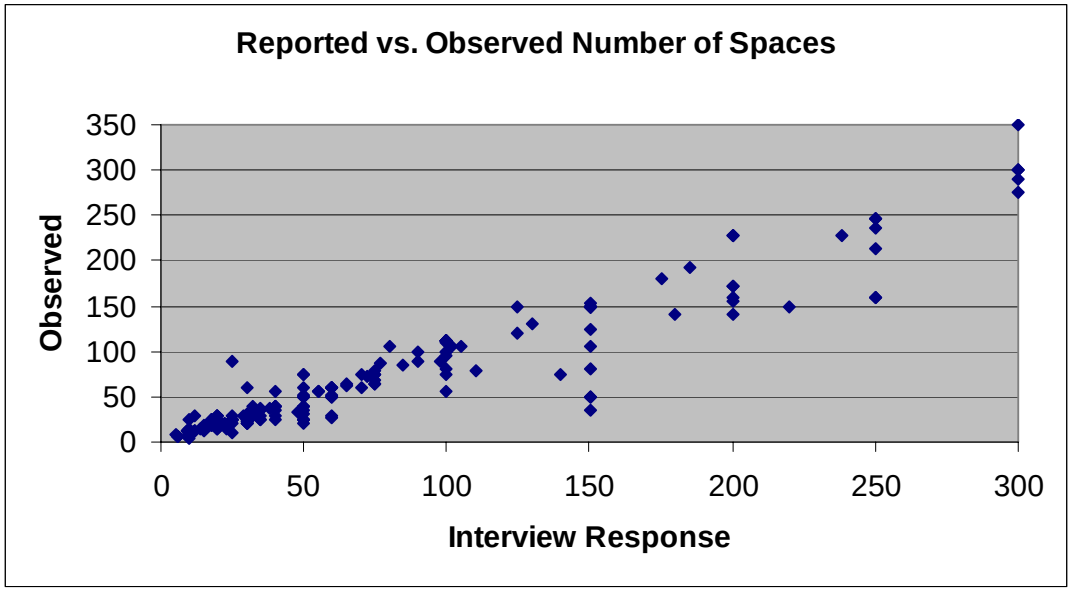


Table 6-14. Stated and Observed Parking Spaces

Regression Statistics	
Multiple R	95%
R-Square	90%
Adjusted R-Square	90%
Standard Error	21%
Observations	208
	Coefficients
Intercept	2.030304
# Truck Spaces (Operator)	0.89199

Figure 6-8 shows a scatterplot of observed and stated data on truck occupancy at truck stops in the collected data. The scatterplot shows a slight relationship between the stated and observed data on occupancy. This slight relationship is confirmed by the 22 percent R-square value, as shown in the regression statistics shown in Table 6-15. A higher R-square would have provided additional confidence regarding using the interviews for expanding the seasonal occupancy data. Nevertheless, the manager interview data are the best data available to expand the occupancy data into additional seasons. However, additional data collected in alternative seasons for each of the stop types, locations and time periods would provide a more robust final model.

Table 6-16 shows descriptive statistics that provide additional information on the correlation between stated and observed data on occupancy. On average, interview managers overestimate occupancy by roughly 15 percent. However, the stated occupancy bins show that when interviewed, managers tend to overestimate the lowest and highest occupancies, while the middle range of occupancies are higher in the stated values relative to the observed values. This erratic relationship between the stated and observed data provides more reason to collect additional observed data in alternative seasons rather than relying on stated data.

Figure 6-8. Stated vs. Observed Occupancy

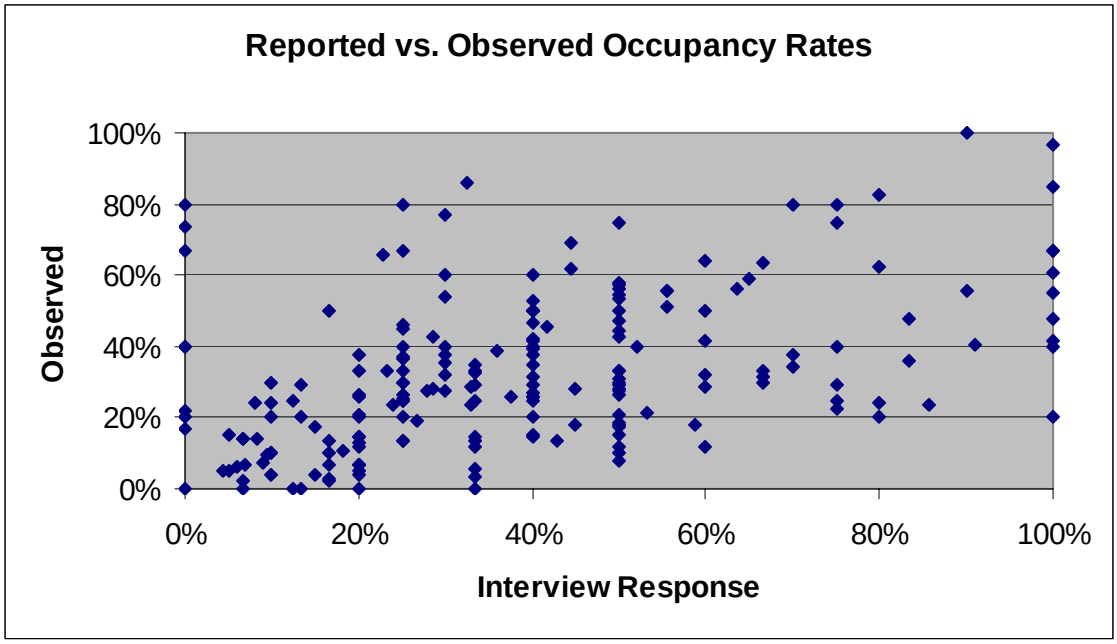


Table 6-15. Stated and Observed Occupancy

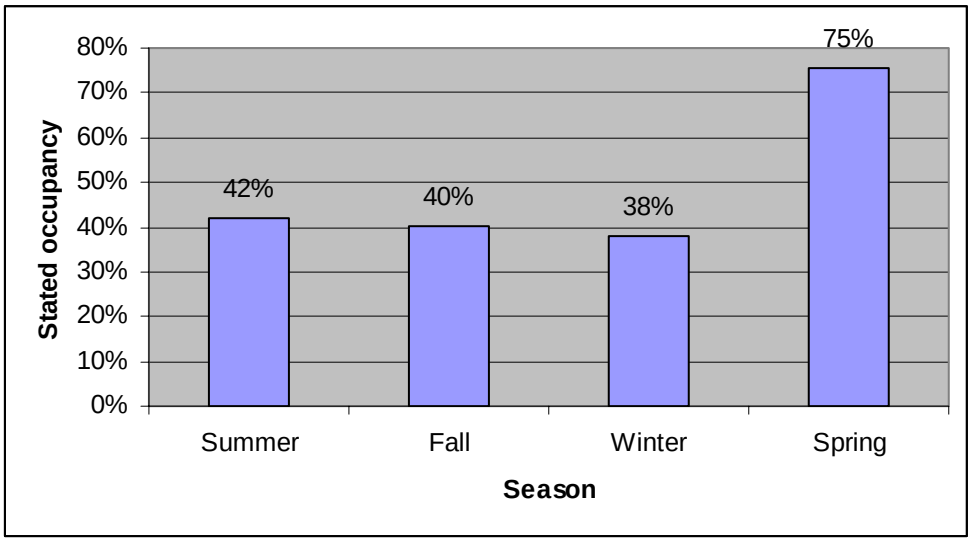
Regression Statistics					
Multiple R	47%				
R-Square	22%				
Adjusted R-Square	22%				
Standard Error	19%				
Observations	207				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	0.173468	0.024257	7.151349	1.49E-11	0.125643
Occupancy % - Operator	0.396403	0.052075	7.612119	9.67E-13	0.293731

Table 6-16. Means Tests for Stated Occupancy Data at Truck stops

	Stated 0%-20%	**Stated 21%-40%**	**Stated 41%-60%**	**Stated 61%-80%**	**Stated 81%-100%**
Low	13%	30%	31%	36%	43%
Mean	18%	34%	36%	47%	55%
High	22%	39%	42%	57%	68%
Standard Deviation	17%	17%	18%	22%	23%
Count	58	70	44	19	16
Confidence Level (95.0%)	5%	4%	5%	11%	12%

The final stated occupancy rates per season are shown in Figure 6-9. These occupancy rates are used in the final model for estimating the amount of idling at truck stops and rest areas in the state.

Figure 6-9. Seasonal Fluctuations in Stated Occupancy per Parking Space



The stated occupancy rates for the summer, fall and winter seasons are roughly equivalent. However, the stated occupancy for the spring season is much higher than that of the other seasons. The high occupancy rates of spring are the result of a combination of higher rates provided by the survey truckstop operators and the general underestimation of occupancy rates on the part of these operators. The results are surprisingly high, and indicate that observed data for springtime occupancy should be a high priority in future data collection efforts. Ideally,

additional field data would be collected for each of the seasons to confirm the stated data of the operator survey.

Seasonal Fluctuations in Idling Rates per Truck

Idling rates per parking space are the product of occupancy per parking space and idling per truck. In the previous section, seasonal factors were developed for occupancy per parking space for each of the four seasons. In this section, seasonal factors are developed for idling per truck. Truck interview data were used to estimate seasonal idling fluctuations for the truck stops.

Table 6-17 shows the descriptive statistics for stated idling rates for each season. The data show that the means of each of the idling rates are not statistically different. This indicates that, based on the driver interviews, the idling rates per truck do not change significantly for each of the seasons. This is a surprising result based on the different operating characteristics of each of the seasons such as the need for air conditioning in the summer and heating systems in the winter. Ideally, these data would be double-checked with some observed data during the other seasons. However, based on these data the seasonal fluctuations in idling per parking space rates will be solely a function of the stated seasonal changes of truck occupancy from the manager interviews.

Table 6-17. Stated Idling per Truck by Season

	Idle - Fall (from stated data)	**Idle - Spring (from stated data)**	**Idle – Winter (from stated data)**
Low	61%	61%	59%
Mean	63%	64%	62%
High	65%	66%	65%
Standard Deviation	10%	10%	13%
Count	62	62	62
Confidence Level (95.0%)	2%	3%	3%

Expansion Factors

The final expansion factors are developed by linking together the different analyses of this section. The six time periods are based on the means tests of the categories shown in Table 6-18. The column of summer data are based on the observed data collected for this project. The idling rates for the other time periods are developed based on proportionally increasing or decreasing the percentages based on the stated changes in occupancy shown in Figure 6-9. These percentages can be combined to estimate a generic year with 91.25 days in each season (365 divided by 4).

The annual number of idling hours for each of the six categories are shown in Table 6-19. The daily and hourly number of idling hours are shown for each of the six categories in Tables 6-20 and 21 respectively. Note that because there is no statistical difference between weekday and weekend data, the factors for the weekday and the weekend are the same.

Table 6-18. Idling rates by parking space for each category

	Season			
Time/Location Category	**Summer**	**Fall**	**Winter**	**Spring**
Non-SA - Daytime	22.7%	21.8%	20.6%	40.9%
San Antonio - Daytime	16.4%	15.7%	14.9%	29.6%
All TS/RA - Morning	37.4%	35.8%	33.9%	67.4%
All TS/RA - Eve/Night	54.3%	52.1%	49.2%	98.0%
Other stops - Daytime	10.3%	9.9%	9.4%	18.6%
Other stops - Night	22.3%	21.4%	20.2%	40.2%

Table 6-19. Annual Hours of Idling per Parking Space

	Number of hrs in period	Season				
Time/Location Category		**Summer**	**Fall**	**Winter**	**Spring**	**Total**
Non-SA - Daytime	12	248	238	225	448	1,160
Non-SA Morning	5	170	164	155	308	796
Non-SA - Eve/Night	7	347	333	315	626	1,620
Non-SA - Total	24	766	735	694	1,382	3,576
San Antonio - Daytime	12	180	172	163	324	838
San Antonio - Morning	5	170	164	155	308	796
San Antonio - Eve/Night	7	347	333	315	626	1,620
San Antonio - Total	24	350	336	317	631	1,635
Other stops - Daytime	12	113	108	102	204	528
Other stops - Night	12	244	234	221	441	1,141
Other - Total	24	357	343	324	645	2,162

Table 6-20. Daily Hours of Idling per Parking Space

Time/Location Category	Number of hrs in period	Season				
		Summer	Fall	Winter	Spring	Total
Non-SA - Daytime	12	2.7	2.6	2.5	4.9	12.7
Non-SA Morning	5	1.9	1.8	1.7	3.4	8.7
Non-SA - Eve/Night	7	3.8	3.6	3.4	6.9	17.8
Non-SA - Total	24	8.4	8.0	7.6	15.1	39.2
San Antonio - Daytime	12	2.0	1.9	1.8	3.5	9.2
San Antonio - Morning	5	1.9	1.8	1.7	3.4	8.7
San Antonio - Eve/Night	7	3.8	3.6	3.4	6.9	17.8
San Antonio - Total	24	3.8	3.7	3.5	6.9	17.9
Other stops - Daytime	12	1.2	1.2	1.1	2.2	5.8
Other stops - Night	12	2.7	2.6	2.4	4.8	12.5
Other - Total	24	3.9	3.8	3.5	7.1	23.7

Table 6-21. Idling per Parking Space per Hour

Time/Location Category	Number of hrs in period	Season				
		Summer	Fall	Winter	Spring	Total
Non-SA - Daytime	12	0.2	0.2	0.2	0.4	1.1
Non-SA Morning	5	0.4	0.4	0.3	0.7	1.7
Non-SA - Eve/Night	7	0.5	0.5	0.5	1.0	2.5
Non-SA - Total	24	1.1	1.1	1.0	2.1	5.3
San Antonio - Daytime	12	0.2	0.2	0.1	0.3	0.8
San Antonio - Morning	5	0.4	0.4	0.3	0.7	1.7
San Antonio - Eve/Night	7	0.5	0.5	0.5	1.0	2.5
San Antonio - Total	24	0.5	0.5	0.5	1.0	2.5
Other stops - Daytime	12	0.1	0.1	0.1	0.2	0.5
Other stops - Night	12	0.2	0.2	0.2	0.4	1.0
Other - Total	24	0.3	0.3	0.3	0.6	3.0

The development of confidence intervals for the above idling estimates is complicated by the number of estimation sources that were incorporated. The final factors for the estimation process include:

- Observed idling activity at truckstops and rest areas
- Surveys of truckstop operators
- Surveys of truck drivers

While a confidence interval for the observed idling estimates is possible, confidence intervals for the surveys would require several assumptions about the distribution of responses and much more data to be collected to develop reasonable error bounds.

Emissions Rates

The above expansion factors can now be combined with gram per hour emission factors to estimate total emissions per parking space for hourly, daily, and annual time periods. The Phase 1 TTI Report identified different sources of idle emission factor data for Class 8 heavy-duty diesel vehicles. One study performed by Clean Air Technologies International (CATI) found highly variable NOx emission rates, between 80 and 250 g/hr, depending on engine RPM and load (1). Another study by Irick and Wilson also found significant emissions variability depending on the nature of the idling cycle (4).

However, given the nature of the current study it was not possible to characterize engine rpm, auxiliary equipment use (e.g., air conditioning) and resulting engine load in order to meaningfully apply these precise emission factors. Therefore ERG relied upon EPA's average value of 144 g NOx/hr, based on 42 tests of 9 Class 8 trucks (2). (Essentially all heavy trucks observed idling at truck stops and rest areas were Class 8, so no emission factor adjustment was needed to account for smaller trucks.) Further refinement of idle emission factors would require direct observation of in-cab auxiliary equipment use and possibly tachometer readings for a large number of trucks for extended periods, under various ambient conditions.

Base Year Emissions Estimates

A Pivot Table was generated in an MS Excel spreadsheet listing total parking spaces by county, for both truck stops and rest areas. ERG then multiplied the expansion factors and grams per hour emission rates by the parking space estimates to obtain estimates of idle NOx emissions per hour, per day, and per year, for the 2004 base year. The statewide totals for different time periods of interest are presented in Table 6-22. Hourly estimates are for a typical ozone-season day. County-level breakouts of these figures are provided in Appendix G.

Table 6-22. 2004 Statewide NOx Idle Emissions -- Truck Stops and Rest Areas (Tons)

	/OSD	/Hr (Morning)	/Hr (Daytime)	/Hr (Evening-Night)	/Yr
Truck Stops	30.2	1.41	0.84	2.05	12,847
Rest Areas	2.4	0.11	0.07	0.17	1,036

OSD = Ozone Season Day
Morning = 5 a.m. – 10 a.m.
Daytime = 10 a.m. – 10 p.m.
Evening/Night = 10 p.m. – 5 a.m.

Future Year Projections

The amount of idling at truck stops and rest areas is a function of (among other things) the number of parking spaces at these locations, and the total number of trucks requiring extending idling (i.e., supply and demand). The number of trucks should be proportional to total truck VMT.[7] The number of truck parking spaces is determined by market forces (for truck stops) and public funding (for rest areas).

A future increase in VMT may not result in a one-to-one increase in idling activity at these locations, especially if parking supplies do not keep pace with demand. On the other hand, supply shortages may be alleviated somewhat, at least in the near-term, as truckers shift their driving times, routes, or "swap" rest area for truck stop parking (or vice versa).

For these reasons it is difficult to accurately predict future year idling activity levels and patterns over time and space, even if future year VMT may be projected with some accuracy. However, assuming that truck stop capacity will adequately respond to market demand in the long-run, VMT projections are probably the most reasonable basis for establishing growth rates for truck stops. Using data from the FHWA Freight Analysis Framework for Texas, we obtained statewide annual VMT growth rates for HDDVs of 1.77% for 1998 – 2010, and 2.17% for 2010 – 2020. ERG selected these estimates as the basis for projecting future increases in truck idling at truck stops.

Since parking capacity at Rest Areas is determined by State Government budget allocations rather than demand, ERG estimated idle growth rates separately for these sites. According to TxDOT Maintenance Division personnel familiar with the State's Safety Rest Area Program, TxDOT plans to increase parking at these areas by roughly 1% per year for at least the next 5 years.[8] Therefore ERG selected a 1% growth rate for estimating future year idle emissions at these facilities.

(Actual increases in parking will obviously by "clumpy", with certain counties receiving significant increases while others remain unchanged. Therefore this estimate could be improved in the future through consultation with TxDOT regarding specific improvement plans).

Statewide annual emissions projections using these growth assumptions are provided in Table 6-23 for truck stops and rest areas. Projections by county are provided in Appendix G.

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[7] This relationship should hold true for long-haul trucks as long as USDOT restrictions on total hours of travel a day (11) remain constant.

[8] Personal communication, Andy Keith, Manager, TxDOT Maintenance and Facilities Division, August 30, 2004.

Table 6-23. NOx Emissions (TPY) at Truck Stops & Rest Areas: 2005 – 2020

Year	Truck Stops	Rest Areas	Total
2005	13,074	1,047	14,120
2006	13,305	1,057	14,362
2007	13,541	1,068	14,608
2008	13,781	1,078	14,859
2009	14,024	1,089	15,113
2010	14,273	1,100	15,373
2011	14,582	1,111	15,693
2012	14,899	1,122	16,021
2013	15,222	1,133	16,355
2014	15,552	1,145	16,697
2015	15,890	1,156	17,046
2016	16,235	1,168	17,402
2017	16,587	1,179	17,766
2018	16,947	1,191	18,138
2019	17,315	1,203	18,518
2020	17,690	1,215	18,905

Finally, note that the above projections assume no change in average idle activity per parking space, or in emission rates per truck over time. Although previous studies such as the one by CATI found no clear relation between engine model year and NOx idle emission rates, these rates may change in the future as a result of fuel formulation changes, or even limited application of tailpipe retrofits.[9] Idle activity per parking space may change due to increased use of idle reduction technologies such as IdleAire, changes in DOT safety regulations regarding driver hours per day, among other factors.

[9] EGR technology, present on 2004 and later model year engines, is not expected to effect NOx emissions levels at idle.

7.0 Data Analysis and Emissions Estimation: Intermodal Facilities

This section addresses potential heavy-duty truck idling at intermodal facilities such as marine ports, airports, and rail terminals. The term "intermodal" refers to facilities that handle truck to ship, truck to rail, and truck to aircraft goods, as opposed to operations that only involve highway trucks. These types of facilities are expected to have restricted space, thereby causing queue lines that could result in substantial idling.

In general it was found that all marine and rail terminal gates were open from 7:00 a.m. to 7:00 p.m., while most airport terminals were open 24 hours a day. Unlike the airport freight operations that mainly run overnight, most containerized facilities had three peak periods: early morning, at noon, and in the early evening.

The following summarizes the major findings and extended idling emissions estimates for the different intermodal facility categories investigated.

7.1 Airport Cargo Facilities

Airport cargo facilities at San Antonio International, George Bush Intercontinental, DFW International, and Alliance were found to have very little heavy-duty truck (HDDV 6-8) activity, being dominated by smaller trucks (HDDV 2b-5). The drivers of these smaller trucks (e.g., UPS) generally turn off their trucks when they are not underway, presumably to save fuel and prevent cargo theft. The few Class 6-8B trucks observed were not idling when waiting or being loaded. Therefore our observations found no significant extended idling emissions at these types of facilities.

This does not mean that there are no extended idling emissions at airport cargo facilities; rather, it means that this survey was not able to make an inference about any peak period delays. (In general, airport cargo facilities operate overnight, but even during these hours no significant idling was observed). It could be possible that air traffic problems, such as delays in aircraft landings caused by weather events, could result in extended queues and truck idling, especially during heavy months such as December. Such loading delays at should be considered an exception, however, and should not be considered in a measure of "idling emissions per average ozone season weekday."

7.2 Marine Terminals

Barbour's Cut is the largest container terminal in Texas. It has been operating at or beyond capacity for the last several years, a prime motivation for constructing the new Bayport

facility (1). As a result, it also is one of the few terminals observed having significant truck idling. It should be noted that additional entry gates are being constructed, to be completed in early to mid-2005, so idling at this facility can be considered a short-term condition. Table 7-1 below lists Barbour's Cut (BCT) as well as the other major container terminals in Texas. On the top row BCT and it's privately-owned neighbor, Sea-Land, are counted together. The 460,000 "box" truck trips per year attributable to BCT account for 52 percent of the container activity in Texas.

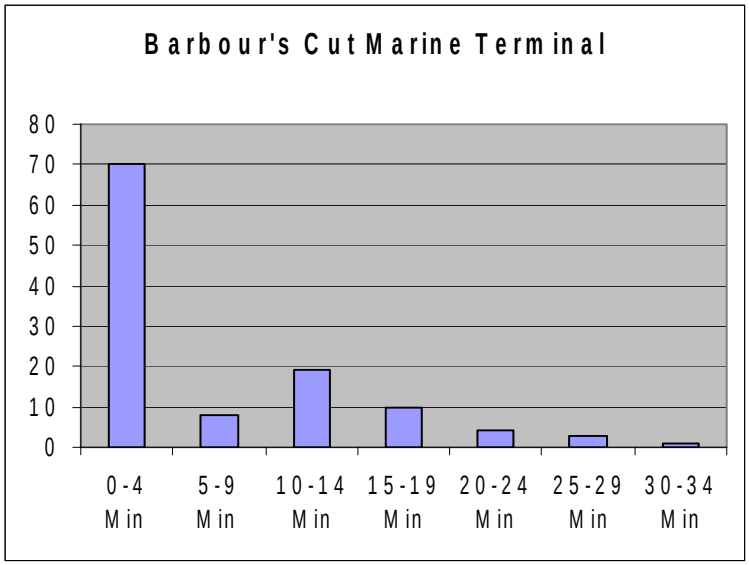
Table 7-1. Container Ports in Texas, 2004

Terminal	TEU	Boxes	Percent
Total BCT & Sea-Land	1,243,706	776,403	88.3%
Subtotal Barbour's Cut	736,866	460,000	52.3%
Subtotal Sea-Land	506,840	316,403	36.0%
Subtotal Turning Basin	64,205	40,081	4.6%
Galveston	32,508	20,294	2.3%
Freeport	67,784	42,315	4.8%
	1,408,203	879,093	100.0%

The shipping industry usually tracks twenty-foot equivalent units (TEU), but for our purposes the study is more concerned with "boxes", which translate directly into truck trips (import, export, and empties). The ratio between TEU and boxes is approximately 1:1.6. This ratio and the data in Table 7-1 was constructed from several Internet sources, including information from the American Association of Port Authorities and the Port of Houston Authority.

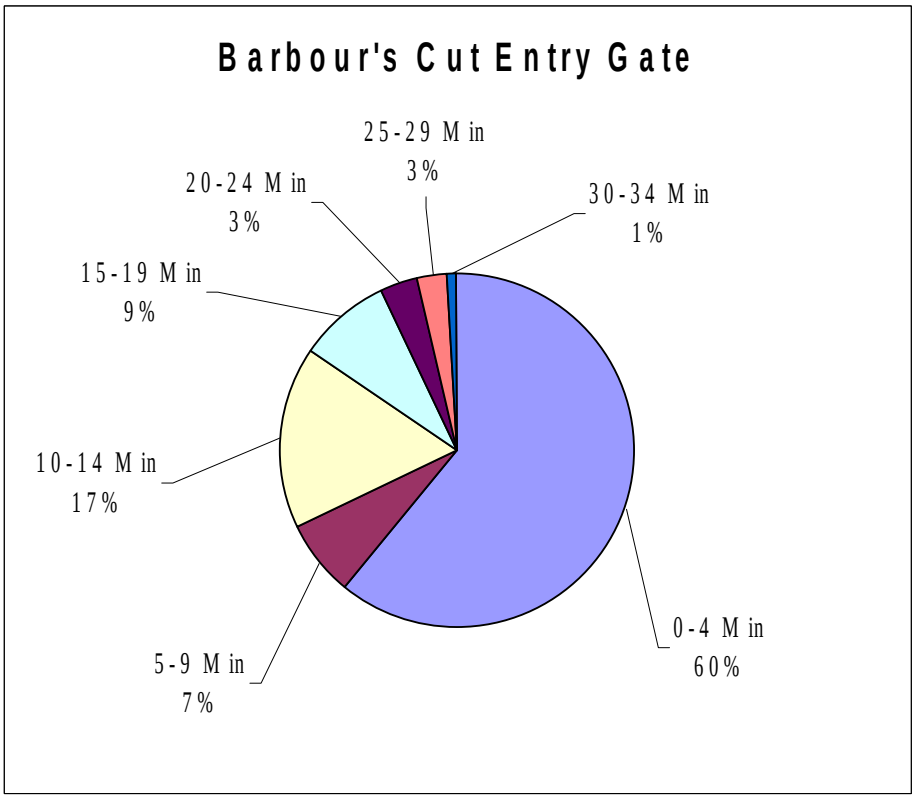
The survey did not find significant idling at other marine terminals, so BCT was the focus of further investigation. 115 trucks were observed for their delay times, as shown in Figure 7-1.

Figure 7-1. Distribution of Delay Times for 115 Observations (9/2/04)



The time bins were divided into 0-4, 5-9, 10-14, 15-19, 20-14, 25-29, and 30-34 minute blocks. Figure 7-2 displays the same information in terms of percentages.

Figure 7-2. Percentage Idling by Duration



The figure shows that 60 percent of the trucks at the entry gate had an idling time of less than 5 minutes, and 84 percent of the trucks had extended idling of less than 15 minutes. The average wait time was 6 minutes, although 16% of the trucks idling for more than 15 minutes. The average of those trucks idling 15 minutes or more ("extended" idling by definition) was 20.5 minutes.

These results should be viewed with caution for two reasons. First, observations were based on "queue length delay", as trucks had to creep ahead to the front of the line over several hundred feet, and therefore were not in a true idling condition at all times (although the speed was probably less than 5 miles per hour at all times). Second, these results should not be applied to other terminals or used to project extended truck idling into the future, because of the pending gate expansion at BCT. Nonetheless, the results are useful in providing a conservative upper bound to extended idling, as shown in Table 7-2.

Table 7-2. Extended Idling NOx Emissions (2004)

Terminal	Trucks	Idling_Hrs	Annual_NOX	Daily_NOX
Barbour's Cut	460,000	25,147	3.74	0.014
Sea-Land	316,403	17,297	2.57	0.010
Turning Basin	40,081	2,191	0.33	0.001
Galveston	20,294	1,109	0.17	0.001
Freeport	42,315	2,313	0.34	0.001
	879,093	48,057	7.15	0.028

In the above table NOx emissions assumed 16 percent of the truck trips had extended idling periods averaging 20.5 minutes in duration. These hours were then multiplied by the suggested EPA value of 135 grams/hour for extended idling. Average ozone season weekday emissions were derived by dividing annual emissions by 260.

Research would be needed to assess potential idling in the future, as several new facilities may be operational by 2007, including:

- Bayport – Port of Houston Authority
- Texas City – Pelican Island
- Corpus Christi
- 7.3 Railway Intermodal Terminals

Railway terminals with quantifiable volume data were identified using the 1997 Rail Intermodal Directory. Table 7-3 lists the major rail intermodal facilities identified. (Note that this

is only a partial list, because it is known that there are also intermodal operations in San Antonio, Beaumont, El Paso, Laredo, and even Barbour's Cut.)

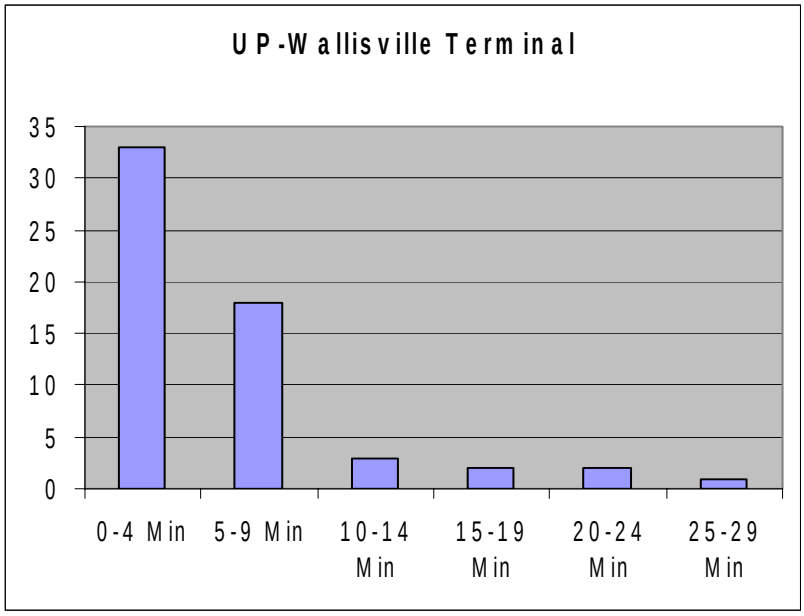
Table 7-3. Intermodal Railway Facilities Evaluated[10]

Railway	Terminal	Area	Trucks/Day	Trucks/Year
UP	Miller	Dallas	900	234,000
UP	Mesquite	Dallas	1000	260,000
KCS	Arlington	Dallas	900	234,000
BNSF	Alliance	Dallas	800	208,000
BNSF	Amarillo	Amarillo	500	130,000
BNSF	El Paso	El Paso	50	13,000
UP	San Antonio	San Antonio	350	91,000
UP	San Antonio	San Antonio	250	65,000
UP	Laredo	Laredo	500	130,000
UP	McAllen	McAllen	10	2,600
UP	Kirkpatric	Houston	700	182,000
BNSF/UP	Barbours Cut	Houston	250	65,000
UP	Wallisville	Houston	500	130,000
BNSF	Hobby	Houston	500	130,000
			7210	1,874,600

As with marine terminals, railway intermodal truck idling can be extrapolated from "worst case" terminals to other terminals in Texas. The Wallisville terminal in Houston was selected as the basis for extrapolation because it had the highest idling observed in the field. Note that this approach over-estimates extended idling, since none of the facilities aside from Wallisville had any observed idling for more 15 minutes. Figure 7-3 shows the results of the Wallisville observation.

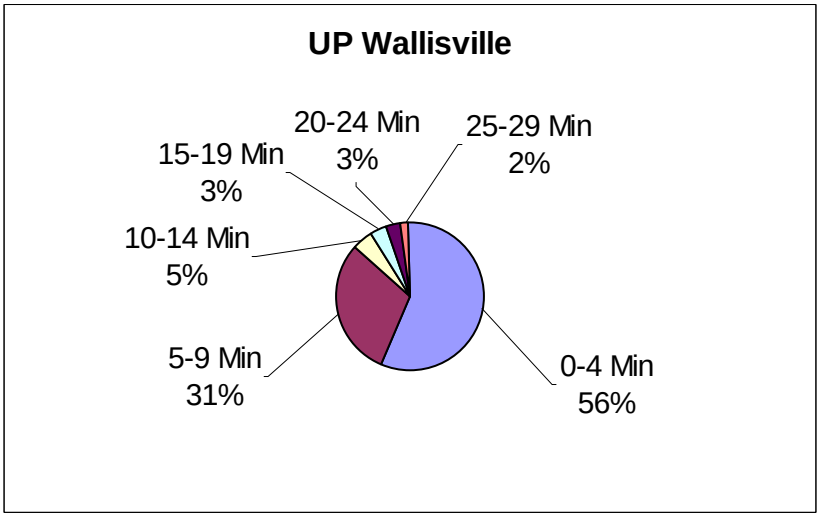
[10] Sites surveyed under current Phase II effort include UP Miller, Mesquite, San Antonio and Wallisville; BNSF Alliance and Hobby; and KCS Arlington.

Figure7-3. Wallisville Rail Terminal Observations, n = 59 (9/8/04)



Interestingly, this facility is relatively congested, had high volumes, and closed one of its entry gates during lunchtime. Figure 7-4 displays the same information in terms of percentages.

Figure 7-4. Percentage Idling by Duration



These findings indicate that 8 percent of trucks had an idling period of more than 15 minutes, with an average of 20.5 minutes. Using the same methodology as was done for BCT, emissions for extended rail – truck idling are provided in Table 7-4.

Table 7-4. Surveyed Intermodal Rail Terminal Idling NOx Emissions

Terminal	Trucks	Idle Hours	Annual_NOX	Daily_NOX
Miller	234,000	6,396	0.95	0.004
Mesquite	260,000	7,107	1.06	0.004
Arlington	234,000	6,396	0.95	0.004
Alliance	208,000	5,685	0.85	0.003
Amarillo	130,000	3,553	0.53	0.002
El Paso	13,000	355	0.05	0.000
San Antonio	91,000	2,487	0.37	0.001
San Antonio	65,000	1,777	0.26	0.001
Laredo	130,000	3,553	0.53	0.002
McAllen	2,600	71	0.01	0.000
Kirkpatric	182,000	4,975	0.74	0.003
Barbours Cut	65,000	1,777	0.26	0.001
Wallisville	130,000	3,553	0.53	0.002
Hobby	130,000	3,553	0.53	0.002
	1,874,600	51,239	7.62	0.029

8.0 Conclusions and Recommendations

8.1 Truck Stops and Rest Areas

The final idle activity and emissions model achieves excellent geographic coverage, with at least one truck stop or rest area identified in 162 Texas counties. The field observations used to build the model exceeded the target number of site visits set in the Data Collection Plan, and established reliable temporal profiles for all time periods and regions of the state.

Independent sources were used to help validate the model results. The FHWA study of truck parking supply and demand estimated between 12,277 and 24,265 truck stop parking spaces in Texas in 1999. This compares to the 24,912 spaces identified for this effort. However, the FHWA estimate based their parking estimate on 284 truck stops, compared to the 563 identified by ERG. Considering this difference, and that the majority of the new stops identified by ERG (but not included in the FHWA study) were typically small sites, ERG's projection of total parking spaces is in line with the FHWA range.

The final estimate of statewide truck stop and rest area emissions is approximately twice that estimated by TTI for the Phase 1 study, again due to the greater number of truck stops identified for this effort. Emissions estimates for large metro areas such as Houston were more similar.

Several recommendations have been identified for potentially improving the accuracy and precision of the activity and emissions model in the future.

- *Conduct a brief follow-up study during the fall, winter, and spring seasons to characterize idle expansion factors for these periods*. This will address lingering doubts concerning the accuracy of interview responses and resulting annual expansion factors.
- *Consult with AACOG and others to identify possible reasons for the significantly different expansion factors for the San Antonio area*. ERG Team members and the TCEQ have not been able to identify any potential explanation for this finding.
- *Contact TxDOT Districts to identify and characterize the roughly 740 state picnic and parking areas across the state*. This can be incorporated under Phase III of the study to estimate emissions at these distinctly different source generators.
- *Work with TxDOT Maintenance Division to refine Rest Area growth factors*. In this way plans for expansion of rest area parking capacity can be made county-specific.

- *Adjust parking space estimates to account for future penetration of idle reduction technologies*. As use of idle reduction techniques become more widespread, site-specific adjustments can be applied to the master truck stop list to account for reduced idling.
- *Develop means of allocating truck stops without GPS coordinates*. As noted above, approximately 50% of the sites identified in the master truck stop list do not have GPS coordinates. In order to facilitate preparation of photochemical modeling inputs, a methodology should be developed to allocate these emissions spatially within a given county. In those cases where GPS coordinates cannot be determined via available locator information, emissions could be allocated evenly along the primary access highway identified on the list. Unfortunately even access highway information is missing for certain sites. For these, emissions could be allocated evenly across all major interstates and highways in a county.
- *Develop a truck stop allocation model using data from this project*. This may be ERG's most important recommendation regarding future idle characterization activities. Based on our experience, we believe it will be very time consuming to keep the current master truck stop list up to date. Doing so would require frequent review of the Internet for new truck stops, and calling existing locations to determine if they have recently closed or modified their parking capacity. An alternative would be to build a truck stop allocation model using regression analyses to identify pertinent factors influencing the number of parking spaces in a county, and subsequently developing the required predictive algorithms. Independent variables in such a model would most likely include region of state, associated Interstate/State Highway, and proximity to key metro areas. Such a model could be periodically validated and refined through a relatively low-cost survey of representative counties (e.g., one urban, one suburban, one rural), simply by driving the major interstates and state highways in the area.
- *Adjust the baseline MOBILE6 emission inventory for extended idle emissions*. The MOBILE model uses in-use fuel economy estimates from the 1992 Truck Inventory and Use Survey (TIUS) to calculate heavy truck gram per mile emission rates. These fuel economy data implicitly include fuel consumed during extended idling events. As such, MOBILE model output includes some amount of extended idle emissions. Therefore we recommend that the extended idle emissions estimated in this study should be netted out of the current heavy-duty diesel on-road inventory, to avoid double-counting. In addition, EPA currently estimates extended idle emissions should account for no more than 3.4% of total on-road emissions (7).[11] However, the 1992 TIUS did not provide specific modal information to definitively determine the amount of fuel consumed during extended idle events. Therefore it cannot be determined if the actual amount of extended idling contained in the TIUS fuel consumption data even matches the relative amount of idling in the engine certification test cycle (which is used to determine engine emission factors in MOBILE). Given these uncertainties it is

[11] The extended idle emission estimates developed here should be compared with the on-road inventories for each region of the state to confirm that they are below the 3.4% cap before proceeding with this recommendation.

likely that the current version of the MOBILE model cannot be adjusted precisely enough to separate idle and on-road emissions. Further refinement of these emissions estimates may require the use of the future MOVES model.

8.2 Intermodal Facilities

Initial findings indicated that intermodal facilities did not experience significant extended truck idling during typical operations. Accordingly, these facilities were not observed as intensively as truck stops and rest areas. However, even under the "worst-case" conditions assumed in our analysis, extended idle emissions at these locations total less than 0.1 tons per day of NOx statewide.

Nevertheless, certain facilities have the potential to become significant sources of NOx under conditions of strained capacity. Therefore periodic monitoring of terminal capacity may be warranted to identify emerging queue problems in the future.

9.0 References

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5. Texas Commission on Environmental Quality, Heavy-Duty Diesel Vehicle (HDDV) Idling Activity and Emissions Study: Phase 1 – Study Design and Estimation of Magnitude of the Problem, Texas Transportation Institute, August 2003.

6. Vehicle Volume Distributions by Classification, Washington State Transportation Center (TRAC) and Chaparral Systems Corporation, July 1997.

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Appendix A
Data Collection Plan for Truck Stops and Rest Areas

Heavy-Duty Idling Activity Characterization and Emissions Inventory Study

Sampling Plan for Truck Stops and Rest Areas

Overview

This sampling plan covers the surveying of idling activity of heavy-duty diesel vehicles at rest areas and truck stops/travel plazas in Texas.12 The goal is to obtain information that allows for the development of temporal and spatial profiles of truck idling throughout the state and to include vehicle information sufficient for emissions estimation. The main objective of the sampling plan is to balance the data collection over spatial and temporal characteristics while remaining within the time and budget allowances for the project. The data must also be collected in a manner that allows for emissions estimates to be statistically quantified. Many aspects of this sampling plan expand upon an earlier study by the Texas Transportation Institute that included developing estimates of NOx emissions at truck stops and rest areas in Texas.

Universe of Rest Areas and Truck stops

Rest Areas

The location of rest areas in Texas was developed using data primarily from the Texas Department of Transportation (TxDOT) Maintenance Division website (www.dot.state.tx.us/mnt/sra/map.htm). There are 93 safety rest areas in the state spread across each of the major metropolitan areas. These areas are officially designated as "safety areas", with specific building facilities and other services maintained by TxDOT. An additional number (~6) of rest areas were identified by TxDOT with distinct entrances, parking spaces, and exits, but without support facilities, for inclusion in the list.13 The current list of Rest Areas is presented in below. The long-term list of rest areas will continue to expand based on TxDOT's plans to develop several more rest areas in the short and long term.

Truck Stops

There is no single source listing the location of all truck stops in the state. This is partially because the characteristics that separate "truck stops" from other facilities are not well defined. Many facilities advertise themselves as truck stops despite having few truck parking spaces and limited amenities within the facility. Other locations advertise as restaurants and gas stations, but have several parking spaces dedicated to extended truck idling.

For purposes of this study, multiple sources were used to develop the list of truck stops for potential data collection. ERG began the list with the 157 truck stops identified in the TTI Phase 1 report. This list was expanded to over 460 truck stops using the following additional Internet sources:

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[12] Travel plazas will be included in the "truck stop" definition for the purposes of this paper.
[13] Personal communication with Andy Keith, TxDOT Maintenance Division, June 24, 2004.

- Yahoo Yellow Pages
- Company websites for large truck stop chains
    - Petro
    - Pilot
    - Love's
    - Travel Centers of America
    - Flying J Travel Plazas
    - Speedco Truck Lube
- Trucker and related transportation websites
    - North American Truck Stop Network -- www.natsn.com
    - Truck Realm – www.truckrealm.com
    - RoadStar Publication – www.roadstaronline.com
    - The Trucking Network – www.truckingnetwork.com

In addition to these sites, "Google searches" were performed for all other truck stop names on the original TTI list to see if additional locations could be identified.

For each location identified, we attempted to collect the following information from the Internet:

- Truck stop name
- City
- Phone
- Street address
- Primary access Highway
- Highway exit #
- Nearest cross-street
- # truck parking spaces

Next, the complete list was reviewed, and duplicates were removed. Then unique ID numbers were assigned to the list for future tracking purposes. Each site was then assigned to a general metropolitan area for the purposes of logistical planning for data collection.

In many instances key information was missing from the Internet data, such as street address and number of parking spaces. In addition, in certain instances it was not clear if a given site listing was actually a functional truck stop (see above). Therefore ERG attempted to obtain this information by phone, although certain facilities could not be reached (no answer, disconnected phone line, etc.) Facilities confirmed to be out of business or non-truck stops were removed from the list.

The final master list represents the best available snapshot of truck stops in the state. The actual number of truck stops can fluctuate due to several factors including new truck stops that are built in the state and existing facilities that expand, limit, or discontinue services for truck drivers.

During the data collection process, truck stop operators will be asked about the location of other major truck stops in each metropolitan area to validate our listing, and to ensure that none of the major truck stops are missed in the modeling effort.

Balancing Temporal and Spatial Coverage

There are not enough project resources to collect firsthand data at each of the 500+ truck stops and rest areas in the state for each of the desired time periods. The sampling plan was developed to incorporate sufficient temporal and spatial coverage of Texas to allow accurate emissions estimates to be generated at the hourly, daily, and annual levels. The spatial coverage includes collecting data in each of the state's broadly-defined metro areas. The temporal coverage includes collecting data throughout the day, for weekends and weekdays, and for different seasons in the year. Guidance on how temporal and spatial coverage is incorporated into the data collection plan is provided in the following sections.

Geographic coverage

Geographic coverage will be ensured by collecting data in every region of the state. Precise region designations are somewhat arbitrary, based on proximity and access to each metro area. Metro designations include the following.

Abilene
Amarillo
Austin
Beaumont/Port Arthur
Bryan/College Station
Corpus Christi
Dallas/Ft. Worth
El Paso
Houston/Galveston/Brazoria
Killeen/Temple
Laredo
Lubbock
McAllen
Midland/Odessa
San Angelo
San Antonio
Texarkana
Tyler/Longview
Victoria
Waco
Wichita Falls

- Major metropolitan areas such as Houston, Dallas and El Paso will be sampled over multiple days to include a broad set of truck stops and rest areas.
- Multiple sampling days will also be used to confirm the temporal patterns discussed below.

Time-of-day variability

- The TTI Phase 1 study showed significant variability in both occupancy and idling rates at different times in the day. Occupancy rates ranged from 20 percent in the middle of the day to 85 percent in the late evening. Idling rates were as high as 90 percent in the early morning and as low as 50 percent in the late afternoon and early evening. However, these temporal data were only collected at a total of 3 locations. The combination of large time-of-day variability and limited prior data collection argue for inclusion of multiple time periods into the sampling plan.
- Four time periods are proposed, predicated on the following assumptions:
    - 9 a.m. – 4 p.m. – Midday driver activities (midday meals and breaks)
    - 4 p.m. – 9 p.m. – Early evening activities (dinner, use of amenities before overnight)
    - 9 p.m. – 6 a.m. – Nighttime activities (sleep)
    - 6 a.m. – 9 a.m. – Morning activities (breakfast, use of amenities)
- Data will be collected in the morning, midday, and late afternoon time periods. However, overnight data will be collected in the separate 24 hour surveillance data collection effort (see below). These time periods will be used as a general guide so the surveyors collect data during both high occupancy and low occupancy time periods. However, because time stamps will be used for each data collection location, new time periods (including hourly periods) can be developed for the final emissions model based on the 24-hour data collection.
- 24-hour data collection will occur in both the Dallas and Houston metropolitan areas to develop full time-of-day variability for truck stops and rest areas. This data collection will occur in August, after all initial data is collected to identify optimal sites for extended observation. Details on this component of the data collection plan will be provided at a later time.
- Data collected in this effort will be compared to data collected in the Beaumont-Port Arthur area by TTI as independent validation of temporal patterns.
- Facility operators/managers will be interviewed at each truck stop to help characterize temporal variability.
- A limited number of truck driver interviews will also be conducted at each truck stop and rest area. These interviews will inquire about the length of the idling period for each truck driver. These data will also help to confirm the amount of idling by time-of-day and for other periods.

Day of Week Variability

- Truck count data indicate that truck activity is heaviest during weekdays, lighter on Saturdays and the lightest on Sundays. Additionally, truck count data tend to be fairly constant between Monday through Friday. Therefore, the three day of week categories considered for this study are:

    - Monday through Friday
    - Saturday
    - Sunday

- Based on observed HDV VMT patterns, it is likely that over 85 percent of the truck idling occurs between Monday and Friday. Therefore, the data collection will focus on weekday activity with more limited data collection on Saturday and Sunday.
- The final data collection plan includes weekend data collection in two of the largest metropolitan areas for both Saturday and Sunday (El Paso and Houston/Galveston/Brazoria). The remaining data will be collected in this survey will be during weekdays.
- Weekend data will only be collected at locations where there is also weekday data so that comparisons can be made directly for a single location. The weekday to weekend ratios developed in these two metropolitan areas will be applied to each of the metropolitan areas in the state.

Seasonal Variability

- Seasonal variability must be obtained through interviews. The data collection activity will be conducted in the summer months of July and August, therefore no firsthand data can be collected during the other seasons in the year.
- Interviews to obtain seasonal data will be conducted for the facility operators and truck drivers. However, the facility operators are better candidates for these interviews, because they likely have access to historical information about the activity at their truck stop and they are likely more willing to participate in survey efforts. Truck drivers will likely be familiar with their singular behavior that may vary significantly from the norm.

Selection of Truck Stops and Observation Times within a Metropolitan Area

- The total time required to collect the data includes the time to collect data at each site and the time to drive between sites. Therefore, data will be collected within a single metropolitan area for each day by each surveyor to minimize time spent driving and maximize the time spent collecting data.
- Within each metropolitan area, specific truck stops are selected based on the number of reported truck parking spaces at the facility. The truck stop information collected thus far indicates that the number of parking spaces at a truck stop can

range from 10 to 300. The data collection plan prioritizes truck stop locations based on the number of parking spaces. This prioritization maximizes the number of parking spaces included in the survey since less time is spent driving to the next truck stop and more time is spent collecting data.

- Data collection will occur at enough locations to determine if there is variability in occupancy and idling for medium-sized and large truck stops. These data will be used in the final emissions model to estimate occupancy and idling at truck stops of all sizes.
- Data collectors will have the flexibility to pick specific data collection locations within a metropolitan area also based on proximity to other sites. For example, if there is a nearby truck stop with 150 parking spaces, this will be given priority over a truck stop that is 50 miles across town with 200 parking spaces. Again, the focus is on collecting the maximum amount of data possible within a given time period.
- It is estimated that a single data collector can sample five locations in a given day. Under this assumption, approximately 210 sites will be sampled.14 Of these, a limited number will be repeat visits (i.e., for Saturday and Sunday site visits, ~20, for roughly 190 unique sites). Please see below for a summary of the proposed area visitation schedule.

Selection of Rest Areas

- Rest areas represent a much smaller set of the truck parking spaces relative to the truck stops. (TTI estimated between 15 and 50 parking spaces per site, compared to up to 300 for truck stops.) Therefore, data collection at rest areas will occur whenever a data collector drives by on their way to a target truckstop, so as to minimize driving time for the data collectors in each metropolitan area. The sampling plan strives to include 20 percent (20 out of 99) of the rest areas, including one in each of the largest metropolitan areas.15 This will add significantly to the data collected by TTI at two rest areas in the Beaumont-Port Arthur area.

Data Collection Process

Before deployment, all data collection and survey templates will be loaded onto laptop computers for use in the field. Field personnel will also be trained in the use of these forms, as well as QA/QC procedures. All data collection will be recorded electronically using standardized forms. For each site location selected from the prioritized list, data collectors will first confirm the street address and record the GPS location of the site (or at multiple points along the path for rest areas). The adjacent roadway name and its MOBILE6 roadway classification will also be noted, as well

[14] On a given day, if greater than 5 sites can be sampled within the available time, additional observations will be made at one or more locations from earlier in the day, to expand the temporal profiling effort. This is most likely to occur in the denser urban areas where sites are closer together and travel times shorter.
[15] The number of rest areas visited is likely to be much larger, given the travel requirements of the field effort.

as whether the parking lot is paved or unpaved.16 Next, day, date, and time will be noted. Total truck parking spaces will then be recorded, along with the number of trucks present, and the number idling. Truck numbers will be broken out by size of vehicle (tractor rigs and other), fuel type (gas/diesel), and long versus short-haul (using the presence of sleeper cabs as a surrogate). Please see the screenshots below for the data collection templates for both truck stops and rest areas.

During field data collection ATG will conduct weekly teleconferences with ERG and the TCEQ Project Manager to review progress regarding schedule and milestones. Any difficulties with respect to the Data Collection Plan will be identified and resolved to the extent possible at this time. ERG will provide the TCEQ with a "percent complete" report prior to each call.

At the completion of the data collection ATG will provide ERG with complete electronic files for the truck stops and rest areas surveyed, along with documentation summarizing the data collection procedure and any assumptions made in recording or preparing the data.

Supplemental Truck Stop Operator Interviews

- Truck stop operators will also be interviewed to clarify information about their facility and collect information on the truck activity at the facility. Questions for truck stop operators include:
    - Number of truck parking spaces
    - Activity on day of data collection relative to typical day
    - Occupancy rate at different times in the day, days in the week, and seasons
    - Amenities offered at the facility
    - Other major truck stops in the region

Please see the screenshots below for a complete listing of the interview questions for truck stop operators.

Supplemental Truck Driver Interviews

- At each truck stop locations, two to three truck drivers with idling engines will be randomly selected and interviewed to collect additional information about vehicle idling.17 Data collected from truck drivers will include the following:
    - Total time spent idling during this idling event
    - Average weekday idling amount at truck stops/ rest areas
    - Average weekend idling amount at truck stops/rest areas
    - Average nighttime idling amount at truck stops/rest areas
    - Seasonal variability in idling
    - Commodity carried (for forecasting purposes)

[16] This information may be used by the TCEQ in subsequent PM re-entrainment estimations.
[17] The number of interviews executed is constrained by the total allotted time for each site.

The screenshot below provides a complete listing of the interview questions for truck drivers.

Sampling Confidence Interval

The following calculation provides a preliminary estimate of the confidence interval, at the 95% confidence level, associated with the proposed sampling plan. Using the Phase 1 TTI data as a starting point, we find that the lowest occupancy rates and idling numbers occur during the midday hours – their Petro Stopping observations found ~25% occupancy, and ~60% idle rates, for an overall idle rate of ~15% for this time period.

As proposed, the data collection effort will visit approximately 210 unique sites across Texas (190 truck stops and 20 rest areas). This corresponds to about 38% of all truck stops/rest areas identified. For a 15% idle rate, at the 95% confidence interval, we assume a normal distribution of idle rates.

Average Idle rate = $0.15 \pm 1.96\sqrt{pq/n*(1-n/N)}$ where:

p = 0.15
q = 1-p = 0.85
n = sample number (210)
N = universe of sites (560)

This equates to 0.15 $\pm$ 0.038. So under these assumptions, the sampling plan will result in less than a 5% error at the 95% confidence level.

List of Rest Areas (as of June 25)

ID#	Metro Area	County	Highway	Location
RA-1	Midland/Odessa	Andrews County Northbound	US 385	US 385 - North Bound, North of Andrews
RA-2	Killeen/Temple	Bell County Northbound	IH 35	IH 35 - Northbound, approximately 2 miles south of Salado, midway between Austin and Waco
RA-3	Killeen/Temple	Bell County Southbound	IH 35	IH 35 - Southbound, approximately 2 miles south of Salado, midway between Austin and Waco
RA-4	San Antonio	Bexar County Eastbound	IH 10	IH 10 - East Bound, east of Converse, approximately 10 miles east of San Antonio
RA-5	San Antonio	Bexar County Westbound	IH 10	IH 10 - West Bound, east of Converse, approximately 10 miles east of San Antonio
RA-6	Texarkana	Bowie County Eastbound	IH 30	IH 30 - East Bound, East of FM 561
RA-7	Texarkana	Bowie County Westbound	IH 30	IH 30 - West Bound, West of FM 990
RA-8	McAllen	Brooks County	US 281	US 281, approximately 9 miles south of Falfurrias, southwest of Corpus Christi.
RA-9	Abilene	Callahan County Eastbound	IH 20	IH 20 - East Bound, East of Abilene
RA-10	Abilene	Callahan County Westbound	IH 20	IH 20 - West Bound, East of Abilene
RA-11	Texarkana	Cass County Southbound	US 59	US 59 - South Bound, South of Atlanta - Facility serves traffic both directions
RA-12		Cherokee County Northbound	US 69	US 69 - North Bound, North of Jacksonville
RA-13	San Angelo	Coke County	US 87	US 87 - North of Water Valley, Serves traffic both directions
RA-14	Amarillo	Collingsworth County Southbound	US 83	US 83 - South Bound, North of Wellington
RA-15	Victoria	Colorado County Eastbound	IH 10	IH 10, approximately 4.5 miles west of Columbus, between Houston and San Antonio
RA-16	Victoria	Colorado County Westbound	IH 10	IH 10, approximately 4.5 miles west of Columbus, between Houston and San Antonio
RA-17	San Antonio	Comal County Northbound	IH 35	IH 35 - North Bound, South of New Braunfels
RA-18	San Antonio	Comal County Southbound	IH 35	IH 35 - South Bound, South of New Braunfels
RA-19	San Angelo	Concho County	US 87	US 87 - West of Eden - Serves traffic both directions
RA-20	Lubbock	Crosby County Eastbound	US 82	US 82 - East Bound, East of Crosbyton
RA-21	El Paso	Culberson County (near Pine Springs)	US 62/180	US 62/180, about 7 miles from Texas/New Mexico state line

ID#	Metro Area	County	Highway	Location
RA-22	Amarillo	Culberson County Eastbound - IH 10	IH 40	IH 10 - East Bound, 4 miles east of Van Horn
RA-23	El Paso	Culberson County Westbound - IH 10	IH 10	IH 10 - West Bound, 4 miles east of Van Horn
RA-24	Amarillo	Donley County Eastbound	IH 40	IH-40, 1 hour drive East of Amarillo
RA-25	Amarillo	Donley County Northbound	IH 40	US-287, 4 miles East of Hedley
RA-26	Amarillo	Donley County Southbound	IH 40	US-287, 4 miles East of Hedley
RA-27	Midland/Odessa	East Pecos County Eastbound	IH 10	IH 10, 23 miles west of Sheffield in west Texas
RA-28	Midland/Odessa	East Pecos County Westbound	IH 10	IH 10, 23 miles west of Sheffield in west Texas
RA-29	El Paso	El Paso County Eastbound	IH 10	IH-10 - East Bound, East of Fabens
RA-30	El Paso	El Paso County Westbound	IH 10	IH-10 - West Bound, East of Fabens
RA-30	Dallas/Fort Worth	Ellis County Northbound	IH 35E	IH 35E - North Bound, South of Waxahachie
RA-31	Dallas/Fort Worth	Ellis County Southbound	IH 35E	IH 35E - South Bound, South of Waxahachie
RA-32	Tyler/Longview	Franklin County Eastbound	IH 30	IH 30 - East Bound, 4 miles west of Mount Vernon
RA-33	Tyler/Longview	Franklin County Westbound	IH 30	IH 30 - West Bound, 4 miles west of Mount Vernon
RA-34	Houston/Galveston	Galveston County North Landing	SH 87	SH-87, next to Galveston Ferry Landing
RA-35	Houston/Galveston	Galveston County South Landing	SH 87	SH-87, next to Port Bolivar Ferry Landing
RA-36	Austin	Gillespie County Ranch Road 1	RR 1	Ranch Road 1 - West Bound, near Stonewall
RA-37	Austin	Gillespie County US 290	US 290	US 290 - West Bound, between Johnson City and Fredericksburg
RA-38	Amarillo	Gray County Westbound	IH 40	IH-40, just west of Alanreed
RA-39	San Antonio	Guadalupe County Eastbound	IH 10	IH 10 - East Bound, East of Seguin
RA-40	San Antonio	Guadalupe County Westbound	IH 10	IH 10 - West Bound, East of Seguin
RA-41	Lubbock	Hale County Northbound	IH 27	IH 27 - North Bound, South of Hale Center
RA-42	Lubbock	Hale County Southbound	IH 27	IH 27 - South Bound, South of Hale Center
RA-43	Wichita Falls	Hardeman County Northbound	US 287	US-287, East of Quanah
RA-44	Wichita Falls	Hardeman County Southbound	US 287	US-287, East of Quanah
RA-45	Tyler/Longview	Harrison County Eastbound	IH 20	IH 20 - East Bound, West of Marshall
RA-46	Tyler/Longview	Harrison County Westbound	IH 20	IH 20 - West Bound, West of Marshall
RA-47	Abilene	Haskell County Southbound	US 277	US 277 - South Bound, South of Haskell

ID#	Metro Area	County	Highway	Location
RA-48	Austin	Hays County Northbound	IH 35	IH 35 - North Bound, North of San Marcos
RA-49	Austin	Hays County Southbound	IH 35	IH 35 - South Bound, North of San Marcos
RA-50	Abilene	Howard County Eastbound	IH 20	IH 20 - East Bound, East of Big Springs
RA-51	Dallas/Fort Worth	Johnson County Northbound	IH 35W	IH 35W - North Bound, South of Burleson
RA-52	Dallas/Fort Worth	Johnson County Southbound	IH 35W	IH 35W - South Bound, South of Burleson
RA-53	Dallas/Fort Worth	Kaufman County Eastbound	IH 20	IH 20 - East Bound, East of Elmo
RA-54	Dallas/Fort Worth	Kaufman County Westbound	IH 20	IH 20 - West Bound, East of Elmo
RA-55	Corpus Christi	Kenedy County	US 77	US-77, about 20 miles south of Kingsville, located in the median serving traffic both directions
RA-56	San Antonio	Kerr County Eastbound	IH 10	IH 10 - East Bound, North of Comfort
RA-57	San Antonio	Kerr County Westbound	IH 10	IH 10 - West Bound, North of Comfort
RA-58	San Antonio	Kinney County	US 90	US-90 westbound, about 7 miles east of Brackettville - Serves traffic both directions
RA-59	Abilene	Knox County Westbound	US 82	US 82 - West Bound, East of Benjamin
RA-60	Corpus Christi	Live Oak County Northbound	IH 37	IH 37 - North Bound, North of Three Rivers
RA-61	Corpus Christi	Live Oak County Southbound	IH 37	IH 37 - South Bound, North of Three Rivers
RA-62	San Antonio	Medina County	US 90	US-90, between D'Hanis and Sabinal, located in the median serving traffic both directions
RA-63	San Antonio	Medina County Northbound - IH 35	IH 35	IH 35 - North Bound, North of Devine
RA-64	San Antonio	Medina County Southbound - IH 35	IH 35	IH 35 - South Bound, North of Devine
RA-65	Abilene	Mitchell County Westbound	IH 20	IH 20 - West Bound, West of Colorado City
RA-66	Dallas/Fort Worth	Navarro County Northbound	IH 45	IH 45 - North Bound, South of Corsicana
RA-67	Dallas/Fort Worth	Navarro County Southbound	IH 45	IH 45 - South Bound, South of Corsicana
RA-68	Abilene	Nolan County Eastbound	IH 20	IH 20 - East Bound, East of Sweetwater
RA-69	Abilene	Nolan County Westbound	IH 20	IH 20 - West Bound, East of Sweetwater
RA-70	Houston/Galveston	Orange County Eastbound	IH 10	IH 10 - East Bound, West of Orange
RA-71	Houston/Galveston	Orange County Westbound	IH 10	IH 10 - West Bound, West of Orange
RA-72	Dallas/Fort	Palo Pinto County Eastbound	IH 20	IH 20 - East Bound, East of US 281

ID#	Metro Area	County	Highway	Location
RA-73	Dallas/Fort Worth	Palo Pinto County Westbound	IH 20	IH 20 - West Bound, East of US 281
RA-74	Houston/Galveston	Polk County Northbound	US 59	US 59 - North Bound, North of Leggett
RA-75	Houston/Galveston	Polk County Southbound	US 59	US 59 - South Bound, North of Leggett
RA-76	Corpus Christi	Refugio County Northbound	US 77	US 77 - North Bound, South of Woodsboro - Serves traffic both directions
RA-77	San Angelo	Sutton County Eastbound	IH 10	IH 10 - East Bound, West of Sonora
RA-78	San Angelo	Sutton County Westbound	IH 10	IH 10 - West Bound, West of Sonora
RA-79	Tyler/Longview	Van Zandt County Eastbound	IH 20	IH 20 - East Bound, West of Van
RA-80	Tyler/Longview	Van Zandt County Westbound	IH 20	IH 20 - West Bound, West of Van
RA-81	Victoria	Victoria County Northbound	US 59	US 59 - North Bound, North of Victoria
RA-82	Victoria	Victoria County Southbound	US 59	US 59 - South Bound, North of Victoria
RA-83	Bryan/College Station	Walker County Northbound	IH 45	IH 45 - North Bound, North of Huntsville
RA-84	Bryan/College Station	Walker County Southbound	IH 45	IH 45 - Southbound, North of Huntsville
RA-85	Midland/Odessa	Ward County Eastbound	IH 20	IH 20 - East Bound, East of Pyote
RA-86	Midland/Odessa	Ward County Westbound	IH 20	IH 20 - West Bound, East of Pyote
RA-87	Midland/Odessa	West Pecos County Eastbound	IH-10	IH 10 - East Bound, 26 miles west of Ft. Stockton
RA-88	Midland/Odessa	West Pecos County Westbound	IH-10	IH 10 - West Bound, 26 miles west of Ft. Stockton
RA-89	Wichita Falls	Wichita County Northbound	US 287	US 287 - North Bound, West of Iowa Park
RA-90	Wichita Falls	Wichita County Southbound	US 287	US 287 - South Bound, West of Iowa Park
RA-91	Austin	Williamson County Northbound	IH 35	IH 35 - North Bound, North of Round Rock
RA-92	Austin	Williamson County Southbound	IH 35	IH 35 - South Bound, North of Round Rock
RA-93	Dallas/Fort Worth	Wise County Northbound	US 287	US 287 - North Bound, 2 miles North of Decatur

List of Truck Stops (as of June 25)

ID	Metropolitan Area	Truck Stop Name
1	Abilene	Red Star Truck Terminal
2	Abilene	Sweetwater 76 Auto/Truck Stop
3	Abilene	Flying J Travel Plaza
4	Abilene	Top 18
5	Abilene	Love's #270
6	Abilene	Big Country Truck Stop
7	Amarillo	Love's #200
8	Amarillo	Love's #261
9	Amarillo	Love's Store #250
10	Amarillo	Love's #229
11	Amarillo	Rip Griffin's Swift Shop
12	Amarillo	Rip Griffin's Travel Center
13	Amarillo	Pilot Travel Center #436
14	Amarillo	Pro Am III Truck Stop
15	Amarillo	Petro
17	Amarillo	Express Lane
18	Amarillo	Frontier Fuel Dumas Short Stop
19	Amarillo	Flying J Travel Plaza
20	Amarillo	Pilot Travel Center
21	Amarillo	Texaco Auto & Truck Plaza
22	Amarillo	Travel Centers of America
23	Amarillo	Travel Centers of America
24	Austin	Sunmart #168
25	Austin	San Marcos Truck Stop Texaco
26	Austin	Travel Centers of America
27	Austin	Love's #264
28	Austin	Stockmans Travel Center
29	Austin	221 Truck Stop
30	Beaumont/Port Arthur	Pilot Travel Center #431
31	Beaumont/Port Arthur	Flying J Travel Plaza
32	Beaumont/Port Arthur	Petro Stopping
33	Beaumont/Port Arthur	Bingo Truck Stop
35	Beaumont/Port Arthur	Polk's Pick It Up
36	Beaumont/Port Arthur	Three Flags Truck Stop
37	Brownsville	Login, Inc.
38	Brownsville	
39	Bryan-College Station	
40	Corpus Christi	Corpus Christi Truck Stop
41	Corpus Christi	Wolffs Travel Stop & Café
42	Corpus Christi	Sinton Travel Ctr. Inc.
43	Corpus Christi	Roadrunner Service Ctr
44	Corpus Christi	George West Truck Stop
45	Corpus Christi	Aycock Oil Co.

ID	Metropolitan Area	Truck Stop Name
46	Dallas/Fort Worth	Texas Oil Enterprise
47	Dallas/Fort Worth	Howdy Doody #14
48	Dallas/Fort Worth	Conoco Fuel Stop
49	Dallas/Fort Worth	Total #4544
50	Dallas/Fort Worth	Phast Phil's
51	Dallas/Fort Worth	Whip In Stop
52	Dallas/Fort Worth	Total #4529
53	Dallas/Fort Worth	Total Fuel Stop
54	Dallas/Fort Worth	Love's #217
55	Dallas/Fort Worth	Love's #283
56	Dallas/Fort Worth	Pride Fuel Stop
57	Dallas/Fort Worth	Love's #294
58	Dallas/Fort Worth	County Line Truck Stop
59	Dallas/Fort Worth	Marlow’s Fuel Center
60	Dallas/Fort Worth	Texaco Travel Plaza
61	Dallas/Fort Worth	Love's #299
62	Dallas/Fort Worth	Love's #216
63	Dallas/Fort Worth	Knox Fuel Stop
64	Dallas/Fort Worth	Love's
65	Dallas/Fort Worth	Midway Truck Stop
66	Dallas/Fort Worth	Lucky Lady Truck Stop
67	Dallas/Fort Worth	Love's #281
68	Dallas/Fort Worth	Drivers Travelmart
69	Dallas/Fort Worth	Pilot Travel Center #157
70	Dallas/Fort Worth	Pilot Travel Center #320
71	Dallas/Fort Worth	Big D Travel Center
72	Dallas/Fort Worth	Drivers Travelmart #412
73	Dallas/Fort Worth	Pilot Travel Center #206
74	Dallas/Fort Worth	Sunpower Travel Plaza
75	Dallas/Fort Worth	Flying J Travel Plaza
76	Dallas/Fort Worth	Williams Travel Center
77	Dallas/Fort Worth	Williams Travel Center
78	Dallas/Fort Worth	Dallas South Travel Center
79	Dallas/Fort Worth	Rip Griffins Center
80	Dallas/Fort Worth	Hitchin Post T/s = 251?
81	Dallas/Fort Worth	Denton Travel Center
82	Dallas/Fort Worth	Pilot Travel Center #433
83	Dallas/Fort Worth	Pilot Travel Center #434
84	Dallas/Fort Worth	Dallas Travel Center
85	Dallas/Fort Worth	Truck Shop
86	Dallas/Fort Worth	Love's #273
87	Dallas/Fort Worth	Mc Donald Fuel Stop
88	Dallas/Fort Worth	Mc Donald Fuel Stop
89	Dallas/Fort Worth	Knox Fuel Stop
90	Dallas/Fort Worth	W. Wheels Truck Stop

ID	Metropolitan Area	Truck Stop Name
91	Dallas/Fort Worth	Travel Centers of America
92	Dallas/Fort Worth	Lucky Lady Oil Co.
93	Dallas/Fort Worth	Knox Fuel Stop
94	Dallas/Fort Worth	Sunmart #170
95	Dallas/Fort Worth	Golden Express
96	Dallas/Fort Worth	AmeriNet
97	Dallas/Fort Worth	Knox Fuel Stop
98	Dallas/Fort Worth	Payless Fuel & Travel Ctr
99	Dallas/Fort Worth	Travel Centers of America
100	Dallas/Fort Worth	Decatur Texaco
101	Dallas/Fort Worth	Quick All Truck Stop
102	Dallas/Fort Worth	Travel Centers of America
103	Dallas/Fort Worth	Affi International
104	Dallas/Fort Worth	Drivers Travel Mart Diner #451
105	Dallas/Fort Worth	Drivers Travelmart
106	Dallas/Fort Worth	Like's Fast Shop
107	Dallas/Fort Worth	Petro
108	El Paso	R&R Food and Full
109	El Paso	Love's #256
110	El Paso	Love's Travel Stop #214
111	El Paso	Petro 2 #50
112	El Paso	Pilot Travel Center #209
113	El Paso	El Paso Truck Terminal Inc.
114	El Paso	Pilot Travel Center #435
115	El Paso	Chevron Truck Stop
116	El Paso	Williams Travel Center #338
117	El Paso	Plateau Truck Stop
118	El Paso	Petro
119	El Paso	El Paso Travel Plaza
120	El Paso	Flying J Travel Plaza
121	El Paso	Petro Stopping Center - Fuel Island
122	El Paso	Trucker's Village
123	El Paso	La Posta
125	Houston/Galveston	Normandy Truck Stop
126	Houston/Galveston	Fuel Mart
127	Houston/Galveston	Speedy Stop #15
128	Houston/Galveston	Mike’s Drive In Grocery
129	Houston/Galveston	Yellow Jacket Grocery
130	Houston/Galveston	Flagship Truckstop
131	Houston/Galveston	Texas Star Stop
132	Houston/Galveston	A-1 Truck Stop
133	Houston/Galveston	Conner’s Gas & Diesel
134	Houston/Galveston	Island Food Mart
135	Houston/Galveston	Midway Drive In
136	Houston/Galveston	Sunmart #136

ID	Metropolitan Area	Truck Stop Name
137	Houston/Galveston	Shopper’s Mart #5
138	Houston/Galveston	Cal-Mod Hempstead Truck Stop
139	Houston/Galveston	Conoco Fuel Center
140	Houston/Galveston	Short Stop Convenience
141	Houston/Galveston	Handi Plus #69
142	Houston/Galveston	786 Truck Stop
143	Houston/Galveston	Conoco Fuel Center
144	Houston/Galveston	Sunmart #361
145	Houston/Galveston	Texas Truck Stop
146	Houston/Galveston	Bingo Truck Stop
147	Houston/Galveston	Cobra Truck Stop
148	Houston/Galveston	Sunmart #128
149	Houston/Galveston	290 Express Way
150	Houston/Galveston	Drivers Travelmart
151	Houston/Galveston	Hilltop Country Store
152	Houston/Galveston	Quick & Easy #3
153	Houston/Galveston	Sunmart #131
154	Houston/Galveston	Welcome Center
155	Houston/Galveston	Baytown Citgo
156	Houston/Galveston	Kountry Mart
157	Houston/Galveston	Sunmart #308
158	Houston/Galveston	Sun Mart #400
159	Houston/Galveston	Keys Truck Stop
160	Houston/Galveston	Sunmart Truck Stop
161	Houston/Galveston	Gas Time Plaza
162	Houston/Galveston	Gateway Truck Plaza
163	Houston/Galveston	Pilot Travel Center # 234
164	Houston/Galveston	Sunmart #116
165	Houston/Galveston	Port Auto Truck Stop
166	Houston/Galveston	Sunmart #363
167	Houston/Galveston	Pilot Travel Center # 383
168	Houston/Galveston	Citgo Travel Center
169	Houston/Galveston	Houston West Travel Center
170	Houston/Galveston	Trucker Paradise
171	Houston/Galveston	Williams Express #3169
172	Houston/Galveston	Conoco Travel Center
173	Houston/Galveston	Flying J Travel Plaza
174	Houston/Galveston	Pilot (old Speedway)
175	Houston/Galveston	Petro Stopping Center #4
176	Houston/Galveston	Travel Centers of America
177	Houston/Galveston	Flying J Travel Plaza
178	Houston/Galveston	Pilot Travel Center # 086
179	Houston/Galveston	Love's Travel Stop #233
180	Houston/Galveston	International World Truck Stop
181	Houston/Galveston	Champion Travel Plaza

ID	Metropolitan Area	Truck Stop Name
182	Houston/Galveston	Horseshoe Truck Stop
183	Houston/Galveston	Love's #315
184	Houston/Galveston	Mobil
185	Houston/Galveston	Owens Truck Stop
186	Houston/Galveston	Super Food Mart
187	Houston/Galveston	Andy Shell
188	Houston/Galveston	Hempstead Truck Stop
189	Houston/Galveston	Single Tree #3
190	Houston/Galveston	Flag Truckstop
191	Houston/Galveston	USA Truck Stop
192	Houston/Galveston	Brookshire Conoco
193	Houston/Galveston	Houston West Travel Center = 169?
194	Houston/Galveston	Angels Conoco Truckstop
195	Houston/Galveston	Baytown Express
196	Killeen/Temple	Texas Star Station #166
197	Killeen/Temple	Ross Truck Stop
198	Killeen/Temple	Love's #232
199	Killeen/Temple	Doc's One Stop
200	Killeen/Temple	Sunpower Liberty Gas
201	Killeen/Temple	Ed's Truck Stop
202	Waco	K's Travel Ctr
203	Laredo	Pilot Travel Center # 377
204	Laredo	Gateway Truck Terminal Inc
205	Laredo	Love's Travel Stop #298
206	Lubbock	Rip Griffins
207	Lubbock	Rip Griffins Center
208	Lubbock	66 Truck & Auto Plaza
209	Lubbock	Bell Gas Co.
210	Lubbock	New Deal Travel Ctr
211	Lubbock	Racer Truck Wash & Lube
213	Lubbock	Town & Country Food Store
214	McAllen	Silver Spur Truck Stop
215	McAllen	Benavides Diesel & Gas
217	McAllen	Love's #284
218	McAllen	Travel Centers of America
219	McAllen	Uncle Sam's #30
220	McAllen	Combes Auto-Truck Stop, Inc.
221	Midland/Odessa	Town & Country #122
222	Midland/Odessa	Drivers Travel Mart #405
223	Midland/Odessa	McLain Truck Service
224	Midland/Odessa	Sunmart #112
225	Midland/Odessa	Sunmart #109
226	Midland/Odessa	Flying J Travel Plaza
227	San Angelo	Circle Bar 76 Auto/Truck Plaza
228	San Angelo	Comanche Springs Fuel Center

ID	Metropolitan Area	Truck Stop Name
229	San Antonio	Rock Bottom Fina
230	San Antonio	Pilot Travel Center #306
231	San Antonio	Love's #297
232	San Antonio	Petro
234	San Antonio	Segovia Truck Stop
235	San Antonio	Love's
236	San Antonio	Flying J Travel Plaza
237	San Antonio	AAA Travel Ctr
238	San Antonio	Sun Mart #167
239	San Antonio	Farmers Truck Stop
240	San Antonio	Love's #242
241	San Antonio	Shell #3055 (?)
242	San Antonio	Tex-Mart Svc Station
243	San Antonio	Travel Centers of America
244	San Antonio	Solms Truck Stop
245	San Antonio	Tex Best Travel Ctr Inc
246	San Antonio	Interstate Stop Mart
247	San Antonio	San Antonio Travel Ctr
248	San Antonio	Trainer Hale Truck Stop
249	San Antonio	Kwik Truck Stop
250	Sherman/Denison	Sherman Truck Stop
251	Sherman/Denison	Hitchin' Post Texaco Truck Stop
252	Sherman/Denison	
253	Texarkana	Total Fuel Stop # 2851
254	Texarkana	Total Fuel Stop # 2724
255	Texarkana	Total Fuel Stop # 2800
256	Texarkana	Total Fuel Stop # 2850
257	Texarkana	Domino Exxon Truck Stop
258	Texarkana	Love's #279
259	Texarkana	Gene's Truck Stop & Restaurant
260	Texarkana	Texas 192 Truck Terminal
261	Tyler/Longview	Total Fuel Stop # 2863
262	Tyler/Longview	Midway
263	Tyler/Longview	Mt. Vernon Fuel Center
264	Tyler/Longview	Love's #287
265	Tyler/Longview	Tyler Truckstop
266	Tyler/Longview	Mr D
267	Abilene	Rip Griffin
268	Tyler/Longview	Pittgrill Pit Stop
269	Tyler/Longview	Love's #290
270	Tyler/Longview	National Truck Stop
271	Tyler/Longview	Running W Truck Stop
272	Tyler/Longview	Nu Time Truck Stop
273	Tyler/Longview	Kelly's Korner
274	Tyler/Longview	Myers Jordan

ID	Metropolitan Area	Truck Stop Name
275	Tyler/Longview	Lindsey's Post Co
276	Victoria	
278	Waco	Pilot Travel Center #432
279	Waco	K's Travel Ctr = 202?
280	Waco	Carl's Corner Truck Stop
281	Waco	Knox Fuel Stop
282	Waco	Love's #231
283	Waco	Stars & Stripest
284	Waco	Love's #288
285	Waco	Sunmart Truck Stop
286	Waco	Flying J Travel Plaza
287	Wichita Falls	Friend's Travel Center #217
288	Wichita Falls	Jolly Truck Stop
289	Wichita Falls	Love's #269
291	Wichita Falls	Tei
292	Wichita Falls	Driver's Travelmart
293	Wichita Falls	Bowie Truck Stop
294	Wichita Falls	Bellevue Truck Stop
295	Wichita Falls	Derrick Truck Stop Inc
296	Victoria	Rip Griffin
298	San Antonio	Rip Griffin
299	Midland/Odessa	Rip Griffin
300	Killeen/Temple	Diamond Shamrock
301	Amarillo	Red Baron Truck Wash
302	Amarillo	Speedco #321
303	Houston/Galveston	Citgo Fuel Center
304	Houston/Galveston	Us Truxstop Exxon
305	Austin	Dorsett #221 = 29?
306	Waco	Sunmart #115
307	Houston/Galveston	Chrome & CB Shop of Houston
308	Dallas/Fort Worth	Speedco #320
309	Waco	Exxon (was Jet Era T/S)
310	Killeen/Temple	Cefco #47 Shell
311	El Paso	Petro = 111?
312	El Paso	Speedco #316
313	Austin	Flatonia Travel Center Shell
314	Houston/Galveston	Country Boys Truck Stop
315	Waco	Sunmart #169
316	Texarkana	Total #4509
317	Texarkana	Wilco Travel Stop Citgo
318	Houston/Galveston	Hitchin Post AMBEST (Texaco)
319	Austin	Tex Best #3 Conoco
320	Tyler/Longview	Pony Express Conoco
321	Midland/Odessa	Warfield Truck Terminal

ID	Metropolitan Area	Truck Stop Name
322	Houston/Galveston	Conoco Travel Plaza
323	Texarkana	Young's I 30 Chevron
324	Killeen/Temple	Wheels Petro Stop Exxon
325	Killeen/Temple	JD's 282 Diamond Sham Truck Stop
326	San Antonio	Speedco #318
327	San Antonio	Winfields Restaurant
328	Houston/Galveston	Knox Fuel Stop
329	Houston/Galveston	Sunmart 123 (Mobil) = 160?
330	San Antonio	Jud's Food & Fuel #5 Chevron
331	Amarillo	Longhorn Texaco T/S
332	Texarkana	Crossroads Travel Center
333	Houston/Galveston	Sunmart #111 Mobil = 160?
336	Amarillo	Speedco Truck Lube #321
337	San Antonio	Highway Travel Center
338	San Antonio	Brush Country Travel Stop
339	Amarillo	Express Lane #4 Mazzios
340	Dallas/Fort Worth	Knox Fuel Stop - Mm#410 = 63?
341	Dallas/Fort Worth	Speedco Truck Lube#320
342	Dallas/Fort Worth	Denton Travel Plaza = 99?
343	Amarillo	Express Lane #7 = 17?
345	El Paso	El Paso Travel Center
346	El Paso	Speedco Truck Lube #316
347	Laredo	Circle K/7 Eleven #52140
348	San Angelo	Johnny's Circle N Truck & Auto
349	Dallas/Fort Worth	Gainesville Truck Stop
350	Waco	RBD's Truck Stop
351	Houston/Galveston	290 Express Way -- Exxon
352	Houston/Galveston	Handi Plus Citgo #69
353	Tyler/Longview	Fastop Foods, Inc.
354	Tyler/Longview	Fifth Wheel of Texas
355	Texarkana	Fast Food #50
356	Tyler/Longview	Tucker Truck Stop
357	Dallas/Fort Worth	Knox Fuel Stop - Mm#258
358	San Antonio	Speedco Truck Lube #318
359	Houston/Galveston	Sealy Truck Stop
360	Killeen/Temple	CEFCO #48
361	Abilene	Wes-T-Go Truck Stop
362	Victoria	Big Vic Truck Stop = 276?
363	Dallas/Fort Worth	Truck & Travel
364	Amarillo	Amarillo 76 Truck Stop
365	Tyler/Longview	American Star Travel Plaza
366	Dallas/Fort Worth	Bar-B Travel Plaza
367	El Paso	Bill Keifer's Truck Stop

ID	Metropolitan Area	Truck Stop Name
368	Laredo	Cleo's Travel Center #1
369	Laredo	Cleo's Travel Center #3
370	Bryan-College Station	Crockett Farm & Fuel Center
371	San Antonio	Del Rio Truck Stop
372	Dallas/Fort Worth	Driver's Travelmart #63402
373	Corpus Christi	Economy #63404
374	Bryan-College Station	Evans Truck Terminal
375	Houston/Galveston	Fifty Nine Truckstop
376	Sherman/Denison	Five Star Food & Fuel Stop = 252?
377	Houston/Galveston	Harris County Oil
378	Texarkana	Hooks Truck Stop
379	Houston/Galveston	Hwy Truck Services
380	Midland/Odessa	K & W Border Cowboy Truck Stop
381	Dallas/Fort Worth	Knox Truck Wash
382	Tyler/Longview	Kwik Fuel
383	Amarillo	Landergin Truck Stop
384	Laredo	Leyendecker Oil
385	Tyler/Longview	Loop 281 Truck Stop
386	Texarkana	Love's #228
387	Texarkana	Mt. Vernon Fuel Center = 355?
388	Laredo	New Laredo Truck Stop
389	Tyler/Longview	Nu Way Food & Fuel #63409
390	Tyler/Longview	Pony Express Travel Center
391	Dallas/Fort Worth	Pride's Travel Stop
392	Dallas/Fort Worth	Racetrac
393	Houston/Galveston	Ronnie's Truck Stop
394	Midland/Odessa	Sandhills Border Cowboy
395	San Antonio	Savannah's Truck Stop
396	Houston/Galveston	Speedy Stop #15
397	Beaumont/Port Arthur	Spindletop Truck Stop
398	Corpus Christi	Sunmart #114
399	Houston/Galveston	Sunmart #150 =160?
400	Houston/Galveston	Sunmart #312 =160?
401	El Paso	Texas Red Express
402	Houston/Galveston	Texas Star Energy =167?
403	Dallas/Fort Worth	Total Fuel Stop # 2854
404	Dallas/Fort Worth	Total Fuel Stop # 2855
405	Dallas/Fort Worth	Total Fuel Stop # 2856
406	Dallas/Fort Worth	Total Fuel Stop # 2857
407	Dallas/Fort Worth	Total Fuel Stop # 2858
408	Tyler/Longview	Total Fuel Stop # 2865
409	Dallas/Fort Worth	Total Fuel Stop # 2875
410	Tyler/Longview	Total Fuel Stop # 2899
411	Midland/Odessa	Town & Country #122
412	Amarillo	Triangle Food & Fuel

ID	Metropolitan Area	Truck Stop Name
413	Waco	Triangle Petroleum Inc.
414	Texarkana	Triple J Truck Center
415	Abilene	Truck & Travel #1
416	El Paso	Truck & Travel #2
417	Dallas/Fort Worth	Love's #299
418	Amarillo	Midway Truck and Travel
419	McAllen	76 Truck Stop
420	Dallas/Fort Worth	Alvarado truck Stop
421	Wichita Falls	Alvord Truckstop
422	San Angelo	Berkly's Travel Center
423	Killeen/Temple	Bill's Exxon Truck Stop
424	Houston/Galveston	Bona Fide Steele Enterprises Inc.
425	Waco	Bond's Texaco Truck Center
426	San Antonio	Bubba's Truck Stop
427	Dallas/Fort Worth	Canton Travel plaza
428	Amarillo	Checkered Flag Convenience
429	Victoria	Circle G Truck Stop
430	Houston/Galveston	Conoco Travel Plaza
431	Beaumont/Port Arthur	Dandy Double 12
432	Corpus Christi	Economy No 2
433	Lubbock	Fast Stop - 10
434	Killeen/Temple	Fas-Start Markets
435	Corpus Christi	FFP Operating CO
436	Midland/Odessa	Circle N Food Store North
437	Dallas/Fort Worth	Classic design Group
438	Houston/Galveston	Clovis Diesel & Auto Repair
439	San Antonio	Country Junction Chevron & Meat Market
440	Wichita Falls	Crossroads Tire Service
441	Lubbock	Hughes Bill Service Center
442	Amarillo	Iron Skillet
443	Austin	Loftin Trucking Shop
444	San Antonio	Gene's Go Truck Stop
445	Tyler/Longview	Grave's Truck Stop-Bagher
446	San Antonio	Highway Travel Center
447	Waco	I-45 Shell Truck Stop
448	Texarkana	Interstate Fuel
449	Waco	Itasca 8 Travel Center
450	Amarillo	J D Service Center
451	Waco	Jet Truck Stop Travel
452	Abilene	Plaza Truck Stop
453	McAllen	Rex Motel
454	Amarillo	Riverview Convenience Store & Fuel Stop
455	Laredo	Royal Mart
456	Waco	Smartstop
457	Houston/Galveston	Star Jet Truck Stop

ID	Metropolitan Area	Truck Stop Name
458	Texarkana	Triple C Truck Stop
459	Tyler/Longview	Trudy's Nu-Way Restaurant & Truck Stop
460	Corpus Christi	Uncle Sam's No 49
461	Beaumont/Port Arthur	Highway 190-Fuel Stop
462	Wichita Falls	Jordan's Truck Stop and Tire Shop

Data Collection Schedule by Area
Data Collector 1 –

Week 1	Day	Sites	Miles	Time	Date
Travel to Texarkana	1		260	5:11	28-Jun
Texarkana	2	5			29-Jun
Texarkana	3	3			30-Jun
Texarkana to Tyler	3		134	2:33	30-Jun
Tyler/Longview	4	5			1-Jul
Tyler/Longview	5	3			2-Jul
Return	5		248	4:50	2-Jul
Week 2					
Travel to Dallas	1		379	6:30	5-Jul
Dallas	2	5			6-Jul
Dallas	3	5			7-Jul
Dallas	4	5			8-Jul
Return	5		379	6:30	9-Jul
Week 3					
Travel to El Paso	1	2			12-Jul
El Paso	2	5			13-Jul
El Paso	3	5			14-Jul
El Paso	4	5			15-Jul
Return	5	1			16-Jul

Data Collector 2 –

Week 1	Day	Sites	Miles	Time	Date
Austin to Laredo	1	1	236	3:50	28-Jun
Laredo to McAllen	1		144	3:03	28-Jun
McAllen	2	2			29-Jun
McAllen to Corpus	2		160	3:30	29-Jun
Corpus	3	4			30-Jun
Corpus to Victoria	3		100	2:01	30-Jun
Victoria to Austin	4	2	123	2:34	1-Jul
Compiling Data in Office	5				2-Jul
Week 2					
Austin to Dallas	1		195	3:12	5-Jul
Dallas	2	5			6-Jul
Dallas	3	5			7-Jul
Dallas to Wichita Falls	3		141	2:36	7-Jul
Wichita Falls	4	3			8-Jul
Wichita Falls to Austin	5		303	5:13	9-Jul
Week 3					
Austin to San Angelo	1	3	226	4:36	12-Jul
San Angelo to Midland	2	3	151	2:51	13-Jul
Midland	3	5			14-Jul
Midland to Austin	4	2	356	7:11	15-Jul
Compiling Data in Office	5				16-Jul
Week 4					
Austin to Houston	1	4	164	3:27	19-Jul
Houston	2	5			20-Jul
Houston	3	5			21-Jul
Houston	4	5			22-Jul
Houston to Austin	5	4	164	3:27	23-Jul

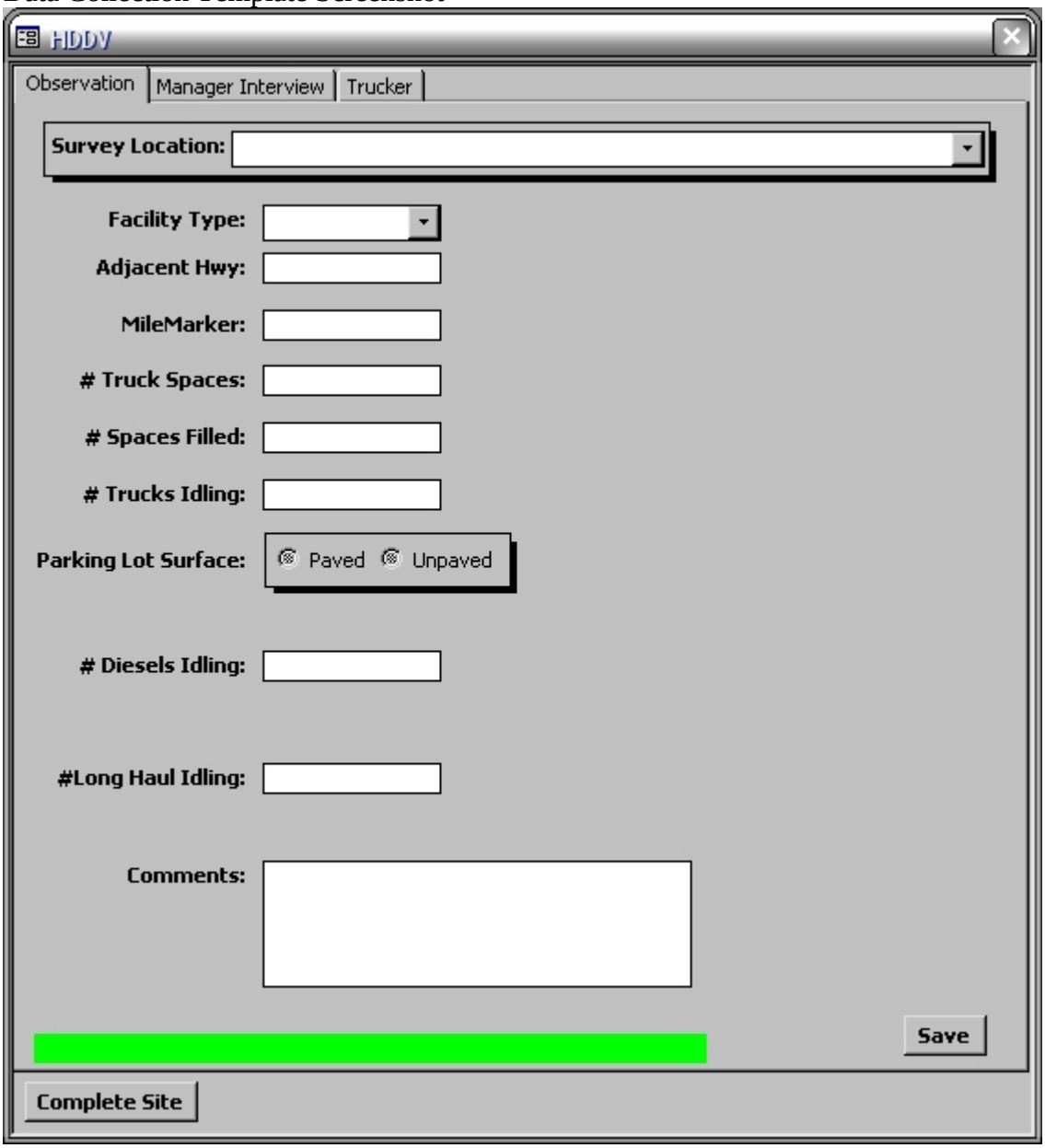
Data Collector 3 –

Week 1	Day	Sites	Miles	Time	Date
Austin	1	5			28-Jun
Austin	2	1			29-Jun
Austin to Killeen	2		67	1:08	29-Jun
Killeen/Temple	2	2	67	1:08	29-Jun
Austin to Waco	3		101	1:41	30-Jun
Waco	3	2	101	1:41	30-Jun
Austin to San Antonio	4	3	240	3:00	1-Jul
Week 2					
Austin to San Antonio	2	4	240	3:00	6-Jul
Austin to San Antonio	3	4	240	3:00	7-Jul
Austin to San Antonio	4	3	240	3:00	8-Jul
Austin to B/CS	5	1	250	4:30	9-Jul

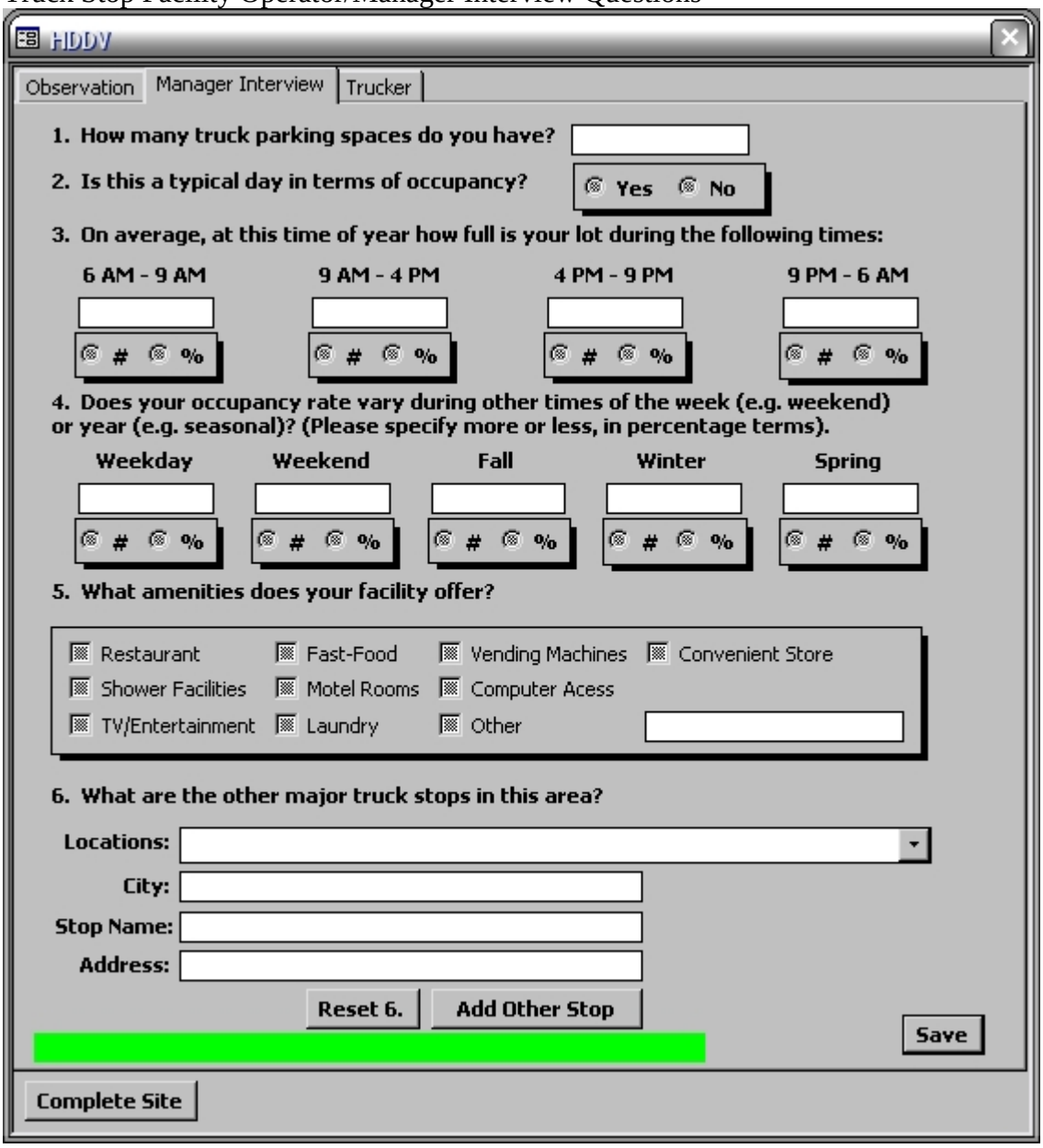
Data Collector 4 –

Week 1	Day	Sites	Miles	Time	Date
Austin to Lubbock	1		498	8:24	28-Jun
Lubbock	2	3			29-Jun
Lubbock to Amarillo	2		122	2:05	29-Jun
Amarillo	3	5			30-Jun
Amarillo	4	6			1-Jul
Amarillo to Austin	5		526	9:31	2-Jul
Week 2					
Austin to Dallas	1		195	3:12	5-Jul
Dallas	2	5			6-Jul
Dallas	3	5			7-Jul
Dallas	4	5			8-Jul
Dallas to Austin	5	5	195	3:12	9-Jul
Week 3					
Austin to Abilene	1	3	238	4:45	12-Jul
Abilene	2	5			13-Jul
Abilene to Houston	3		419	6:41	14-Jul
Houston	4	5			15-Jul
Houston to Austin	5	5	164	3:27	16-Jul
Week 4					
Austin to Houston	1	4	164	3:27	19-Jul
Houston	2	5			20-Jul
Houston	3	5			21-Jul
Houston	4	5			22-Jul
Houston to Austin	5	4	164	3:27	23-Jul

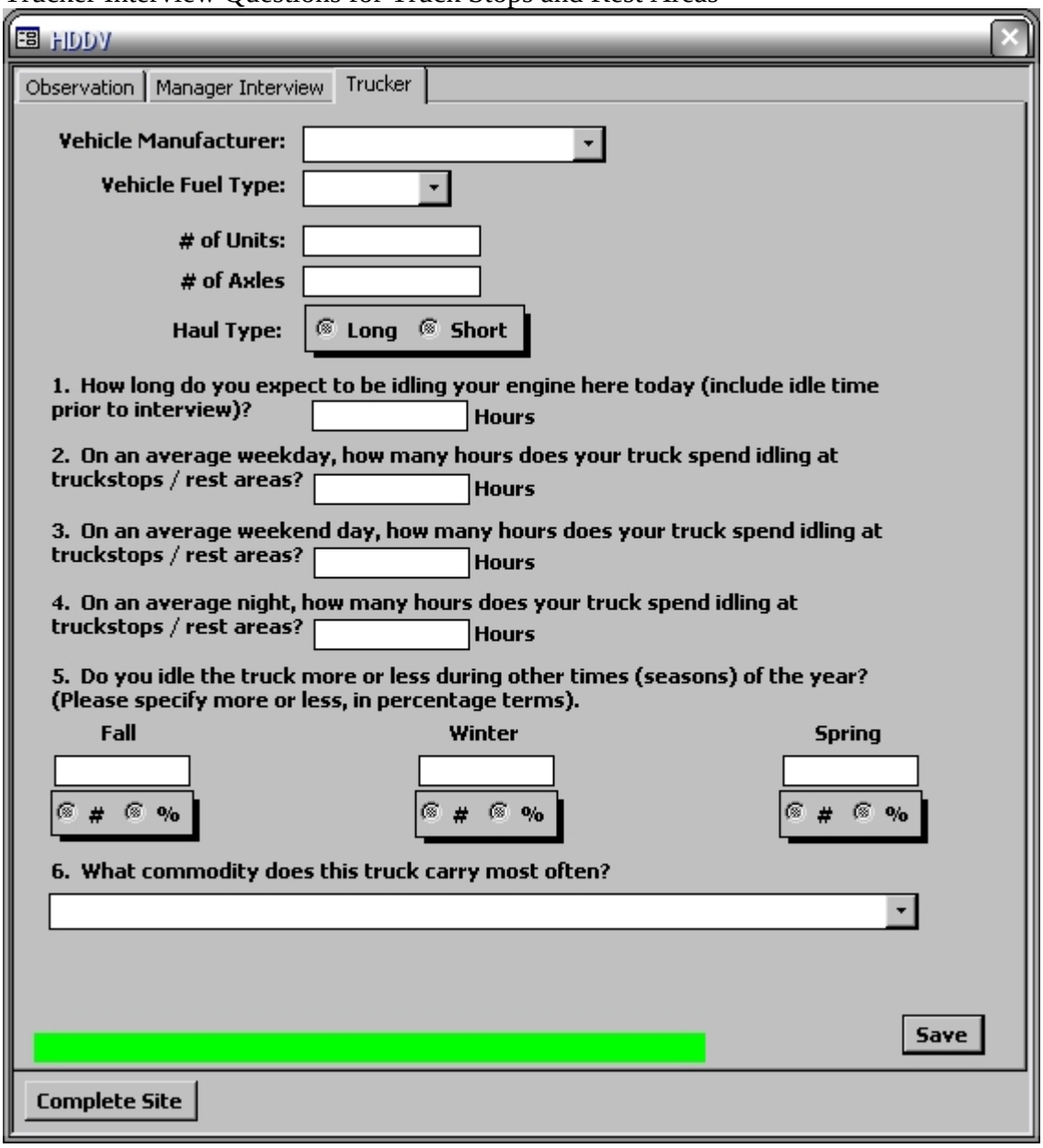
Data Collection Template Screenshot



Truck Stop Facility Operator/Manager Interview Questions



Trucker Interview Questions for Truck Stops and Rest Areas



Appendix B
Data Collection Plan for Intermodal Facilities

Heavy-Duty Idling Activity Characterization and Emissions Inventory Study

Draft Sampling Plan for Marine Ports, Airports and Intermodal Rail Yards

Overview

This sampling plan covers the surveying of idling activity of heavy-duty diesel vehicles at marine ports, airports and intermodal rail yards. The goal is to obtain information that allows for the development of temporal and spatial profiles of truck idling throughout the state and to include vehicle information sufficient for emissions estimation. The main objective of the sampling plan is to balance the data collection over spatial and temporal characteristics while remaining within the time and budget allowances for the project.

Universe of Marine Ports, Airports and Intermodal Rail Yards

Marine Ports

The location of marine ports in Texas was compiled through combining port information from the Texas Port Association, the Business & Industry Data Center, and the TTI report on HDDV Idling Activity and Emissions. The final list includes the following 16 ports:

- Port of Beaumont
- Port of Brownsville
- Port of Corpus Christi
- Port of Freeport
- Port of Galveston
- Port of Houston
- Port of Port Arthur
- Port of Texas City
-

Airports

Texas has 388 airports, second in the nation to Alaska18. However, the vast majority of these airports are for passenger service only. Truck is likely to occur only at major airports during one of three activities: 1) loading or unloading of air cargo, 2) loading or unloading supplies for the airplane, including fuel, and 3) deliveries and pickups due to airport operations. The latter two activities are done with a mix of gas and diesel powered vehicles, but most of the trucks are likely to be light and medium trucks. Only the loading or unloading of air cargo is done using heavy-duty diesel vehicles. Therefore, this study restricts its focus to airports with significant air cargo activities. This includes airports where air cargo is carried in the belly of passenger airplanes, air cargo carried by dedicated freighters and air cargo delivered by parcel delivery companies.

[18] http://www.airnav.com/airports/us/TX, July 1, 2004

The most comprehensive and current list or air cargo facilities found during this internet search was on the website of Air Cargo World at the following IP address: http://www.aircargoworld.com/directories/2004_ad/tx.htm

This website includes the following information for each of the air cargo airports in the state: number of carriers at the airport, number of all-cargo carriers, cargo space, special services/facilities available (e.g. HAZMAT, refrigeration), number of freight forwarders serving the airport, tonnage moved in 2002, aircraft moved in 2002, and planned new cargo space (near-term)

This website provided eight major air cargo facilities for Texas including:

- Alliance Airport – Fort Worth
- Austin-Bergstrom International Airport – Austin
- Brownsville/South Padre Island International Airport - Brownsville
- Dallas/Fort Worth International Airport – Dallas
- El Paso International Airport – El Paso
- George Bush Intercontinental Airport – Houston
- San Antonio International Airport – San Antonio
- Valley International Airport - Harlingen

Intermodal rail yards

The major intermodal facilities were identified through searching the websites of the three major railroads in Texas: the Burlington Northern Santa Fe (BNSF), the Union Pacific (UP), and the Kansas City Southern (KCS). These searches provided 14 major intermodal rail yards as shown in Table 1.

Table 1 – List of Major Intermodal Yards in Texas

Location of Facility	Owner
Fort Worth (Haslet)	BNSF
Houston (Englewood)	UP
Dallas	UP
Houston (Brisbane Road)	BNSF
Dallas	UP
Houston (Kirkpatric Blvd)	UP
Dallas	KCS
Laredo	UP
Amarillo	BNSF
San Antonio	UP
San Antonio	UP
Houston (Barbour's Cut)	BNSF/UP
El Paso	BNSF
McAllen	UP

Balancing Temporal and Spatial Coverage

Similar to the data collection for truckstops and rest areas, there are not enough project resources to collect firsthand data at each of the intermodal locations in the state for each of the desired time periods. This sampling plan was developed to incorporate sufficient temporal and spatial coverage of Texas to allow accurate emissions estimates to be generated at the hourly, daily, and annual levels. The spatial coverage includes collecting data in each geographic region in the state where major intermodal activity occurs. The temporal coverage includes collecting data throughout the day, for weekends and weekdays, and for different seasons in the year. Due to the resource constraints of this project much of the temporal variability will be estimated based on interviews with freight facility operators. Specific guidance on how temporal and spatial coverage is incorporated into the data collection plan is provided in the following sections.

Geographic Coverage

It is unlikely that geographic features would impact the amount of idling at the intermodal locations. However, geographic coverage will be ensured by collecting data in every relevant region of the state for ports, airports and intermodal rail yards. This geographic coverage will be superceded in terms of priority by the need to collect data at the most active intermodal facilities in the state, and the need to efficiently utilize the project resources. Therefore, the focus of this data collection effort will be on the areas with large intermodal traffic levels: Houston and Dallas/Fort Worth.

Time-of-day variability

Most marine ports and intermodal yards have regular daytime, weekday operating hours. Therefore, the bulk of the data collection for these intermodal locations will be during these periods. Available resources will allow for short duration data collection during off-peak hours to confirm the relatively low levels of truck activity.

Because a large amount of air cargo travels in the belly of airplanes, the daytime peak period for air cargo is similar to the peak period for passengers. Data on truck idling will be collected at the two major airports in the state, Bush Intercontinental and Dallas, during this peak period. However, there is a significant amount of air cargo activity in the evening and nighttime periods, particularly for dedicated air freighters and air cargo related to parcel delivery at major airports (e.g. UPS and FedEx). Truck idling during off-peak hours will be estimated based on overall air cargo activity during these periods. Time-of-day variability in air cargo levels will be gathered from airport historical records including scheduled flight service.

Day-of-week variability

For marine ports and intermodal rail yards, minimal activity occurs on the weekends. Interviews with the facility operators at each of these intermodal locations will be used to determine the variability based on the day of the week. Air cargo activity is more

prevalent on the weekends than port and rail activity. Interviews with airport air cargo operators will be used to determine fluctuations throughout the week.

Seasonal Variability

For major ports and airports, freight activity is tracked with enough precision to generate month-by-month profiles of freight activity. Much of these data are available on the port websites. For other major facilities, interviews with the operators will be used to attempt to obtain seasonal data. If no formal set of data are available from the facility, then interviews will generate seasonal data based on historical knowledge available from the interviewee. The seasonal characteristics from the larger ports and airports will be used to develop seasonal profiles for the smaller ports and airports.

Seasonal data at intermodal rail yards may or may not exist depending on the operational characteristics of each yard. However, because most intermodal yards are operated by a single company with headquarters and data processing occurring far away from the facility, the seasonal data could potentially be difficult to collect. For these cases, interviews with yard operators will be used to determine the extent of seasonal variation in freight activity.

Selection of Marine Ports

Data collection from marine ports will be prioritized based on a combination of freight activity at the port and TTI's initial estimates of trucks per day and NOx emissions. As shown in Table 2 below, there are six marine ports in the state that have over 20 million tons per year. There is a sharp drop-off to 9.6 million tons for the seventh largest port in the state. The Port of Houston will be visited for one day during the first shift to generate a firsthand estimate of the number of trucks per day and the average amount of idling per truck. The firsthand data collection is important because the truck estimates based on the TTI phone interviews appear to be lower than what would be expected for the volumes of tonnage moved at the ports in Texas. As an example, information from a separate Cambridge Systematics project in Texas has confirmed that there are actually hundreds of trucks that use the Port of Texas City. Truck estimates from the other ports will be based on a combination of factoring based on the ton/truck ratios found in Houston and interviews from Sam Wells who has access to key staff and data at the Ports of Houston and Beaumont.

Table 2 – Tonnage, Truck and Emissions Estimates at Major Texas Ports

Port	Area	Millions of Tons (2002)[19]	TTI Estimate of Trucks Per Day	TTI Estimate (tpd)
Houston	Houston Area	115.2	3,100	0.246
Beaumont	BPA	85.9	45	0.009
Corpus Christi	Corpus Christi	72.0	200	0.016
Texas City	Houston Area	55.2	0	0.000
Freeport	Houston Area	27.2	150	0.000
Port Arthur	BPA	22.7	65	0.013
Galveston	Houston Area	9.1	60	0.005
Brownsville	Brownsville	4.7	70	0.000

Selection of Airports

Of the 17 commercial airports, only two carried more than 200,000 tons in air cargo in 2003[20.] DFW carried 668,000 tons and Houston carried 384,000 tons. Based on resource constraints of this project, these two airports will be the sole locations for firsthand data collection of idling related to air cargo activity. Truck idling at other airports will be estimated based on the amount of air cargo activity.

Selection of Intermodal Rail Yards

Intermodal rail yards are owned and operated by private railroads. Therefore, data on freight activity at the intermodal rail yards are not easily available. The only available information indicating freight volumes at each of the rail yards come from the TTI report. However, the TTI estimates of truck visits per day are based on phone surveys of intermodal rail yard operators rather than firsthand data collection. These estimates are shown in the table below and will be used as the first cut in prioritizing rail yards to collect data.

Table 3 – Intermodal Rail Yards in Texas

Location of Facility	Owner	Truck Visits per day
Fort Worth (Haslet)	BNSF	1,000
Houston (Englewood)	UP	1,000
Dallas	UP	950
Houston (Brisbane Road)	BNSF	800
Dallas	UP	750
Houston (Kirkpatric Blvd)	UP	700
Dallas	KCS	500
Laredo	UP	500
Amarillo	BNSF	500
San Antonio	UP	350
San Antonio	UP	250
Houston (Barbour's Cut)	BNSF/UP	250
El Paso	BNSF	50
McAllen	UP	10

Source: Texas Transportation Institute, Heavy-Duty Diesel Vehicle (HDDV) Idling Activity and Emissions Study: Phase 1

[19] American Association of Port Authorities
[20] Airports Council International

Data Collection Process

Before deployment, survey templates and interview guides will be established for surveys. Because there are limited locations included in each of these studies, the data collection subcontractor will have the option of collecting the data onto hard copy forms or electronic format.

Generally, data collection will follow a two-step process. First, data will be collected to allow for the estimation of the number of trucks using the facility per day. Then, data will be collected to determine the amount of idling per truck that occurs.

Ports

To develop estimates of the number of trucks at the ports, firsthand surveys will be used that count the number of trucks entering and exiting the port facility. Each entry will be time stamped to determine the average occupancy of the port throughout the day. This truck count data collection will be conducted during the first shift at the Port which is generally 9 a.m. to 4 p.m. Interspersed throughout the day, the percentage of trucks that are idling will also be estimated based on visual observation of the data collector. Depending on the port layout, this may be possible for only one terminal at a time rather than for the entire port.

Day-of-week variability will be collected based on interviews with the port authorities. Seasonal variability will be collected based on historical data recorded by each port.

Airports

Airports operate throughout the day with a significant portion of dedicated air cargo airplanes landing and arriving in the evening and late hours. Therefore, 24-hour profiles of truck and idling activity must be developed for each airport. This will be accomplished by collecting firsthand data of truck volumes in and out of the state's two large air cargo airports during the peak period in the daytime. These data will be supplemented with snapshots of the percent of trucks idling in the air cargo facility.

Interviews with airport operators will be used to determine the day-of-week variability. Historical data on air cargo activity will be used to determine the seasonal variability. Interviews with airport operators will also be used to determine air cargo and idling activity at the other commercial airports in the state.

Intermodal Rail Yards

There are several intermodal rail yards in Texas with relatively high volumes of freight. To estimate the number of trucks using the facilities, firsthand data will be collected from one of the major facilities of each of the major railroads in the state (UP, BNSF and KCS). Rail operations are 24 hours, but the peak freight rail activity occurs during the daytime hours. Therefore the data collection at each site will focus on the peak-period

activity. Truck counts will be taken during the peak period. Interspersed with the truck count data collection, there will be snapshots taken of the percent of trucks inside the facility that are idling.

The facility operator at each of these three facilities will also be interviewed to determine the number of trucks that use the other company's intermodal rail yards in the state. Interviews with facility operators will also be used to estimate day-of-week and seasonal variations.

Final Data Collection Plan

The resources allocated for this project allow for roughly 10 days of onsite data collection. This must be divided between the three facility types (ports, intermodal rail yards and airports) and 14 metropolitan areas. We propose the ten days be split between cities and facility types as shown in Table 4. Six of the ten data collection sites are at marine ports. This is because the ocean carrier-to-truck modal type dwarfs the other intermodal moves in the state. The Bureau of Transportation Statistics Commodity Flow Survey estimated that for the state of Texas in 1997 shipments by water were 95.2 million tons much larger than the 4.1 million tons shipped by intermodal rail and the 0.2 million tons shipped by air. Even with a large percentage of the water shipments having rail as a second mode, the ocean carrier-to-truck modal type is dominant over the other two modes. The onsite data collection will occur between Tuesday and Thursday. Temporal variability will be estimated based on phone interviews.

Table 4 – Onsite Data Location by Facility Type and City

Facility Type	Houston area	Dallas	Total
Marine Ports	6	0	6
Intermodal Rail yards	1	1	2
Airports	1	1	2
Total	8	2	10

Marine Ports

Within the marine mode, the Houston area is the location of the vast majority of port activity in the state. The six days of onsite data collection will be focused on the Port of Houston. However, there are over 200 terminals at this port meaning that firsthand data collection at each location will not be possible. Instead, we will seek out the six most congested terminals with the assistance of staff at the Port of Houston and collect data at these locations.

Idling can potentially occur during three periods of time: 1) entering a marine terminal, 2) loading/unloading goods, and 3) exiting a marine terminal. Prior experience at the port indicates that extended idling activity (defined by the EPA as 15 minutes of idling or more) is most likely to occur at the entry gates to the terminal. Therefore, the data collection will be focused at six entry gates for the Port of Houston.

The data collection will be used to count the number of trucks entering the gate and develop correlations between queue length and wait time for entering trucks. This data collection process should start roughly two hours before the gates open since queues start developing during this time. The arrival pattern including hour and minute of truck arrival should be recorded. When the gates open, the truck at the end of the queue will be noted along with the number of trucks that are queued. The time for the noted truck to complete processing for entry will be recorded. After it has been recorded, the truck at the end of the new queue will be noted, and the process repeated. This process will occur throughout the day to develop a full day of arrival patterns, queue lengths and wait time for the gate.

Data from the Port of Houston will be used to develop generalized profiles of each of the terminals including estimates of overall tonnage moved, commodities carried, and percent of goods moved by truck. Operators at a selection of these terminals will also be contacted to inquire about average truck wait times for entry, exit and loading/unloading and weekend vs. weekday fluctuations in truck idling. Information collected from these phone interviews will be combined with the onsite data collection and expanded to the larger population of terminals at the Port of Houston. Monthly data available from the Port will be used to develop seasonal profiles of truck idling.

Phone interviews will also be conducted at the other ports in the state to determine the levels of extended truck idling at these locations.

Intermodal Railyards

The Houston and Dallas metropolitan areas are the primary locations for intermodal rail yard activity. The top seven yards in terms of truck volumes are in these two regions, and eight of the 14 total are in either the Houston or Dallas areas. Therefore, these two regions will be the focus of the onsite data collection for this facility type. There are four intermodal rail yards in the Houston area, and four in the Dallas area. Data collection will occur for one day in each city. The intermodal yards in these facilities are owned and operated by the Union Pacific Railroad and the Burlington Northern Santa Fe Railroad. Staff at these railroads will be contacted to arrange for site visits.

The data collector will visit 2-3 yards in each city recording the wait time associated with trucks while they are loading and unloading. It is hypothesized that there is minimal idling entering and exiting the gates of the intermodal rail yards, but this will also be confirmed through visual observation at each site. Phone interviews will be conducted to determine stated estimates of average idling time at each yard and temporal variations in this idling activity. The stated data at each yard combined with the observed data in Houston and Dallas will be used to develop estimates of idling time for all intermodal rail yards in the state.

There are not enough project resources to collect firsthand truck count data at each rail yard. The number of trucks in and out of each of the intermodal rail yards will be estimated based on three sources: 1) the Rail Intermodal Terminal Directory, 2) interviews of key staff at the railroads and 3) estimates provided by TTI. The interviews

of railroad staff will include collecting information on temporal variation of truck counts and average idling time.

Airports

The international airports in Dallas and Houston are the largest air cargo facilities in the state. Onsite data collection will occur at both of these facilities. Staff at each of these airports will be contacted to coordinate site visits. The onsite data collection will include a half day of truck counts in and out of the airports, and a half day of visual observation of time spent idling. For each truck recorded, the data collector will attempt to determine the classification of the vehicle both in terms of gross vehicle weight rating and fuel type. Number of axles, body type, vehicle length and exhaust type will be the recorded for each vehicle to assist with this determination. Phone interviews will occur at each of the air cargo airports in the state to determine the total number of trucks per day and the amount of temporal variability in truck activity at the airport.

Example of Data Collection Template for Marine Ports

The template below represents the field data that will be collected at marine ports in Houston. Additional data collected in the field includes observations about number of ships that are docked at the terminal, size and configuration of the terminal, and space allotted for truck queuing. The field data will be used as surrogates for wait time under select operating conditions at the port. These data will be expanded using data on variability of conditions at the terminals (e.g. arrival patterns of ships and gate hours) to develop estimates of idling throughout the annual cycle.

Arrival Pattern

Truck	Time of Arrival to Gate
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Queue Length

Observation Time	Number of Trucks in Queue
7:00 AM	
7:30 AM	
8:00 AM	
8:30 AM	
9:00 AM	
9:30 AM	
10:00 AM	
10:30 AM	
11:00 AM	
11:30 AM	
12:00 PM	
12:30 PM	
1:00 PM	
1:30 PM	
2:00 PM	
2:30 PM	

Time through Queue

Obs. No.	Time at back of queue	Time after processing
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Arrival Pattern

Truck	Time of Arrival to Gate
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	

Queue Length

Observation Time	Number of Trucks in Queue
3:00 PM	
3:30 PM	
4:00 PM	
4:30 PM	
5:00 PM	

Time through Queue

Obs. No.	Time at back of queue	Time after processing
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		

Data Collection Template for Intermodal Rail Yards

Observation No.	Arrival time at loading/ unloading location (hour and minute)	Departure time at loading/unloading location (hour and minute)
1		
2		
3		
4		
5		
6		
7		
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Example of Data Collection Template for Airports

Arrival Pattern

Truck	Time of Arrival to Gate (hour and minute)
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Loading/Unloading Time

Observation No.	Arrival time at loading/unloading location (hour and minute)	Departure time at loading/unloading location (hour and minute)
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Appendix C
Master Truck Stop List (9/10/04)

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
658	Abilene	Eastland	Cisco	Texas Express #10	No	25
1	Abilene	Eastland	Eastland	Red Star Truck Terminal	No	89
5	Abilene	Eastland	Ranger	Love's #270	Yes	38
707	Abilene	Jones	Stamford	Super 7 Convenience Store	No	12
4088	Abilene	Nolan	Roscoe	Plowboy Fuel Stop	No	87
415	Abilene	Nolan	Roscoe	Truck & Travel #1	Yes	30
2	Abilene	Nolan	Sweetwater	Sweetwater 76 Auto/Truck Stop	No	179
26	Abilene	Nolan	Sweetwater	Travel Centers of America	Yes	35
452	Abilene	Scurry	Snyder	Plaza Truck Stop (Sisters)	Yes	45
267	Abilene	Scurry	Snyder	Rip Griffin	No	75
702	Abilene	Taylor	Abilene	Skinny's # 77	No	12
6	Abilene	Taylor	Merkel	Big Country Truck Stop	Yes	75
3	Abilene	Taylor	Tye	Flying J Travel Plaza #64	Yes	160
4	Abilene	Taylor	Tye	Top 18	Yes	20
361	Abilene	Taylor	Tye	West-T-Go Truck Stop	Yes	150
752	Amarillo	Armstrong	Claude	Ballard Texaco	No	5
710	Amarillo	Armstrong	Claude	Taylor Petroleum # 30	No	10
10	Amarillo	Carson	Panhandle	Love's #229	Yes	24
618	Amarillo	Dallam	Dalhart	Conoco Plaza	No	50
712	Amarillo	Dallam	Dalhart	Conoco Plaza	No	10
339	Amarillo	Dallam	Dalhart	Express Lane #4 Mazzios	No	9
655	Amarillo	Dallam	Dalhart	Taylor Petroleum # 15	No	29
647	Amarillo	Deaf Smith	Hereford	Town & Country #211	No	30
653	Amarillo	Gray	Pampa	Taylor Petroleum # 35	No	30
722	Amarillo	Hale	Plainview	Friend's #406	No	10
428	Amarillo	Hall	Memphis	Checkered Flag Convenience	No	15
751	Amarillo	Hemphill	Canadian	Ampride	No	5
692	Amarillo	Hemphill	Canadian	Oasis Truck Stop	No	15
454	Amarillo	Hutchinson	Borger	Riverview Convenience Store & Fuel Stop	No	10
17	Amarillo	Moore	Dumas	Express Lane	Yes	49
4063	Amarillo	Moore	Dumas	Frontier Fuel Dumas Short Stop	No	9
694	Amarillo	Ochiltree	Perryton	Ampride	No	15
663	Amarillo	Ochiltree	Perryton	Imo's Country Store #3	No	25
4157	Amarillo	Ochiltree	Perryton	Waterhole 83	No	67
4032	Amarillo	Oldham	Vega	Allsup's Convenience Store	No	4
4137	Amarillo	Oldham	Vega	Texas Quick Stop	No	22
742	Amarillo	Parmer	Friona	Fast Stop Truck Wash	No	6
669	Amarillo	Potter	Amarillo	Fifth Wheel Truck Stop	No	20
19	Amarillo	Potter	Amarillo	Flying J Travel Plaza	Yes	160
7	Amarillo	Potter	Amarillo	Love's #200	Yes	40
15	Amarillo	Potter	Amarillo	Petro #7	Yes	300
13	Amarillo	Potter	Amarillo	Pilot Travel Center #436	Yes	90
14	Amarillo	Potter	Amarillo	Pro Am III Truck Stop	Yes	72
21	Amarillo	Potter	Amarillo	Texaco Auto & Truck Plaza	Yes	55
23	Amarillo	Potter	Amarillo	Travel Centers of America	Yes	204
8	Amarillo	Randall	Amarillo	Love's #261	Yes	12
9	Amarillo	Randall	Amarillo	Love's Store #250	Yes	22
11	Amarillo	Swisher	Tulia	Rip Griffin's Travel Center	No	80
331	Amarillo	Wheeler	Shamrock	Cantrell Longhorn Texaco T/S	Yes	80
729	Amarillo	Wheeler	Shamrock	Joe's Irish Service Center	No	10
418	Amarillo	Wheeler	Shamrock	Midway Truck and Travel	Yes	83

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
629	Amarillo	Wheeler	Shamrock	T&M Truck Stop	No	50
4080	Austin	Bastrop	McDade	M-N-J Grocery	No	9
27	Austin	Caldwell	Luling	Love's #264	Yes	10
791	Austin	Fayette	Flatonia	C.M.S.I #1214	No	9
313	Austin	Fayette	Flatonia	Flatonia Travel Center Shell	Yes	21
714	Austin	Fayette	Flatonia	Joel's Conoco	No	10
28	Austin	Fayette	Flatonia	Stockmans Travel Center	Yes	15
29	Austin	Hays	Buda	221 Truck Stop	Yes	105
3001	Austin	Hays	Buda	Tex Best	Yes	13
25	Austin	Hays	San Marcos	San Marcos Truck Stop Texaco	Yes	30
756	Austin	Lee	Giddings	Wilbert's Tire Center	No	5
682	Austin	Travis	Pflugerville	Circle K Truxtop #3286	No	20
24	Austin	Williamson	Georgetown	Sunmart #168	Yes	10
709	Beaumont/ Port Arthur	Jasper	Buna	Coastal Mart # 3	No	10
461	Beaumont/ Port Arthur	Jasper	Jasper	Highway 190-Fuel Stop	No	15
32	Beaumont/ Port Arthur	Jefferson	Beaumont	Petro Stopping	Yes	168
36	Beaumont/ Port Arthur	Newton	Bon Wier	Three Flags Truck Stop	No	13
31	Beaumont/ Port Arthur	Orange	Orange	Flying J Travel Plaza	Yes	150
30	Beaumont/ Port Arthur	Orange	Orange	Pilot Travel Center #431	Yes	115
1013	Beaumont/ Port Arthur	Orange	Orange	TxDOT Rest Area	Yes	30
748	Beaumont/ Port Arthur	Orange	Vidor	E-Z Mart	No	5
397	Beaumont/ Port Arthur	Orange	Vidor	Spindletop Truck Stop	Yes	55
691	Bryan-College Station	Brazos	Bryan	Circle K Truxtop #3351	No	15
434	Bryan-College Station	Brazos	Bryan	Fas-Start Markets	Yes	25
413	Bryan-College Station	Leon	Buffalo	Buffalo Truck Stop	Yes	33
649	Bryan-College Station	Madison	Madisonville	I-45 Truck Stop	No	30
662	Bryan-College Station	Madison	Madisonville	K-D Timmons	No	25
613	Bryan-College Station	Milam	Cameron	Hilltop Food Mart	No	60
680	Bryan-College Station	Milam	Milano	Milano Truck Plaza	No	20
753	Bryan-College Station	Polk	Corrigan	Dandy Double # 9	No	5
711	Bryan-College Station	Polk	Corrigan	Hughes Truck Stop	No	10
750	Bryan-College Station	Washington	Brenham	Jud's Food & Fuel	No	5
639	Bryan-College Station	Washington	Brenham	Petticoat Junction Truck Stop	No	30
2005	Corpus Christi	Jim Wells	Alice	El Tigre	Yes	25
770	Corpus Christi	Jim Wells	Alice	Times Market #299 (Economy #2)	No	25
602	Corpus Christi	Kleberg	Kingsville	Get & Go # 37	No	120
743	Corpus Christi	Live Oak	George West	Best Fuel Stop #2	No	6
676	Corpus Christi	Live Oak	George West	Circle K Truxtop #2157	No	20
460	Corpus Christi	Live Oak	George West	Uncle Sam's No 49	No	75
41	Corpus Christi	Live Oak	Three Rivers	Wolffs Travel Stop & Café	Yes	25
40	Corpus Christi	Nueces	Corpus Christi	Corpus Christi Truck Stop	Yes	35
43	Corpus Christi	Nueces	Robstown	Roadrunner Service Ctr	Yes	105
2002	Corpus Christi	Nueces	Robstown	US Travel Center	Yes	29
767	Corpus Christi	Refugio	Refugio	Gas Go Market	No	5
4141	Corpus Christi	San Patricio	Mathis	Texas Star	No	7
4140	Corpus Christi	San Patricio	Mathis	Texas Star	No	23
42	Corpus Christi	San Patricio	Sinton	Sinton Travel Ctr. Inc.	Yes	30

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
4005	Dallas/Fort Worth	Collin	Anna	Anna Truck Stop	Yes	150
104	Dallas/Fort Worth	Collin	Anna	Drivers Travel Mart Diner #451	Yes	75
61	Dallas/Fort Worth	Collin	McKinney	Love's #299	Yes	56
56	Dallas/Fort Worth	Collin	McKinney	Pride Fuel Stop	No	20
4046	Dallas/Fort Worth	Collin	Plano	Circle K	No	14
96	Dallas/Fort Worth	Cooke	Gainesville	AmeriNet	Yes	30
737	Dallas/Fort Worth	Cooke	Gainesville	E&M Mini Market	No	7
349	Dallas/Fort Worth	Cooke	Gainesville	Gainesville Truck Stop	Yes	20
251	Dallas/Fort Worth	Cooke	Gainesville	Hitchin' Post Texaco Truck Stop	Yes	65
738	Dallas/Fort Worth	Cooke	Gainesville	Little Reds Truck Stop	No	7
2018	Dallas/Fort Worth	Dallas	Dallas	Am West	Yes	40
781	Dallas/Fort Worth	Dallas	Dallas	Cosby Fuels #2030	No	20
78	Dallas/Fort Worth	Dallas	Dallas	Dallas South Travel Center	Yes	190
75	Dallas/Fort Worth	Dallas	Dallas	Flying J Travel Plaza #520	Yes	192
782	Dallas/Fort Worth	Dallas	Dallas	Friendly's	No	3
63	Dallas/Fort Worth	Dallas	Dallas	Knox Fuel Stop	Yes	8
57	Dallas/Fort Worth	Dallas	Dallas	Love's #294	Yes	20
59	Dallas/Fort Worth	Dallas	Dallas	Marlow’s Fuel Center	Yes	6
82	Dallas/Fort Worth	Dallas	Dallas	Pilot Travel Center #433	Yes	135
783	Dallas/Fort Worth	Dallas	Dallas	Whip In #105	No	2
46	Dallas/Fort Worth	Dallas	Grand Prairie	Texas Oil Enterprise	No	2
71	Dallas/Fort Worth	Dallas	Irving	Big D Travel Center	Yes	68
84	Dallas/Fort Worth	Dallas	Mesquite	Dallas Travel Center	No	250
50	Dallas/Fort Worth	Dallas	Seagoville	Phast Phil's	No	9
4135	Dallas/Fort Worth	Dallas	Seagoville	Texaco Travel Plaza	No	36
52	Dallas/Fort Worth	Dallas	Seagoville	Total #4529	Yes	15
58	Dallas/Fort Worth	Dallas	Sunnyvale	County Line Truck Stop	No	18
2011	Dallas/Fort Worth	Dallas	Wilmer	Citgo	Yes	25
49	Dallas/Fort Worth	Dallas	Wilmer	Total #4544	No	8
48	Dallas/Fort Worth	Denton	Denton	Conoco Fuel Stop	Yes	8
47	Dallas/Fort Worth	Denton	Denton	Howdy Doody #14	No	5
64	Dallas/Fort Worth	Denton	Denton	Love's #217	Yes	18
74	Dallas/Fort Worth	Denton	Denton	Sunpower Travel Plaza	Yes	80
99	Dallas/Fort Worth	Denton	Denton	Travel Centers of America	Yes	150
60	Dallas/Fort Worth	Denton	Haslet	Texaco Travel Plaza	Yes	18
65	Dallas/Fort Worth	Denton	Krum	Midway Truck Stop	Yes	16
51	Dallas/Fort Worth	Denton	Lewisville	Whip In Stop	No	9
4132	Dallas/Fort Worth	Denton	Roanoke	Texaco Metro Mart	No	3
2012	Dallas/Fort Worth	Ellis	Ennis	Ennis Truck Stop	Yes	12
407	Dallas/Fort Worth	Ellis	Ennis	Total Fuel Stop # 2858	Yes	45
2019	Dallas/Fort Worth	Ellis	Italy	Tiger Mart 32	Yes	84
62	Dallas/Fort Worth	Ellis	Midlothian	Love's #216	Yes	52
406	Dallas/Fort Worth	Ellis	Midlothian	Total Fuel Stop #4519	No	6
357	Dallas/Fort Worth	Ellis	Palmer	Knox Fuel Stop - Mm#258	Yes	30
94	Dallas/Fort Worth	Ellis	Palmer	Sunmart #170	Yes	24
93	Dallas/Fort Worth	Ellis	Red Oak	Knox Fuel Stop	Yes	24
69	Dallas/Fort Worth	Hopkins	Sulphur Springs	Pilot Travel Center #157	Yes	85
1009	Dallas/Fort Worth	Hunt	Caddo Mills	Exxon	Yes	35
673	Dallas/Fort Worth	Hunt	Caddo Mills	Greenville Truck Stop	No	20
1010	Dallas/Fort Worth	Hunt	Caddo Mills	Shell Travel Plaza	Yes	40
405	Dallas/Fort Worth	Hunt	Greenville	Total Fuel Stop # 2856	Yes	15
2010	Dallas/Fort Worth	Johnson	Alvarado	Chevron	Yes	14
97	Dallas/Fort Worth	Kaufman	Forney	Knox Fuel Stop	Yes	30
98	Dallas/Fort Worth	Kaufman	Forney	Payless Fuel & Travel Ctr	Yes	24
87	Dallas/Fort Worth	Kaufman	Terrell	Mc Donald Fuel Stop	No	50

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
88	Dallas/Fort Worth	Kaufman	Terrell	Mc Donald Fuel Stop	No	50
79	Dallas/Fort Worth	Kaufman	Terrell	Rip Griffins Center	Yes	350
4130	Dallas/Fort Worth	Kaufman	Terrell	Terrell Travel Plaza	No	22
1008	Dallas/Fort Worth	Kaufman	Terrell	Tiger Mart Exxon	Yes	25
403	Dallas/Fort Worth	Kaufman	Terrell	Total Fuel Stop # 2854	Yes	25
4077	Dallas/Fort Worth	Navarro	Angus	Lucky Seven Quick Stop	No	27
2013	Dallas/Fort Worth	Navarro	Corsicana	Fina Truck Stop	Yes	35
614	Dallas/Fort Worth	Navarro	Corsicana	Interstate 66	No	60
366	Dallas/Fort Worth	Palo Pinto	Gordon	Bar-B Travel Plaza	Yes	75
363	Dallas/Fort Worth	Parker	Weatherford	(Wayside) Truck & Travel #3	Yes	50
372	Dallas/Fort Worth	Parker	Weatherford	Driver's Travelmart #402	Yes	60
86	Dallas/Fort Worth	Parker	Weatherford	Love's #273	Yes	40
107	Dallas/Fort Worth	Parker	Weatherford	Petro #2	Yes	275
73	Dallas/Fort Worth	Parker	Weatherford	Pilot Travel Center #206	Yes	140
688	Dallas/Fort Worth	Rains	Emory	Max-A-Mart	No	18
55	Dallas/Fort Worth	Rockwall	Rockwall	Love's #283	Yes	60
91	Dallas/Fort Worth	Rockwall	Rockwall	Travel Centers of America	Yes	100
89	Dallas/Fort Worth	Rockwall	Royse City	Knox Fuel Stop	Yes	50
90	Dallas/Fort Worth	Rockwall	Royse City	W. Wheels Truck Stop	No	20
672	Dallas/Fort Worth	Tarrant	Burleson	Snappy Jack's Texaco	No	20
67	Dallas/Fort Worth	Tarrant	Edgecliff Village	Love's #281	Yes	20
68	Dallas/Fort Worth	Tarrant	Fort Worth	Drivers Travelmart	Yes	36
72	Dallas/Fort Worth	Tarrant	Fort Worth	Drivers Travelmart #412	No	100
4000	Dallas/Fort Worth	Tarrant	Fort Worth	Exxon	Yes	15
106	Dallas/Fort Worth	Tarrant	Fort Worth	Like's Fast Shop	No	13
83	Dallas/Fort Worth	Tarrant	Keller	Pilot Travel Center #434	Yes	200
765	Dallas/Fort Worth	Tarrant	Mansfield	Vannett's Food & Fill	No	5
427	Dallas/Fort Worth	Van Zandt	Canton	Canton Travel plaza	No	90
735	Dallas/Fort Worth	Van Zandt	Canton	Overland Express	No	7
640	Dallas/Fort Worth	Wise	Bridgeport	Circle S #9	No	30
641	Dallas/Fort Worth	Wise	Bridgeport	Diamond W	No	30
4033	Dallas/Fort Worth	Wise	Decatur	Allsup's Convenience Store	No	13
4034	Dallas/Fort Worth	Wise	Decatur	Allsup's Convenience Store	No	4
100	Dallas/Fort Worth	Wise	Decatur	Decatur Texaco	Yes	30
101	Dallas/Fort Worth	Wise	Decatur	Quick All Truck Stop	No	9
115	El Paso	Culberson	Van Horn	Chevron Truck Stop	No	100
109	El Paso	Culberson	Van Horn	Love's #256	Yes	30
112	El Paso	Culberson	Van Horn	Pilot Travel Center #209	Yes	70
117	El Paso	Culberson	Van Horn	Plateau Truck Stop	Yes	100
416	El Paso	Culberson	Van Horn	Truck & Travel #2	No	150
120	El Paso	El Paso	Anthony	Flying J Travel Plaza	Yes	175
114	El Paso	El Paso	Anthony	Pilot Travel Center #435	Yes	98
121	El Paso	El Paso	Canutillo	Petro Stopping Center - Fuel Island	Yes	125
119	El Paso	El Paso	El Paso	El Paso Travel Plaza	Yes	150
113	El Paso	El Paso	El Paso	El Paso Truck Terminal Inc.	Yes	55
123	El Paso	El Paso	El Paso	La Posta	No	66
110	El Paso	El Paso	El Paso	Love's Travel Stop #214	Yes	90
311	El Paso	El Paso	El Paso	Petro #1	Yes	300
401	El Paso	El Paso	El Paso	Texas Red Express	Yes	30
108	El Paso	El Paso	Fabens	R&R Food and Full	No	27
122	El Paso	Hudspeth	Fort Hancock	Trucker's Village	Yes	150
1012	El Paso	Hudspeth	Van Horn	Chevron	Yes	75
4086	El Paso	Pecos	Sheffield	Pecos River Crossing	No	35
630	El Paso	Reeves	Toyah	Toyah Texaco	No	50

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
4018	El Paso	Ward	Monahans	Town & Country #82	No	9
701	El Paso	Wichita	Electra	Food Mart	No	13
328	Houston/Galveston	Austin	Sealy	Knox Fuel Stop	Yes	30
359	Houston/Galveston	Austin	Sealy	Sealy Truck Stop	Yes	60
837	Houston/Galveston	Austin	Sealy	Sunmart #121	No	5
329	Houston/Galveston	Austin	Sealy	Sunmart 123 (Mobil) = 160?	Yes	18
129	Houston/Galveston	Brazoria	Alvin	Yellow Jacket Grocery	No	6
755	Houston/Galveston	Brazoria	Freeport	Buc-ee's # 7	No	5
745	Houston/Galveston	Brazoria	Freeport	Mike's Drive In Grocery	No	6
194	Houston/Galveston	Chambers	Baytown	Angels Conoco Truckstop	No	5
314	Houston/Galveston	Chambers	Hankamer	Country Boys Truck Stop	Yes	20
322	Houston/Galveston	Chambers	Mont Belvieu	Conoco Travel Plaza	Yes	130
33	Houston/Galveston	Chambers	Winnie	Bingo Truck Stop	Yes	20
4012	Houston/Galveston	Chambers	Winnie	Mobil	Yes	22
396	Houston/Galveston	Chambers	Winnie	Speedy Stop #15	Yes	5
333	Houston/Galveston	Chambers	Winnie	Sunmart #111 Mobil = 160?	No	13
142	Houston/Galveston	Fort Bend	Beasley	786 Truck Stop	Yes	20
151	Houston/Galveston	Fort Bend	Kendleton	Hilltop Country Store	No	100
4013	Houston/Galveston	Fort Bend	Rosenberg	Chevron	Yes	86
634	Houston/Galveston	Fort Bend	Rosenberg	Circle K Truxtop #2273	No	40
4053	Houston/Galveston	Fort Bend	Rosenberg	Cottonwood Travel Ctr	No	27
150	Houston/Galveston	Fort Bend	Rosenberg	Drivers Travelmart	No	27
4014	Houston/Galveston	Fort Bend	Rosenberg	Rosenberg Shell Travel Plaza	Yes	30
830	Houston/Galveston	Fort Bend	Rosenberg	Sunmart #125	No	13
761	Houston/Galveston	Fort Bend	Rosenberg	Tanner Food Mart	No	5
134	Houston/Galveston	Galveston	Galveston	Island Food Mart	No	9
137	Houston/Galveston	Galveston	LaMarque	Shopper’s Mart #5	No	13
140	Houston/Galveston	Hardin	Silsbee	Short Stop Convenience	No	13
185	Houston/Galveston	Harris	Aldine	Owens Truck Stop	No	3
186	Houston/Galveston	Harris	Aldine	Super Food Mart	Yes	18
605	Houston/Galveston	Harris	Bamel	45 Travel Center	No	100
177	Houston/Galveston	Harris	Bamel	Flying J Travel Plaza	Yes	228
155	Houston/Galveston	Harris	Baytown	Baytown Citgo	Yes	78
195	Houston/Galveston	Harris	Baytown	Baytown Express	Yes	40
174	Houston/Galveston	Harris	Baytown	Pilot (old Speedway) (#086)	Yes	154
158	Houston/Galveston	Harris	Baytown	Sunmart #400	Yes	40
176	Houston/Galveston	Harris	Baytown	Travel Centers of America	Yes	150
778	Houston/Galveston	Harris	Channelview	Exxon Food Road	No	18
190	Houston/Galveston	Harris	Channelview	Flag Truckstop	No	20
818	Houston/Galveston	Harris	Channelview	Handi Stop #32	No	36
159	Houston/Galveston	Harris	Channelview	Keys Truck Stop	Yes	30
147	Houston/Galveston	Harris	Channelview	Cobra Truck Stop	Yes	30
149	Houston/Galveston	Harris	Hockley	290 Express Way	No	23
802	Houston/Galveston	Harris	Houston	Airway Food Mart	No	7
138	Houston/Galveston	Harris	Houston	Cal-Mod Hempstead Truck Stop	Yes	10
794	Houston/Galveston	Harris	Houston	Circle S Food Store	No	9
4010	Houston/Galveston	Harris	Houston	Citgo Truckstop 2000	Yes	12
133	Houston/Galveston	Harris	Houston	Conner’s Gas & Diesel	Yes	5
760	Houston/Galveston	Harris	Houston	Conoco Time Mart #6	No	5
161	Houston/Galveston	Harris	Houston	Gas Time Plaza	No	47
816	Houston/Galveston	Harris	Houston	Hammerley Conoco	No	13
182	Houston/Galveston	Harris	Houston	Horseshoe Truck Stop	Yes	5
732	Houston/Galveston	Harris	Houston	Houston Truck Wash	No	8
798	Houston/Galveston	Harris	Houston	King Texaco	No	25

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
183	Houston/Galveston	Harris	Houston	Love's #315	Yes	86
184	Houston/Galveston	Harris	Houston	Mobil	Yes	4
125	Houston/Galveston	Harris	Houston	Normandy Truck Stop	No	4
167	Houston/Galveston	Harris	Houston	Pilot Travel Center # 383	Yes	193
733	Houston/Galveston	Harris	Houston	Royalwood Truck Stop	No	8
4015	Houston/Galveston	Harris	Houston	Shell	Yes	25
4125	Houston/Galveston	Harris	Houston	Star Grocery	No	9
819	Houston/Galveston	Harris	Houston	Sunmart #110	No	18
814	Houston/Galveston	Harris	Houston	Sunmart #119	No	35
148	Houston/Galveston	Harris	Houston	Sunmart #128	No	22
399	Houston/Galveston	Harris	Houston	Sunmart #150 =160?	No	2
811	Houston/Galveston	Harris	Houston	Sunmart #171	No	35
815	Houston/Galveston	Harris	Houston	Sunmart #190	No	89
667	Houston/Galveston	Harris	Houston	Sunmart #201	No	24
400	Houston/Galveston	Harris	Houston	Sunmart #312	No	35
796	Houston/Galveston	Harris	Houston	Sunmart #314	No	35
144	Houston/Galveston	Harris	Houston	Sunmart #361	No	18
145	Houston/Galveston	Harris	Houston	Texas Truck Stop	Yes	10
821	Houston/Galveston	Harris	Houston	Time Mart #10	No	5
170	Houston/Galveston	Harris	Houston	Trucker Paradise	Yes	95
809	Houston/Galveston	Harris	Houston	T's Mini Mart	No	25
4040	Houston/Galveston	Harris	Humble	Blaze Star	No	25
375	Houston/Galveston	Harris	Humble	Fifty Nine Truckstop	No	22
4108	Houston/Galveston	Harris	Humble	Sam's Mart	No	4
131	Houston/Galveston	Harris	Humble	Texas Star Stop	Yes	40
153	Houston/Galveston	Harris	Katy	Sunmart #131	No	27
165	Houston/Galveston	Harris	La Porte	Port Auto Truck Stop	No	60
4011	Houston/Galveston	Harris	Pasadena	Chevron	Yes	32
130	Houston/Galveston	Harris	Pasadena	Flagship Truckstop	Yes	10
162	Houston/Galveston	Jefferson	Beaumont	Gateway Truck Plaza	No	54
156	Houston/Galveston	Liberty	Cleveland	Kountry Mart	Yes	30
135	Houston/Galveston	Liberty	Cleveland	Midway Drive In	No	9
189	Houston/Galveston	Liberty	Cleveland	Single Tree #3	No	15
4074	Houston/Galveston	Montgomery	Conroe	Kountry Kwick	No	58
173	Houston/Galveston	Montgomery	New Caney	Flying J Travel Plaza	Yes	154
600	Houston/Galveston	Montgomery	New Caney	New Caney Truck Terminal	No	150
180	Houston/Galveston	Montgomery	Splendora	International World Truck Stop	No	18
4110	Houston/Galveston	Montgomery	Splendora	Singletree Convenient Mart (#1)	No	4
166	Houston/Galveston	Montgomery	Spring	Sunmart #363 (#116)	Yes	60
139	Houston/Galveston	Montgomery	The Woodlands	Conoco Fuel Center	No	13
757	Houston/Galveston	Polk	Goodrich	A-1 Shamrock	No	5
35	Houston/Galveston	Polk	Goodrich	Polk's Pick It Up	No	7
157	Houston/Galveston	Polk	Livingston	Sunmart #308	No	36
181	Houston/Galveston	San Jacinto	Shepherd	Champion Travel Plaza	Yes	125
318	Houston/Galveston	Walker	Huntsville	Hitchin Post AMBEST (Texaco)	Yes	92
163	Houston/Galveston	Walker	Huntsville	Pilot Travel Center # 234	Yes	62
4083	Houston/Galveston	Walker	Riverside	Papa Keith's Market & Deli	No	4
303	Houston/Galveston	Waller	Brookshire	Citgo Fuel Center	Yes	15
193	Houston/Galveston	Waller	Brookshire	Houston West Travel Center	Yes	112
304	Houston/Galveston	Waller	Brookshire	Us Truxstop Exxon	Yes	30
188	Houston/Galveston	Waller	Hempstead	Hempstead Truck Stop	Yes	32
717	Houston/Galveston	Waller	Hempstead	Zip 'N Food Store # 106	No	10
179	Houston/Galveston	Waller	Waller	Love's Travel Stop #233	Yes	65
675	Houston/Galveston	Wharton	El Campo	Corner Mart	No	20
457	Houston/Galveston	Wharton	El Campo	Star Jet Truck Stop	No	36

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
678	Houston/Galveston	Wharton	Hungerford	Diamond Mini Mart #302	No	20
4097	Houston/Galveston	Wharton	Wharton	Quick & Easy	No	4
300	Killeen/Temple	Bell	Belton	Diamond Shamrock #1324	Yes	30
610	Killeen/Temple	Bell	Salado	JD's 282 Texaco Truck Stop	No	75
360	Killeen/Temple	Bell	Temple	CEFCO #48	Yes	52
609	Killeen/Temple	Bell	Temple	W-Wheels #3	No	80
198	Killeen/Temple	Bell	Troy	Love's #232	Yes	17
704	Killeen/Temple	Coryell	Gatesville	Pruitt's Texaco	No	12
716	Killeen/Temple	Hamilton	Hamilton	Cosby's Convenience Store (Cefco)	No	10
4026	Killeen/Temple	Lampasas	Lometa	1 Stop	No	9
310	Killeen/Temple	McClennan	Eddy	Cefco #47 Shell	Yes	15
643	Killeen/Temple	McClennan	Eddy	Texaco Travel Mart	No	30
197	Killeen/Temple	McLennan	Ross	Ross Truck Stop	No	175
324	Killeen/Temple	McLennan	Ross	Wheels Petro Stop Exxon	Yes	30
423	Killeen/Temple	Williamson	Jarrell	Bill's Exxon Truck Stop	No	15
199	Killeen/Temple	Williamson	Jarrell	Doc's One Stop	Yes	25
196	Killeen/Temple	Williamson	Jarrell	Texas Star Station #166	Yes	20
455	Laredo	Dimmit	Carrizo Springs	Royal Mart	No	31
347	Laredo	Duval	Freer	Circle K/7 Eleven #52140	No	25
368	Laredo	LaSalle	Cotulla	Cleo's Travel Center #1	Yes	150
205	Laredo	LaSalle	Encinal	Love's Travel Stop #298	Yes	105
369	Laredo	Maverick	Eagle Pass	Cleo's Travel Center #3	No	28
693	Laredo	Maverick	Eagle Pass	Mr B's Fuel Stop	No	15
619	Laredo	Maverick	Eagle Pass	Mr Cartender #3	No	50
642	Laredo	Maverick	Eagle Pass	Valley Mart #9	No	30
204	Laredo	Webb	Laredo	Gateway Truck Terminal Inc	Yes	150
203	Laredo	Webb	Laredo	Pilot Travel Center # 377	Yes	275
825	Laredo	Webb	Laredo	Speedy Stop #34	No	1
4123	Laredo	Webb	Laredo	Speedy Stop 78	No	13
4045	Lubbock	Crosby	Crosbyton	Centex/Ampride - Crosby County Fuels	No	7
213	Lubbock	Lamb	Littlefield	Town & Country #203	Yes	12
207	Lubbock	Lubbock	Lubbock	Rip Griffins Center	Yes	72
603	Lubbock	Lubbock	Lubbock	Town & Country #206	No	120
210	Lubbock	Lubbock	New Deal	New Deal Travel Ctr	Yes	35
4109	Lubbock	Lubbock	Shallowater	Shallowater Truck Stop	No	9
208	Lubbock	Lubbock	Slaton	66 Truck & Auto Plaza	Yes	60
664	Lubbock	Lubbock	Slaton	Ince Oil #17	No	25
209	Lubbock	Lubbock	Slaton	Sun Country # 1599	No	5
768	Lubbock	Lubbock	Wolfforth	Rip Griffin Star Mart # 4 (Swif Shop)	No	5
433	Lubbock	Terry	Brownfield	Fast Stop - 10	Yes	40
4068	Lubbock	Terry	Brownfield	Ince 26	No	11
2004	McAllen	Brooks	Falfurrias	Circle K	Yes	21
2003	McAllen	Cameron	Brownsville	Circle K	Yes	6
419	McAllen	Cameron	Harlingen	76 Truck Stop	Yes	150
220	McAllen	Cameron	Harlingen	Combes Auto-Truck Stop, Inc.	Yes	60
759	McAllen	Cameron	Harlingen	Speedy Stop #35	No	5
4048	McAllen	Cameron	San Benito	Circle K	No	13
217	McAllen	Hidalgo	Edinburg	Love's #284	Yes	65
218	McAllen	Hidalgo	Edinburg	Travel Centers of America	Yes	120
219	McAllen	Hidalgo	Edinburg	Uncle Sam's #30	No	5
4105	McAllen	Hidalgo	Pharr	River Mart	No	13
214	McAllen	Hidalgo	Pharr	Silver Spur Truck Stop	Yes	300
4153	McAllen	Hidalgo	Pharr	Valley 66	No	13
766	McAllen	Willacy	Raymondville	Gateway Truck Stop	No	5
4024	Midland/Odessa	Andrews	Andrews	Town & Country #156	No	7

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
222	Midland/Odessa	Ector	Odessa	Drivers Travel Mart #405	Yes	30
4019	Midland/Odessa	Ector	Odessa	Town & Country #104	No	9
606	Midland/Odessa	Ector	Penwell	Texas Interstate Truck Stop	No	100
4029	Midland/Odessa	Gaines	Seminole	Allsup's Convenience Store	No	4
299	Midland/Odessa	Howard	Big Spring	Rip Griffin	Yes	78
671	Midland/Odessa	Howard	Big Spring	Town & Country #103	No	20
2061	Midland/Odessa	Martin	Stanton	Town & Country #209	Yes	30
2058	Midland/Odessa	Midland	Midland	Exxon Travelmart	Yes	50
828	Midland/Odessa	Midland	Midland	Town & Country #107	No	13
4022	Midland/Odessa	Midland	Midland	Town & Country #122	No	9
650	Midland/Odessa	Midland	Midland	Town & Country #207	No	30
622	Midland/Odessa	Midland	Midland	Travel Mart #10	No	50
321	Midland/Odessa	Midland	Midland	Warfield Truck Terminal (Sunmart)	Yes	213
226	Midland/Odessa	Reeves	Pecos	Flying J Travel Plaza	Yes	141
628	Midland/Odessa	Reeves	Saragosa	I-10 Fina	No	50
4025	Midland/Odessa	Terrell	Sanderson	Town & Country #228	No	13
224	Midland/Odessa	Ward	Wickett	Sunmart #112	Yes	110
354	Nacogdoches	Angelina	Lufkin	Fifth Wheel of Texas	Yes	75
269	Nacogdoches	Angelina	Lufkin	Love's #290	Yes	25
764	Nacogdoches	Angelina	Lufkin	Okay Food Store # 22	No	5
370	Nacogdoches	Houston	Crockett	Crockett Farm & Fuel Center	No	39
4162	Nacogdoches	Houston	Crockett	Express Truck Stop	No	39
1006	Nacogdoches	Nacogdoches	Nacogdoches	Diamond Shamrock	Yes	15
623	Nacogdoches	Nacogdoches	Nacogdoches	Morgan Oil Fuel Stop	No	50
459	Nacogdoches	Nacogdoches	Nacogdoches	Trudy's Nu-Way Restaurant & Truck Stop	Yes	30
431	Nacogdoches	Polk	Corrigan	Dandy Double 12	No	18
727	Nacogdoches	San Augustine	San Augustine	Mixon Brothers Chevron	No	10
4020	San Angelo	Coke	Bronte	Town & Country #114	No	11
227	San Angelo	Crockett	Ozona	Circle Bar 76 Auto/Truck Plaza	Yes	125
422	San Angelo	McCulloch	Brady	Berkly's Travel Center	Yes	40
645	San Angelo	Pecos	Fort Stockton	7-D Exxon	No	30
228	San Angelo	Pecos	Fort Stockton	Comanche Springs Fuel Center	Yes	50
348	San Angelo	Pecos	Fort Stockton	Johnny's Circle N Truck & Auto	No	30
2055	San Angelo	Pecos	Fort Stockton	Oasis	Yes	30
708	San Angelo	Runnels	Ballinger	Town & Country #208	No	10
665	San Angelo	Sterling	Sterling City	Town & Country #144	No	25
635	San Angelo	Tom Green	San Angelo	Rainbow Plaza	No	40
723	San Angelo	Tom Green	San Angelo	Shots #8	No	10
4021	San Angelo	Tom Green	San Angelo	Town & Country #119	No	9
2064	San Angelo	Tom Green	San Angelo	Town & Country #179	Yes	21
4017	San Angelo	Tom Green	San Angelo	Town & Country #5	No	3
686	San Angelo	Tom Green	Wall	CNW Truck Stop	No	20
426	San Antonio	Atacosa	Pleasanton	Bubba's Truck Stop (#301)	No	20
668	San Antonio	Atacosa	Pleasanton	JP's Super Stop	No	24
626	San Antonio	Atacosa	Pleasanton	Kuntry Korner Steak & Eggs	No	50
239	San Antonio	Bexar	Converse	Farmers Truck Stop	Yes	50
247	San Antonio	Bexar	Converse	San Antonio Travel Ctr	Yes	25
248	San Antonio	Bexar	Converse	Trainer Hale Truck Stop	Yes	15
695	San Antonio	Bexar	Elmendorf	Ram Travel Center # 4	No	15
245	San Antonio	Bexar	Elmendorf	Tex Best Travel Ctr Inc	Yes	12
726	San Antonio	Bexar	San Antonio	Best Fuel Stop #4	No	10
724	San Antonio	Bexar	San Antonio	Conoco Fuel Center #1	No	10
236	San Antonio	Bexar	San Antonio	Flying J Travel Plaza	Yes	228
834	San Antonio	Bexar	San Antonio	Loves #242	No	134
232	San Antonio	Bexar	San Antonio	Petro #5	Yes	237

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
734	San Antonio	Bexar	San Antonio	Pico #10	No	8
230	San Antonio	Bexar	San Antonio	Pilot Travel Center #306	Yes	40
607	San Antonio	Bexar	San Antonio	Ram Travel Center #16	No	100
241	San Antonio	Bexar	San Antonio	Shell #3055 (?)	Yes	4
832	San Antonio	Bexar	San Antonio	Star Enterprises - Texaco #9	No	9
683	San Antonio	Bexar	San Antonio	Stockyard Service Center	No	20
2008	San Antonio	Bexar	San Antonio	Tetco Travel Center	Yes	35
831	San Antonio	Bexar	San Antonio	Tex Best Travel Center #4	No	4
242	San Antonio	Bexar	San Antonio	Tex-Mart Svc Station	Yes	20
243	San Antonio	Bexar	San Antonio	Travel Centers of America	Yes	247
747	San Antonio	Bexar	San Antonio	Whiteside's Fuel Station	No	6
725	San Antonio	Bexar	Thelma	EZ Mart #601	No	10
237	San Antonio	Bexar	Von Ormy	AAA Travel Ctr	Yes	57
235	San Antonio	Bexar	Von Ormy	Love's	Yes	101
627	San Antonio	Blanco	Round Mountain	Red-Eye Stops	No	50
298	San Antonio	Comal	New Braunfels	Rip Griffin #97	Yes	172
244	San Antonio	Comal	New Braunfels	Solms Truck Stop	Yes	5
3002	San Antonio	Comal	New Braunfels	Tex Best	Yes	13
2007	San Antonio	Frio	Dilley	Bigs #33	Yes	14
4062	San Antonio	Frio	Dilley	Frio Self Svc	No	18
625	San Antonio	Frio	Pearsall	D&D Express Stop (Valley Mart)	No	50
330	San Antonio	Guadalupe	Seguin	Jud's Food & Fuel #5 Chevron	Yes	24
238	San Antonio	Guadalupe	Seguin	Sunmart #167	Yes	23
657	San Antonio	Kendall	Boerne	Kwik Pantry #5119	No	25
249	San Antonio	Kendall	Boerne	Kwik Truck Stop	No	11
444	San Antonio	Kimble	Junction	Gene's Go Truck Stop	Yes	75
234	San Antonio	Kimble	Junction	Segovia Truck Stop	No	100
2051	San Antonio	Kimble	Junction	Shamrock/McDonalds	Yes	52
395	San Antonio	Medina	D'Hanis	Shivani Truck Stop	No	5
731	San Antonio	Uvalde	Uvalde	North Getty Texaco	No	10
713	San Antonio	Val Verde	Del Rio	Town & Country #210	No	10
763	San Antonio	Wilson	Loma Alta	Loma Alta General Store	No	5
4075	Sherman/Denison	Fannin	Trenton	Kwik Chek	No	18
250	Sherman/Denison	Grayson	Sherman	Sherman Truck Stop	Yes	6
687	Sherman/Denison	Grayson	Whitesboro	Whitesboro Truck Stop	No	20
697	Sherman/Denison	Sherman	Stratford	Gophers Travel Center	No	15
703	Texarkana	Bowie	De Kalb	Red River Truck Stop	No	12
260	Texarkana	Bowie	De Kalb	The Central Store	Yes	30
386	Texarkana	Bowie	Hooks	Love's #228	No	10
1001	Texarkana	Bowie	Hooks	Total #4509 (converting to Diamond Shamrock)	Yes	40
317	Texarkana	Bowie	Hooks	Willco Travel Stop Citgo	Yes	20
1002	Texarkana	Bowie	New Boston	Total # 4522 (Pasco's Texaco)	Yes	6
414	Texarkana	Bowie	Texarkana	Triple J Truck Center	No	45
698	Texarkana	Bowie	Texarkana/Nash	Triple C Truck Stop	No	15
257	Texarkana	Cass	Domino	Domino Exxon Truck Stop	No	100
355	Texarkana	Franklin	Mount Vernon	Fast Food #50 (Food Fast)	No	27
1003	Texarkana	Franklin	Mount Vernon	Fina	Yes	30
258	Texarkana	Franklin	Mount Vernon	Love's #279	Yes	26
387	Texarkana	Franklin	Mount Vernon	Mt. Vernon Fuel Center = 355?	No	40
332	Texarkana	Hopkins	Sulphur Springs	Crossroads Travel Center	Yes	40
638	Texarkana	Lamar	Blossom	Blossom Food Mart	No	30
624	Texarkana	Lamar	Paris	Short Stop Fuel Ctr & C-Store	No	50
259	Texarkana	Marion	Jefferson	Gene's Truck Stop & Restaurant	No	75
736	Texarkana	Morris	Daingerfield	Topps Fuel Stops	No	7
706	Texarkana	Morris	Omaha	S-Mart	No	12

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
254	Texarkana	Tarrant	Saginaw	Total Fuel Stop # 2724	No	11
681	Texarkana	Titus	Mount Pleasant	Highway 271 Texaco	No	20
739	Texarkana	Titus	Mount Pleasant	Total #4520	No	7
323	Texarkana	Titus	Mount Pleasant	Young's I 30 Exxon	Yes	10
1005	Tyler/Longview	Anderson	Palestine	Trucker Truck Stop	Yes	25
754	Tyler/Longview	Angelina	Diboll	Dandy Double # 8	No	5
741	Tyler/Longview	Angelina	Diboll	Okay Food Store # 15	No	6
408	Tyler/Longview	Angelina	Diboll	Total Fuel Stop # 2865	No	20
660	Tyler/Longview	Cherokee	Jacksonville	Corner Market #102	No	25
272	Tyler/Longview	Cherokee	Jacksonville	Nu Time Truck Stop	Yes	20
718	Tyler/Longview	Gregg	Kilgore	Interstate 20 Food Mart	No	10
648	Tyler/Longview	Gregg	Kilgore	Patriot Truck Stop/I-20 Shamrock	No	30
661	Tyler/Longview	Gregg	Longview	Fastop Foods Inc	No	25
353	Tyler/Longview	Gregg	Longview	Honey Stop Texaco	Yes	30
270	Tyler/Longview	Gregg	Longview	National Truck Stop	Yes	80
320	Tyler/Longview	Harrison	Marshall	Pony Express Conoco	No	110
705	Tyler/Longview	Morris	Lone Star	Jerry's Food Mart	No	12
445	Tyler/Longview	Panola	Carthage	Grave's Truck Stop-Bagher	Yes	90
382	Tyler/Longview	Panola	Carthage	Kwik Fuel	No	75
666	Tyler/Longview	Shelby	Tenaha	Tenaha Express	No	25
4098	Tyler/Longview	Shelby	Timpson	Quick Stop Grocery	No	4
762	Tyler/Longview	Smith	Lindale	Express Shop	No	5
271	Tyler/Longview	Smith	Lindale	Running W Truck Stop	Yes	75
4106	Tyler/Longview	Smith	Tyler	Road Island	No	22
261	Tyler/Longview	Smith	Tyler	Total Fuel Stop # 2863	No	35
265	Tyler/Longview	Smith	Tyler	Tyler Truckstop	Yes	25
769	Tyler/Longview	Tyler	Woodville	Okay Food Store # 27	No	5
749	Tyler/Longview	Upshur	Big Sandy	O&S Fuel Stop	No	5
365	Tyler/Longview	Upshur	Gilmer	American Star Travel Plaza	No	30
264	Tyler/Longview	Van Zandt	Van	Love's #287	Yes	55
429	Victoria	Gonzales	Gonzales	Circle G Truck Stop	No	67
646	Victoria	Gonzales	Gonzales	Ken's Truck Stop	No	30
231	Victoria	Jackson	Edna	Love's #297	Yes	30
296	Victoria	Jackson	Ganado	Rip Griffin	Yes	102
4066	Victoria	Live Oak	George West	George West Truck Stop	No	9
362	Victoria	Victoria	Victoria	Big Vic Truck Stop	Yes	60
699	Victoria	Victoria	Victoria	Chubby's Exxon	No	15
2001	Victoria	Victoria	Victoria	Conoco FastStop #5 Loop 175	Yes	15
2000	Victoria	Victoria	Victoria	Corder Travel Stop	Yes	32
689	Victoria	Victoria	Victoria	Diamond Mini Mart	No	18
4061	Victoria	Victoria	Victoria	Fina Truck Stop	No	13
4112	Victoria	Victoria	Victoria	Speedy Stop	No	4
309	Waco	Freestone	Dew	Exxon (was Jet Era T/S)	Yes	50
451	Waco	Freestone	Dew	Jet Truck Stop Travel	No	71
425	Waco	Freestone	Fairfield	Bond's Texaco Truck Center	No	40
447	Waco	Freestone	Fairfield	I-45 Shell Truck Stop	Yes	26
284	Waco	Freestone	Fairfield	Love's #288	Yes	28
285	Waco	Hill	Abbott	Sunmart Truck Stop	Yes	55
280	Waco	Hill	Hillsboro	Carl's Corner Truck Stop	Yes	50
281	Waco	Hill	Hillsboro	Knox Fuel Stop	Yes	10
282	Waco	Hill	Hillsboro	Love's #231	Yes	38
315	Waco	Hill	Hillsboro	Sunmart #169	No	60
621	Waco	Hill	Hillsboro	W-Wheels Truck Stop	No	50
283	Waco	Hill	Itasca	Stars & Stripes	Yes	50
631	Waco	Leon	Centerville	Woody's Diesel Express	No	45

ID	Region	County	City	Truck Stop Name	Visited?	# Spaces
4073	Waco	Limestone	Kosse	Kosse One Stop	No	4
201	Waco	McClennan	Elm Mott	Ed's Truck Stop #40	No	40
350	Waco	McClennan	Hewitt	RBD's Truck Stop	Yes	15
4057	Waco	McLennan	Elm Mott	Exxon Travel Plaza	No	33
278	Waco	McLennan	Robinson	Pilot Travel Center #432	Yes	160
286	Waco	McLennan	Waco	Flying J Travel Plaza	Yes	155
685	Waco	McLennan	Waco	Imperial Texaco	No	20
202	Waco	McLennan	Waco	K's Travel Ctr #3	No	20
744	Wichita Falls	Archer	Holliday	Kamay Y Convenience Store	No	6
4035	Wichita Falls	Baylor	Seymour	Allsup's Convenience Store	No	4
684	Wichita Falls	Baylor	Seymour	Brasher Brothers Truck Stop	No	20
287	Wichita Falls	Childress	Childress	Friend's Travel Center #217	Yes	15
294	Wichita Falls	Clay	Bellevue	Bellevue Truck Stop	Yes	30
637	Wichita Falls	Clay	Bellevue	Drivers Travelmart #403	No	35
656	Wichita Falls	Clay	Bellevue	Honey Dew Truck Stop	No	25
677	Wichita Falls	Clay	Henrietta	Dry Fork One Stop	No	20
4003	Wichita Falls	Clay	Jolly	TOTAL	Yes	75
4027	Wichita Falls	Hardeman	Chillocothe	Allsups	No	18
293	Wichita Falls	Montague	Bowie	Bowie Truck Stop	No	30
4064	Wichita Falls	Montague	Nocona	Fuel World	No	7
633	Wichita Falls	Wichita	Iowa Park	Shamrock Truck Stop	No	40
289	Wichita Falls	Wichita	Wichita Falls	Love's #269	Yes	20
4016	Wichita Falls	Wichita	Wichita Falls	Texaco Travel Plaza	No	47
292	Wichita Falls	Wilbarger	Harrold	Driver's Travelmart #410	Yes	20
654	Wichita Falls	Wilbarger	Vernon	Exxon Travel Center	No	30
421	Wichita Falls	Wise	Alvord	Alvord Truckstop	No	80
295	Wichita Falls	Wise	Alvord	Derrick Truck Stop Inc	Yes	75

Appendix D
Master Rest Area List (9/10/04)

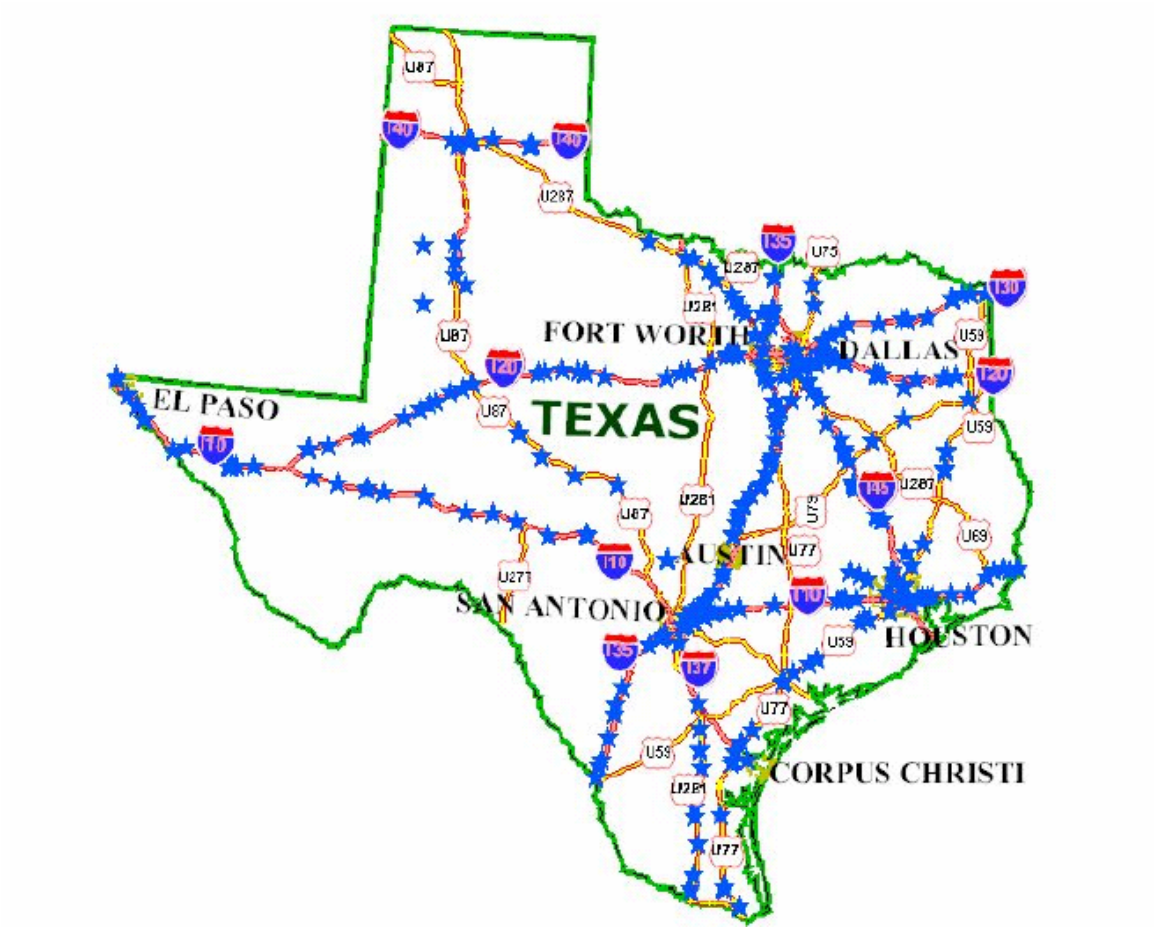
ID#	Metropolitan Area	County	Name	Site Visited?	# Spaces
510	Abilene	Callahan	Callahan County Westbound	Yes	12
509	Abilene	Callahan	Callahan County Eastbound	Yes	16
548	Abilene	Haskell	Haskell County Southbound	No	18
551	Abilene	Howard	Howard County Eastbound	No	18
560	Abilene	Knox	Knox County Westbound	No	18
566	Abilene	Mitchell	Mitchell County Westbound	No	18
569	Abilene	Nolan	Nolan County Eastbound	Yes	6
570	Abilene	Nolan	Nolan County Westbound	Yes	6
514	Amarillo	Collingsworth	Collingsworth County Southbound	No	18
522	Amarillo	Culberson	Culberson County Eastbound - IH 10	No	18
525	Amarillo	Donley	Donley County Northbound	No	18
526	Amarillo	Donley	Donley County Southbound	No	18
524	Amarillo	Donley	Donley County Eastbound	Yes	52
539	Amarillo	Gray	Gray County Westbound	Yes	48
4018	Amarillo	Potter	Amarillo	Yes	15
537	Austin	Gillespie	Gillespie County Ranch Road 1	No	18
538	Austin	Gillespie	Gillespie County US 290	No	18
592	Austin	Williamson	Williamson County Northbound	Yes	15
593	Austin	Williamson	Williamson County Southbound	Yes	15
572	Beaumont/Port Arthur	Orange	Orange County Westbound	Yes	5
571	Beaumont/Port Arthur	Orange	Orange County Eastbound	Yes	11
4023	Beaumont/Port Arthur	Orange	Orange	Yes	15
1013	Beaumont/Port Arthur	Orange	Rest Area	Yes	30
4021	Brownsville	Cameron	Harlingen	Yes	15
584	Bryan/College Station	Walker	Walker County Northbound	Yes	16
585	Bryan/College Station	Walker	Walker County Southbound	Yes	24
556	Corpus Christi	Kenedy	Kenedy County	No	18
561	Corpus Christi	Live Oak	Live Oak County Northbound	Yes	0
562	Corpus Christi	Live Oak	Live Oak County Southbound	No	18
577	Corpus Christi	Refugio	Refugio County Northbound	Yes	4
1007	Dallas	Eastland	Rest Area	Yes	20
4002	Dallas/Fort Worth	Clay	Rest Area	Yes	30
532	Dallas/Fort Worth	Ellis	Ellis County Southbound	Yes	17
531	Dallas/Fort Worth	Ellis	Ellis County Northbound	No	18
552	Dallas/Fort Worth	Johnson	Johnson County Northbound	Yes	5
553	Dallas/Fort Worth	Johnson	Johnson County Southbound	Yes	6
554	Dallas/Fort Worth	Kaufman	Kaufman County Eastbound	Yes	7
555	Dallas/Fort Worth	Kaufman	Kaufman County Westbound	No	18
4001	Dallas/Fort Worth	Montague	Rest Area	Yes	17
568	Dallas/Fort Worth	Navarro	Navarro County Southbound	Yes	15
567	Dallas/Fort Worth	Navarro	Navarro County Northbound	No	18
573	Dallas/Fort Worth	Palo Pinto	Palo Pinto County Eastbound	Yes	8
574	Dallas/Fort Worth	Palo Pinto	Palo Pinto County Westbound	Yes	8
4004	Dallas/Fort Worth	Tarrant	Rest Area	Yes	11
594	Dallas/Fort Worth	Wise	Wise County Northbound	Yes	20

ID#	Metropolitan Area	County	Name	Site Visited?	# Spaces
521	El Paso	Culberson	Culberson County (near Pine Springs)	Yes	17
523	El Paso	Culberson	Culberson County Westbound - IH 10	Yes	17
529	El Paso	El Paso	El Paso County Eastbound	Yes	7
530	El Paso	El Paso	El Paso County Westbound	Yes	7
4017	El Paso	El Paso	Anthony	Yes	15
4022	El Paso	Val Verde	Judge Roy Bean	Yes	15
535	Houston/Galveston	Galveston	Galveston County North Landing	No	18
536	Houston/Galveston	Galveston	Galveston County South Landing	No	18
575	Houston/Galveston	Polk	Polk County Northbound	No	18
576	Houston/Galveston	Polk	Polk County Southbound	No	18
502	Killeen/Temple	Bell	Bell County Northbound	Yes	15
503	Killeen/Temple	Bell	Bell County Southbound	Yes	15
2006	Laredo	Webb	Visitor Center	Yes	25
520	Lubbock	Crosby	Crosby County Eastbound	No	18
543	Lubbock	Hale	Hale County Southbound	No	18
542	Lubbock	Hale	Hale County Northbound	Yes	30
508	McAllen	Brooks	Brooks County	Yes	12
501	Midland/Odessa	Andrews	Andrews County Northbound	No	18
527	Midland/Odessa	Pecos	East Pecos County Eastbound	No	18
528	Midland/Odessa	Pecos	East Pecos County Westbound	Yes	30
588	Midland/Odessa	Pecos	West Pecos County Eastbound	Yes	35
589	Midland/Odessa	Pecos	West Pecos County Westbound	Yes	35
586	Midland/Odessa	Ward	Ward County Eastbound	Yes	30
587	Midland/Odessa	Ward	Ward County Westbound	Yes	30
512	Nacogdoches	Cherokee	Cherokee County Northbound	No	18
513	San Angelo	Coke	Coke County	Yes	40
519	San Angelo	Concho	Concho County	Yes	28
578	San Angelo	Sutton	Sutton County Eastbound	No	18
579	San Angelo	Sutton	Sutton County Westbound	Yes	20
504	San Antonio	Bexar	Bexar County Eastbound	Yes	20
505	San Antonio	Bexar	Bexar County Westbound	Yes	20
517	San Antonio	Comal	Comal County Northbound	Yes	12
518	San Antonio	Comal	Comal County Southbound	Yes	12
540	San Antonio	Guadalupe	Guadalupe County Eastbound	Yes	15
541	San Antonio	Guadalupe	Guadalupe County Westbound	Yes	15
557	San Antonio	Kerr	Kerr County Eastbound	No	18
558	San Antonio	Kerr	Kerr County Westbound	No	18
559	San Antonio	Kinney	Kinney County	No	18
564	San Antonio	Medina	Medina County Northbound - IH 35	Yes	13
563	San Antonio	Medina	Medina County	No	18
565	San Antonio	Medina	Medina County Southbound - IH 35	No	18
4020	Sherman/Denison	Cooke	Gainseville	Yes	15
4019	Sherman/Denison	Grayson	Denison	Yes	15
4024	Texarkana	Bowie	Texarkana	Yes	15
506	Texarkana	Bowie	Bowie County Eastbound	No	18
507	Texarkana	Bowie	Bowie County Westbound	Yes	23
1000	Texarkana	Bowie	Rest Area	Yes	36
511	Texarkana	Cass	Cass County Southbound	No	18

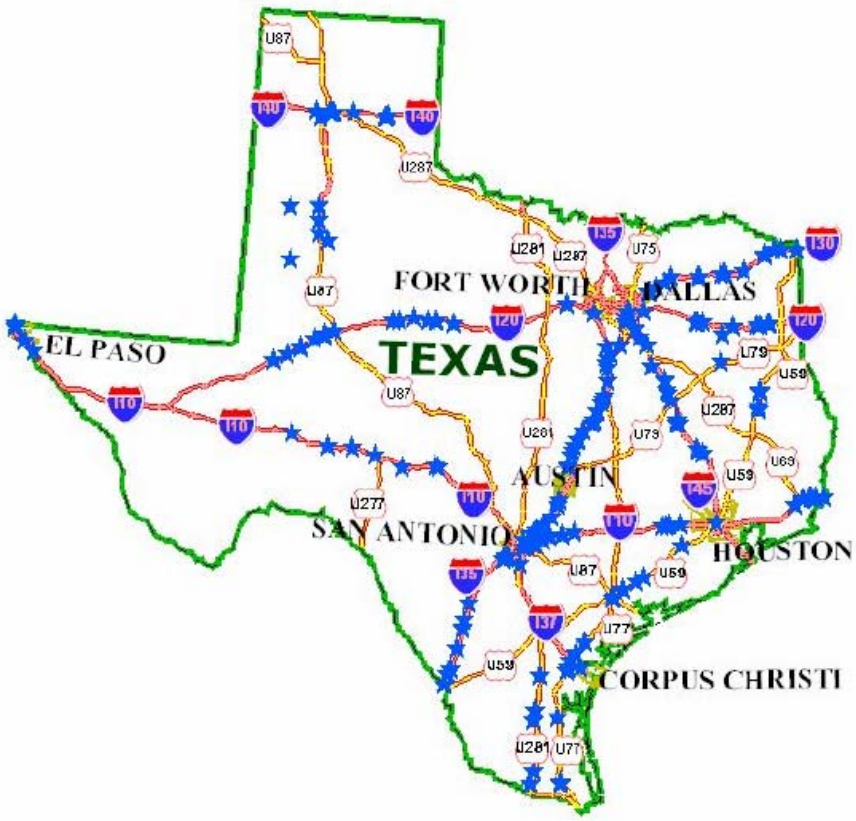
ID#	Metropolitan Area	County	Name	Site Visited?	# Spaces
533	Tyler/Longview	Franklin	Franklin County Eastbound	Yes	8
534	Tyler/Longview	Franklin	Franklin County Westbound	Yes	8
546	Tyler/Longview	Harrison	Harrison County Eastbound	Yes	8
547	Tyler/Longview	Harrison	Harrison County Westbound	Yes	8
4025	Tyler/Longview	Harrison	Waskom	Yes	15
1004	Tyler/Longview	Smith	Rest Area	Yes	5
580	Tyler/Longview	Van Zandt	Van Zandt County Eastbound	Yes	14
581	Tyler/Longview	Van Zandt	Van Zandt County Westbound	Yes	15
515	Victoria	Colorado	Colorado County Eastbound	No	18
516	Victoria	Colorado	Colorado County Westbound	No	18
582	Victoria	Victoria	Victoria County Northbound	Yes	16
583	Victoria	Victoria	Victoria County Southbound	Yes	16
544	Wichita Falls	Hardeman	Hardeman County Northbound	No	18
545	Wichita Falls	Hardeman	Hardeman County Southbound	No	18
4026	Wichita Falls	Wichita	Wichita Falls	Yes	15
590	Wichita Falls	Wichita	Wichita County Northbound	No	18
591	Wichita Falls	Wichita	Wichita County Southbound	No	18

Appendix E
Truck Stop/Rest Area Observation Locations

All Sites



Sites with Multiple Observations



Weekend Observations

Appendix F

Intermodal Facility Observation Field Notes

Survey Notes

Houston

Bush Intercontinental Airport: Visited both the central and East cargo areas. Only 5 large trucks were observed. Cargo at these facilities is better suited for two-ton trucks. These trucks are not idled at rest like line-haul diesels. Instead they are turned off like automobiles.

Galveston Harbor: Gate personnel confirmed that there is rarely two trucks at the gate at one time (no lines) and that there is a no-idle policy on the port.

BCCT: Significant lines were observed at BCCT as predicted by their gate report. They are building some new gate and wait times should diminish accordingly.

BNSF Container Terminal: They experience a peak at mid-day and again between 5 and 7 pm.

BNSF Car/rail Terminal: No lines. The trucks drive in, shut down to load, and drive out.

UP Wallisville: Because of the approach from the street and having only two gates, lines and congestion during mid-day were observed as predicted.

UP Kirkpatrick: Four gates and less traffic (300 v. 500 /day at Wallisville) allows this facility to operate without lines.

PHA Turning basin: No lines.

Dallas

UP Mesquite: This facility has four electronic gates – no lines.

UP Miller: This facility has a mid-morning and lunch-time peak with moderate waits.

KCS Arlington: Two gates, moderate waits.

BNSF Alliance: Busy place. Three gates, building three more.

Alliance Airport – FedEx Terminal: No gate idling time. License/ID check at gate is it. Peak time is evening.

DFW – UPS: No gate wait. Truck automatically shut down if idled over a couple of minutes.

DFW – Other: Observed the central cargo and north cargo areas. Like Bush, very few large trucks use these facilities.

San Antonio

East Rail Yard: Normally 2-3 trucks idling up to 10 minutes from 10:00 till 11:00. On the day visited (19 Aug 2004) traffic was very light due to a derailment west of town. Interview states that there are no lines at the South San Antonio yard.

Appendix G
County Level Emissions (2004 – 2020)

Truck Stops

County	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Anderson	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19	19	20
Andrews	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5
Angelina	77	78	80	81	83	84	86	87	89	91	93	95	97	99	102	104	106
Archer	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
Armstrong	8	9	9	9	9	9	9	10	10	10	10	11	11	11	11	11	12
Atacosa	24	25	25	26	26	27	27	28	28	29	29	30	31	31	32	33	34
Austin	64	65	66	67	69	70	71	73	74	76	77	79	81	83	84	86	88
Bastrop	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	7	7
Baylor	14	14	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19
Bell	144	146	149	152	154	157	160	163	167	170	174	178	182	186	190	194	198
Bexar	362	368	375	381	388	395	402	411	419	429	438	447	457	467	477	487	498
Blanco	13	13	13	14	14	14	14	15	15	15	16	16	16	17	17	17	18
Bowie	101	103	104	106	108	110	112	114	117	119	122	125	127	130	133	136	139
Brazoria	10	10	10	10	10	11	11	11	11	11	12	12	12	12	13	13	13
Brazos	23	23	23	24	24	25	25	26	26	27	27	28	29	29	30	31	31
Brooks	12	12	12	13	13	13	13	14	14	14	14	15	15	15	16	16	16
Caldwell	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8
Cameron	133	135	137	140	142	145	147	150	154	157	160	164	168	171	175	179	183
Carson	14	14	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19
Cass	57	58	59	60	61	62	63	64	66	67	69	70	72	73	75	76	78
Chambers	122	124	126	128	131	133	135	138	141	144	147	151	154	157	161	164	168
Cherokee	25	26	26	27	27	28	28	29	30	30	31	32	32	33	34	34	35
Childress	8	9	9	9	9	9	9	10	10	10	10	11	11	11	11	11	12
Clay	105	107	109	110	112	114	116	119	122	124	127	130	132	135	138	141	144
Coke	6	6	6	7	7	7	7	7	7	7	8	8	8	8	8	8	9
Collin	178	182	185	188	191	195	198	203	207	211	216	221	225	230	235	240	246

	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Comal	49	50	51	52	53	54	55	56	57	58	60	61	62	64	65	66	68
Cooke	73	74	76	77	78	80	81	83	85	87	88	90	92	94	96	98	101
Coryell	7	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9
Crockett	71	72	73	75	76	77	79	80	82	84	86	88	89	91	93	95	98
Crosby	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5
Culberson	255	259	264	269	273	278	283	289	296	302	309	315	322	329	336	344	351
Dallam	56	56	57	59	60	61	62	63	64	66	67	69	70	72	73	75	76
Dallas	593	604	614	625	636	647	659	673	688	703	718	734	750	766	782	799	817
Deaf Smith	17	17	18	18	18	19	19	19	20	20	21	21	21	22	22	23	23
Denton	174	177	180	183	187	190	193	197	202	206	211	215	220	225	229	234	239
Dimmit	18	18	18	19	19	19	20	20	20	21	21	22	22	23	23	24	24
Duval	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19	19	20
Eastland	86	88	89	91	92	94	96	98	100	102	104	106	109	111	114	116	119
Ector	79	80	82	83	84	86	87	89	91	93	95	97	100	102	104	106	108
El Paso	632	643	655	666	678	690	702	718	733	749	765	782	799	816	834	852	871
Ellis	156	159	161	164	167	170	173	177	181	185	189	193	197	201	205	210	215
Fannin	10	10	11	11	11	11	11	12	12	12	12	13	13	13	13	14	14
Fayette	31	32	32	33	33	34	35	35	36	37	38	39	39	40	41	42	43
Fort Bend	197	201	204	208	211	215	219	224	229	234	239	244	249	255	260	266	271
Franklin	70	71	72	73	75	76	77	79	81	83	84	86	88	90	92	94	96
Freestone	122	124	126	128	131	133	135	138	141	144	147	151	154	157	161	164	168
Frio	21	22	22	22	23	23	24	24	25	25	26	26	27	27	28	29	29
Gaines	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
Galveston	12	13	13	13	13	14	14	14	14	15	15	15	16	16	16	17	17
Gonzales	55	56	57	58	59	60	61	62	64	65	67	68	69	71	72	74	76
Gray	17	17	18	18	18	19	19	19	20	20	21	21	21	22	22	23	23
Grayson	15	15	15	16	16	16	16	17	17	17	18	18	19	19	19	20	20
Gregg	99	101	103	104	106	108	110	113	115	117	120	123	125	128	131	134	137
Guadalupe	12	12	13	13	13	13	14	14	14	14	15	15	15	16	16	16	17
Hale	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8
Hall	8	9	9	9	9	9	9	10	10	10	10	11	11	11	11	11	12
Hamilton	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8
Hardeman	10	10	11	11	11	11	11	12	12	12	12	13	13	13	13	14	14
Hardin	7	7	8	8	8	8	8	8	9	9	9	9	9	10	10	10	10

	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Harris	1,196	1217	1238	1260	1283	1305	1329	1357	1387	1417	1448	1479	1511	1544	1577	1612	1647
Harrison	62	63	65	66	67	68	69	71	72	74	75	77	79	80	82	84	86
Hays	84	85	87	88	90	92	93	95	97	99	101	104	106	108	111	113	115
Hemphill	11	12	12	12	12	12	13	13	13	13	14	14	14	15	15	15	16
Hidalgo	292	297	303	308	314	319	325	332	339	346	354	362	369	377	386	394	403
Hill	177	180	184	187	190	194	197	201	206	210	215	219	224	229	234	239	244
Hopkins	71	72	73	75	76	77	79	80	82	84	86	88	89	91	93	95	98
Houston	44	45	46	47	47	48	49	50	51	52	53	55	56	57	58	60	61
Howard	56	56	57	59	60	61	62	63	64	66	67	69	70	72	73	75	76
Hudspeth	127	130	132	134	137	139	142	145	148	151	154	158	161	165	168	172	176
Hunt	62	63	65	66	67	68	69	71	72	74	75	77	79	80	82	84	86
Hutchinson	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8
Jackson	75	76	77	79	80	82	83	85	87	89	91	92	94	97	99	101	103
Jasper	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19	19	20
Jefferson	126	128	130	133	135	137	140	143	146	149	152	156	159	162	166	169	173
Jim Wells	28	29	29	30	30	31	31	32	33	34	34	35	36	37	37	38	39
Johnson	8	8	8	8	9	9	9	9	9	9	10	10	10	10	10	11	11
Jones	7	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9
Kaufman	326	332	338	344	350	356	362	370	378	387	395	404	412	421	430	440	449
Kendall	9	9	10	10	10	10	10	11	11	11	11	12	12	12	12	13	13
Kimble	59	60	61	62	63	64	65	67	68	70	71	73	74	76	78	79	81
Kleberg	68	69	70	72	73	74	76	77	79	81	82	84	86	88	90	92	94
Lamar	45	46	47	48	49	49	50	51	53	54	55	56	57	59	60	61	62
Lamb	7	7	7	7	7	7	8	8	8	8	8	8	9	9	9	9	9
Lampasas	5	5	5	5	5	6	6	6	6	6	6	6	6	7	7	7	7
LaSalle	144	147	150	152	155	158	160	164	168	171	175	179	183	187	191	195	199
Lee	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Leon	44	45	46	47	47	48	49	50	51	52	53	55	56	57	58	60	61
Liberty	31	31	32	32	33	33	34	35	35	36	37	38	39	39	40	41	42
Limestone	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3
Live Oak	76	78	79	81	82	83	85	87	89	91	93	95	97	99	101	103	105
Lubbock	187	191	194	198	201	205	208	213	217	222	227	232	237	242	247	253	258
Madison	31	32	32	33	33	34	35	35	36	37	38	39	39	40	41	42	43
Marion	42	43	44	45	46	46	47	48	49	50	51	53	54	55	56	57	59

	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Martin	17	17	18	18	18	19	19	19	20	20	21	21	21	22	22	23	23
Maverick	70	71	72	73	75	76	77	79	81	83	84	86	88	90	92	94	96
McClennan	57	58	59	60	61	62	63	64	66	67	69	70	72	73	75	76	78
McCulloch	23	23	23	24	24	25	25	26	26	27	27	28	29	29	30	31	31
McLennan	336	342	348	354	360	367	373	381	390	398	407	415	425	434	443	453	463
Medina	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
Midland	207	210	214	218	222	226	230	235	240	245	250	256	261	267	273	279	285
Milam	45	46	47	48	49	49	50	51	53	54	55	56	57	59	60	61	62
Montague	21	21	22	22	22	23	23	24	24	25	25	26	26	27	28	28	29
Montgomery	259	263	268	273	278	283	288	294	300	307	313	320	327	334	341	349	356
Moore	33	33	34	35	35	36	37	37	38	39	40	41	42	42	43	44	45
Morris	18	18	18	19	19	19	20	20	20	21	21	22	22	23	23	24	24
Nacogdoches	54	55	56	57	58	59	60	61	62	64	65	67	68	69	71	73	74
Navarro	69	70	72	73	74	75	77	78	80	82	84	85	87	89	91	93	95
Newton	7	7	8	8	8	8	8	8	9	9	9	9	9	10	10	10	10
Nolan	187	191	194	198	201	205	208	213	217	222	227	232	237	242	247	253	258
Nueces	96	97	99	101	103	105	106	109	111	113	116	118	121	124	126	129	132
Ochiltree	61	62	63	64	65	66	67	69	70	72	73	75	77	78	80	82	83
Oldham	15	15	15	16	16	16	16	17	17	17	18	18	19	19	19	20	20
Orange	201	205	208	212	216	220	223	228	233	238	243	249	254	260	265	271	277
Palo Pinto	42	43	44	45	46	46	47	48	49	50	51	53	54	55	56	57	59
Panola	93	95	97	99	100	102	104	106	108	111	113	116	118	121	123	126	129
Parker	320	326	331	337	343	349	356	363	371	379	387	396	404	413	422	431	441
Parmer	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
Pecos	99	101	103	104	106	108	110	113	115	117	120	123	125	128	131	134	137
Polk	46	47	48	48	49	50	51	52	53	54	56	57	58	59	61	62	63
Potter	533	542	552	562	572	582	592	605	618	632	645	659	674	688	703	718	734
Rains	10	10	11	11	11	11	11	12	12	12	12	13	13	13	13	14	14
Randall	19	20	20	20	21	21	21	22	22	23	23	24	24	25	25	26	27
Reeves	137	139	141	144	146	149	152	155	158	162	165	169	173	176	180	184	188
Refugio	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Rockwall	130	133	135	137	140	142	145	148	151	154	158	161	165	168	172	176	179
Runnels	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8
San	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	8	8

	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Augustine																	
San Jacinto	71	72	73	75	76	77	79	80	82	84	86	88	89	91	93	95	98
San Patricio	34	35	35	36	36	37	38	39	39	40	41	42	43	44	45	46	47
Scurry	68	69	70	72	73	74	76	77	79	81	82	84	86	88	90	92	94
Shelby	16	17	17	17	18	18	18	19	19	19	20	20	21	21	22	22	23
Sherman	8	9	9	9	9	9	9	10	10	10	10	11	11	11	11	11	12
Smith	92	93	95	97	98	100	102	104	106	109	111	114	116	118	121	124	126
Sterling	14	14	15	15	15	15	16	16	16	17	17	18	18	18	19	19	20
Swisher	45	46	47	48	49	49	50	51	53	54	55	56	57	59	60	61	62
Tarrant	238	242	246	251	255	260	264	270	276	282	288	294	301	307	314	321	328
Taylor	236	240	245	249	253	258	262	268	274	280	286	292	299	305	312	318	325
Terrell	7	7	8	8	8	8	8	8	9	9	9	9	9	10	10	10	10
Terry	29	29	30	30	31	32	32	33	34	34	35	36	37	37	38	39	40
Titus	21	21	22	22	22	23	23	24	24	25	25	26	26	27	28	28	29
Tom Green	58	59	60	61	63	64	65	66	68	69	71	72	74	75	77	79	80
Travis	11	12	12	12	12	12	13	13	13	13	14	14	14	15	15	15	16
Tyler	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Upshur	20	20	21	21	21	22	22	23	23	23	24	25	25	26	26	27	27
Uvalde	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Val Verde	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
Van Zandt	86	88	89	91	92	94	96	98	100	102	104	106	109	111	114	116	119
Victoria	89	91	92	94	95	97	99	101	103	105	108	110	112	115	117	120	122
Walker	90	91	93	94	96	98	99	102	104	106	108	111	113	116	118	121	123
Waller	150	152	155	158	160	163	166	170	173	177	181	185	189	193	197	202	206
Ward	67	69	70	71	72	74	75	77	78	80	82	83	85	87	89	91	93
Washington	20	20	21	21	21	22	22	23	23	23	24	25	25	26	26	27	27
Webb	249	253	258	262	267	271	276	282	288	295	301	308	314	321	328	335	342
Wharton	45	46	47	48	49	49	50	51	53	54	55	56	57	59	60	61	62
Wheeler	126	129	131	133	136	138	140	143	146	150	153	156	160	163	167	170	174
Wichita	68	69	70	72	73	74	76	77	79	81	82	84	86	88	90	92	94
Wilbarger	28	29	29	30	30	31	31	32	33	34	34	35	36	37	37	38	39
Willacy	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4
Williamson	40	40	41	42	43	43	44	45	46	47	48	49	50	51	52	53	55
Wilson	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2

	Annual Tons of NOx Emissions, Truck Stops (2004 - 2020)																
County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Wise	154	156	159	162	165	168	171	174	178	182	186	190	194	198	203	207	211
Total	13,460	13,698	13,940	14,187	14,438	14,694	14,954	15,278	15,610	15,949	16,295	16,648	17,009	17,379	17,756	18,141	18,535

Rest Areas

Annual Tons of NOx Emissions, Rest Areas (2004 - 2020)

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Andrews	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Bell	17	17	17	18	18	18	18	18	18	19	19	19	19	19	20	20	20
Bexar	10	10	11	11	11	11	11	11	11	11	11	12	12	12	12	12	12
Bowie	52	53	53	54	54	55	55	56	56	57	58	58	59	59	60	61	61
Brooks	7	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8
Callahan	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	18	19
Cameron	8	9	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10
Cass	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Cherokee	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Clay	17	17	17	18	18	18	18	18	18	19	19	19	19	19	20	20	20
Coke	23	23	23	23	24	24	24	24	25	25	25	25	26	26	26	26	27
Collingsworth	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Colorado	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Comal	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	7
Conchol	16	16	16	16	17	17	17	17	17	17	18	18	18	18	18	18	19
Cooke	8	9	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10
Crosby	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Culberson	29	30	30	30	31	31	31	32	32	32	33	33	33	34	34	34	35
Donley	50	50	51	51	52	52	53	53	54	55	55	56	56	57	57	58	58
Eastland	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13
El Paso	16	17	17	17	17	17	17	18	18	18	18	18	19	19	19	19	19
Ellis	20	20	20	20	21	21	21	21	21	22	22	22	22	23	23	23	23
Franklin	9	9	9	9	9	10	10	10	10	10	10	10	10	10	10	11	11
Galveston	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Gillespie	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Gray	27	27	28	28	28	29	29	29	29	30	30	30	31	31	31	32	32
Grayson	8	9	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10
Guadalupe	8	8	8	8	8	8	8	8	8	8	9	9	9	9	9	9	9
Hale	27	27	28	28	28	29	29	29	29	30	30	30	31	31	31	32	32
Hardeman	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Harrison	18	18	18	18	18	18	19	19	19	19	19	20	20	20	20	20	21
Haskell	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Howard	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12

Annual Tons of NOx Emissions, Rest Areas (2004 - 2020)

County	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Johnson	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	7
Kaufman	14	14	14	15	15	15	15	15	15	15	16	16	16	16	16	16	17
Kenedy	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Kerr	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Kinney	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Knox	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Live Oak	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Medina	13	13	13	13	13	13	13	14	14	14	14	14	14	14	15	15	15
Mitchell	10	10	10	11	11	11	11	11	11	11	11	11	11	12	12	12	12
Montague	10	10	10	10	10	10	10	10	10	11	11	11	11	11	11	11	11
Navarro	19	19	19	19	19	20	20	20	20	20	21	21	21	21	21	22	22
Nolan	7	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8
Orange	35	35	35	36	36	36	37	37	37	38	38	39	39	39	40	40	41
Palo Pinto	9	9	9	9	9	10	10	10	10	10	10	10	10	10	10	11	11
Pecos	67	68	68	69	70	70	71	72	72	73	74	75	75	76	77	78	78
Polk	20	21	21	21	21	21	22	22	22	22	23	23	23	23	23	24	24
Potter	8	9	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10
Refugio	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
Smith	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Sutton	22	22	22	22	22	23	23	23	23	24	24	24	24	24	25	25	25
Tarrant	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	7
Val Verde	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
Van Zandt	16	17	17	17	17	17	17	18	18	18	18	18	19	19	19	19	19
Victoria	18	18	18	19	19	19	19	19	20	20	20	20	20	21	21	21	21
Walker	23	23	23	23	24	24	24	24	25	25	25	25	26	26	26	26	27
Ward	34	34	35	35	35	36	36	36	37	37	38	38	38	39	39	39	40
Webb	14	14	14	15	15	15	15	15	15	15	16	16	16	16	16	16	17
Wichita	29	29	29	30	30	30	31	31	31	32	32	32	33	33	33	34	34
Williamson	17	17	17	18	18	18	18	18	18	19	19	19	19	19	20	20	20
Wise	11	11	12	12	12	12	12	12	12	12	13	13	13	13	13	13	13
Total	1,036	1,047	1,057	1,068	1,078	1,089	1,100	1,111	1,122	1,133	1,145	1,156	1,168	1,179	1,191	1,203	1,215