Heavy-Duty Vehicle Idle Activity and Emissions, San Antonio-New Braunfels MSA

Technical Report

October 31st, 2011

Prepared by:

Alamo Area Council of Governments

Prepared in Cooperation with the Texas Commission on Environmental Quality

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Abstract: The trucking industry is a major contributor to North America's economy, transporting over 80% of the nation's goods, and truck traffic is growing rapidly. Since IH-35, IH-10, and other major highways converge in San Antonio, truck drivers frequently use truck stops, rest areas, and picnic areas in the San Antonio area. These are important emissions sources since they are associated with frequent and prolonged truck engine idling. In San Antonio there are 27 truck stops with a combined capacity of 1,997 parking spaces, 8 rest areas with a combined total of 159 parking spaces, and 5 picnic areas with a combined total of 104 parking spaces. Every truck stop, rest area, and picnic area was surveyed multiple times on weekdays and weekends to determine truck engine idling rates. The average idling rate per parking space was between 8 and 32 percent throughout the day with the highest values occurring between 11 pm and 3 am. Average idling rates per parking space were similar for all facility types: between 14% and 19%. The total annual NOx emissions from extended truck engine idling in the San Antonio-New Braunfels MSA was estimated to be 883 tons per year while total VOC emissions was estimated at 226 tons per year. A geographic dataset that spatially allocates truck idling emissions by truck stop or rest/picnic area was developed in EPS3 format for the photochemical model. Seasonal and weekly adjustment factors used in the model were set to one because there was no statistically significant difference in idling rates per parking space by month or day of the week. Several recommendations for future improvements in data collection and emission inventory development are provided in the report: perform additional surveys between 5 pm and 10 pm, conduct additional surveys during August and September, survey new truck idling locations and truck electrification facilities, perform 24-hour or 48-hour samples at truck idling locations, and project truck idling emissions to future years.

Related Reports:	**Distribution Statement:**	**Permanent File:**
Heavy-Duty Idling Activity Characterization and Emissions Inventory Survey Protocol: Truck Stops, Rest Stops, and Picnic Areas	Alamo Area Council of Governments, Natural Resources/Transportation Department	Alamo Area Council of Governments, Natural Resources/Transportation Department

EXECUTIVE SUMMARY

The trucking industry is a major contributor to North America's economy, transporting over 80% of the nation's goods, and truck traffic is growing rapidly.[1] The population of large trucks is estimated at 4.2 million, 1.3 million of which are "long haul" trucks equipped with sleeper cabs and powered by diesel engines.[2] The Department of Transportation requires rest of 10 hours after every 11 hours driving for property-carrying commercial motor vehicle (CMV) drivers.[3] Since IH-35, IH-10, and other major highways converge in San Antonio, truck drivers frequently use truck stops, rest areas, and picnic areas in the San Antonio area to comply with mandatory rest breaks. Truck drivers sometimes idle their engines throughout their rest periods to provide electricity for cooling and heating their cabins, or to keep their engine fluids warm.[4] This extended idling consumes fuel, creates air and noise pollution, and is an inefficient use of the nation's energy supply.[5] Emissions from engine idling contribute to the formation of ozone – one of the most pervasive air pollutants in the nation.

Ambient ozone concentrations in the San Antonio area become elevated to an extent and on a frequent enough basis to warrant preparation for a non-attainment designation, particularly as the U.S. Environmental Protection Agency has proposed setting a more stringent ozone standard in 2011. As a "near" non-attainment area, an element of this preparation includes developing emission inventories that identify and quantify sources of the chemical precursors which react to form ozone. Emission inventories provide important input for airshed models that replicate the atmospheric conditions which contribute to elevated ozone concentrations and predict the effectiveness of pollution control measures. Accurately characterizing emission rates and spatially allocating emission sources improves a model's forecasting capabilities. Hence, a great deal of effort is put into creating accurate emission inventories; an effort that often benefits from conducting on-site surveys. This report describes one such survey conducted between October 2010 and June 2011 that involved observing and documenting the incidence of extended (30 minutes or more) engine idling at truck stops and rest areas.

There are 27 truck stops with a total of 1,997 truck parking spaces, 8 rest areas with a total of 159 truck parking spaces, and 5 picnic areas with a total of 104 truck parking spaces in the San Antonio-New Braunfels MSA. Every truck stop, rest area, and picnic area was surveyed multiple times and every time period, morning, daytime, and nighttime, was covered during the survey. The average utilization rate varied between 26 percent at 1:00 in the afternoon to 73 percent at 1:00 in the morning. The average idling rate per parking space was between 8 and 32 percent throughout the day with the highest values occurring

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[1] IdleAire Technologies Corp., August 2007. "Diesel Idling and the IdleAire Solution Fact Sheet". Available online: http://www.idleaire.com/images/Users/1/pdf/Diesel%20Idling%20Fact%20Sheet.pdf. Accessed 08/23/10.

[2] *Ibid*.

[3] Department of Transportation Federal Motor Car Safety Administration, November 18, 2008. "Hours-of-Service Regulations". 49 CFR Parts 385 and 395. Washington D.C. Available online: http://www.fmcsa.dot.gov/rules-regulations/topics/hos/HOS-2005.htm. Accessed 08/23/10.

[4] EPA, January 2004. "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity". Research Triangle Park, North Carolina. p. 2. Available online: http://www.epa.gov/otaq/smartway/documents/420b04001.pdf. Accessed 08/23/10.

[5] Dr. Linda Gaines and Terry Levinson Argonne National Laboratory September 23, 2009. "Idling Reduction Makes $ense". U.S. Department of Energy, Energy Efficiency and Renewable Energy. Available online: http://www1.eere.energy.gov/cleancities/pdfs/idle_reduction.pdf. Accessed 08/23/10.

between 11:00 pm and 3:00 am. A drop in the idling rate per parking space began around 8:00 am and the idling rate started to increase again around 5:00 pm.

The idling rates determined from the survey results are within the 95% confidence level for every day of the week and for every month during the survey. Utilization rates and idling rates vary greatly by facility type, while the idling rate per parking space was similar for every facility type. Utilization rates were 53 percent for truck stops, 35 percent for rest areas, and 21 percent for picnic areas. Although picnic areas had low utilization rates, idling rates at these facilities were high (67%). The opposite was observed for truck stops that had high utilization rates, but a low average idling rate of 35%. Idling rates per parking space were similar for all facility types: between 14% and 19%.

Since particular amenities may be more attractive to truck drivers than others, statistical analyses were performed to determine if there was significant variation in utilization/idling rates due to the availability of amenities. Facility size and the presence of showers, certified scales, fast food restaurants, and repair shops had the strongest correlation with utilization rates. The weakest correlation with utilization rates were the month when the survey took place, weekend or weekday, and the presence of a hotel. Observed utilization rates were not dependant on the day of the week or the month of the survey.

Idling rates were not correlated with time of the day, while time of day had the strongest correlation with idling rate per parking space. The idling rate per parking space was not impacted by the type of facility and day of the week. The presence of a truck wash, fuel supply, and convenience store had no impact on the idling rate per parking space. Also, there was no correlation between facility size and idling rates and idling rates per parking space. There was no correlation between temperature and utilization rates, idling rates, and idling rates per parking space. Recorded temperature during the survey ranged between 36ºF and 95ºF; however the percentage of trucks idling remained uniform.

Based on the results of the survey, total annual extended truck idling NOx emissions in the San Antonio-New Braunfels MSA were estimated to be 883 tons per year while total VOC emissions were estimated at 226 tons per year. Truck idling emissions were highest for Bexar County, 575 tons of NOx a year, because there is a concentration of large truck stops on the east side of the city near the IH-410 and IH-10 interchange. In addition, there are a number of truck stops on IH-35 in the southwestern area of the county and on IH-37 in southern Bexar County. Comal County also has several large truck stops where trucks emit significant amounts of NOx emissions, 144 tons of NOx a year. These truck stops are concentrated along IH-35 between San Antonio and Austin.

A geographic dataset of truck stop and rest facilities was developed for the photochemical model. All truck idling emission inventory data files were converted to Emissions Preprocessor System (EPS3) format. Temporal allocation of truck idling emissions is based on the three time periods used for data collection: morning, daytime, and nighttime. The seasonal and weekly adjustment factors used for the photochemical model was set to one because there was no statistically significant difference in idling rates per parking space by month or day of the week.

Several recommendations for future improvements in data collection and emission inventory development are provided in the report. Future surveys should collect more data during the early evening between 5:00 pm and 10:00 pm. Truck idling observations indicate the overnight idling time period starts earlier in the San Antonio-New Braunfels MSA rather than the 10:00 pm start time used in other truck idling studies. Additional surveys should be

conducted in late summer and early fall. Although there was no significant variation in utilization/idling rates per parking space by month, additional surveys should be conducted during the late summer ozone season peak in August and September to confirm the results. When new truck idling facilities are built in the San Antonio area, they should be surveyed and added to the emission inventory. If truck idling electrification facilities are built in the region, they also need to be surveyed and included in the emission inventory results. Additional 24-hour or 48-hour samples at selected truck idling locations should be conducted to determine the length of idling for each truck. Once future photochemical modeling base cases are determined, extended truck idling emissions need to be projected.

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1. INTRODUCTION

The trucking industry is a major contributor to North America's economy, transporting over 80% of the nation's goods, and truck traffic is growing rapidly.[6] The population of large trucks is estimated at 4.2 million, 1.3 million of which are "long haul" trucks equipped with sleeper cabs and powered by diesel engines.[7] The Department of Transportation requires rest of 10 hours after every 11 hours driving for property-carrying commercial motor vehicle (CMV) drivers.[8] Since IH-35, IH-10, and other major highways converge in San Antonio, truck drivers frequently use truck stops, rest areas, picnic areas, and other facilities in the San Antonio area to comply with mandatory rest breaks. Truck drivers sometimes idle their engines throughout their rest periods to provide electricity for cooling and heating their cabins, or to keep their engine fluids warm.[9] This extended idling consumes fuel, creates air and noise pollution, and is an inefficient use of the nation's energy supply. According to an estimate by the US Department of Energy, each year in the U.S. trucks consume over 25 million barrels of fuel a year for overnight truck idling.[10]

The Texas Commission on Environmental Quality (TCEQ), in an interagency contract with the Texas Transportation Institute (TTI), conducted phase 1 of a statewide study on the magnitude of emissions from heavy-duty truck idling in 2003. The report provides an account of the heavy-duty (long-haul) trucks using truck stops and a review of methodologies to calculate the truck idling emission factors.[11] This report paved the way for the second TCEQ report prepared by the Eastern Research Group Inc., which provided annual truck idling emission estimates for the base year 2004 through 2030 on a county-based level.[12] The latter study expanded the truck stop database used to calculate state wide truck idling emissions. Neither report provided a complete survey of all the truck idling facilities in the San Antonio area and the reports are out of date because of changes in locations of truck stops, idling characteristics, fuel prices, and technology.

Because San Antonio may become a non-attainment region in the near future, assessing idling emissions from heavy-duty diesel trucks is necessary for photochemical modeling.

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[6] IdleAire Technologies Corp., August 2007. "Diesel Idling and the IdleAire Solution Fact Sheet". Available online: http://www.idleaire.com/images/Users/1/pdf/Diesel%20Idling%20Fact%20Sheet.pdf. Accessed 08/23/10.

[7] *Ibid*.

[8] Department of Transportation Federal Motor Car Safety Administration, November 18, 2008. "Hours-of-Service Regulations". 49 CFR Parts 385 and 395. Washington D.C. Available online: http://www.fmcsa.dot.gov/rules-regulations/topics/hos/HOS-2005.htm. Accessed 08/23/10.

[9] EPA, January 2004. "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity". Research Triangle Park, North Carolina. p. 2. Available online: http://www.epa.gov/otaq/smartway/documents/420b04001.pdf. Accessed 08/23/10.

[10] Dr. Linda Gaines and Terry Levinson Argonne National Laboratory September 23, 2009. "Idling Reduction Makes $ense". U.S. Department of Energy, Energy Efficiency and Renewable Energy. Available online: http://www1.eere.energy.gov/cleancities/pdfs/idle_reduction.pdf. Accessed 08/23/10.

[11] TTI, Aug. 2003. "HDDV Idling Activity and Emissions, Study: Phase 1, Study Design and Estimation of Magnitude of the Problem". Sponsored by TCEQ. College Station, Texas. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase1-tti.pdf. Accessed 08/23/10.

[12] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

This assessment provides key information on the impact of truck idling on local emissions. The results from the survey are used to improve the emission inventory inputs in the June 2006 photochemical modeling episode.

1.1. Air Quality Trends

The U.S. Environmental Protection Agency (EPA) is charged with the maintenance of air quality across the United States through a series of standards, the National Ambient Air Quality Standards (NAAQS). San Antonio is currently in attainment of the NAAQS for all pollutants. However, "on January 6, 2010, EPA proposed to strengthen the national ambient air quality standards (NAAQS) for ground-level ozone, the main component of smog. The proposed revisions are based on scientific evidence about ozone and its effects on people and the environment. EPA is proposing to strengthen the 8-hour "primary" ozone standard, designed to protect public health, to a level within the range of 0.060-0.070 parts per million (ppm). EPA is also proposing to establish a distinct cumulative, seasonal "secondary" standard, designed to protect sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. EPA is proposing to set the level of the secondary standard within the range of 7-15 ppm-hours."[13]

From 2008 through 2010, San Antonio registered ozone concentrations at several monitors that could cause the region to exceed the proposed revision to the eight-hour primary ozone standard. In 2008, the San Antonio region recorded 13 days in excess of 70 ppb, the upper end of the range under consideration by the EPA, while in 2009 there were 8 days in excess and in 2010 there were 11 days in excess. The 2008-2010 design value is 75 ppb at C23 and 75 ppb at C58, indicating the San Antonio region ended 2010 with two monitors exceeding the least stringent threshold under consideration. The design values at all regulatory-sited monitors are greater than 60 and 65 ppb – the lower and middle values of the range under consideration for the revised ozone standard.

1.2. Study Area

The truck idling survey encompassed the 8 county area of the San Antonio-New Braunfels MSA, which includes Bexar, the most populous county of the region, and the 7 adjacent counties of Atascosa, Bandera, Comal, Guadalupe, Kendall, Medina, and Wilson.

1.3. Definition of Heavy-Duty Trucks

The focus of this study is a visual survey of engine idling practices by long-haul truck drivers. Survey results provide inputs that are used to estimate extended idling emissions for the combination (tractor/trailer) long-haul trucks, the only source use type within the current version of the Motor Vehicle Emission Simulator model (MOVES)[14] for which extended idling emissions can be estimated. This vehicle category is more commonly referred to as diesel-powered five-axle "eighteen-wheelers", but other four-axle and six-axle configurations are also included in this category. Combination long-haul trucks are classified in MOVES as trucks with a majority of their operation outside of 200 miles of home base.[15]

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[13] EPA, January 6, 2010. "Fact Sheet: Proposal to Revise the National Ambient Air Quality Standards for Ozone". p. 1. Available online: http://www.epa.gov/air/ozonepollution/pdfs/fs20100106std.pdf. Accessed 07/11/11.

[14] U.S. EPA, December 2009. Office of Transportation and Air Quality Washington, DC. Motor Vehicle Emission Simulator. Available online: http://www.epa.gov/otaq/models/moves/index.htm. Accessed 07/11/11.

[15] John Koupal, Mitch Cumberworth, and Megan Beardsley, June 9, 2004. "Introducing MOVES2004, the initial release of EPA's new generation mobile source emission model". U.S. EPA Office of Transportation and Air Quality, Assessment and Standards Division. Ann Arbor, MI. Available online: http://www.epa.gov/ttn/chief/conference/ei13/ghg/koupal.pdf. Accessed 07/11/11.

The primary inputs needed by MOVES to estimate idling emissions are the number of hours operating (SHO) in extended idling mode by source type. Since EPA has required that states begin using the MOVES model for on-road inventory development, this report did not use any on-road emission factors or inventories developed with the MOBILE6.2 model. Likewise, the simplified extended idling emission estimation procedure outlined by EPA for use with MOBILE6.2 in the January 2004 "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity"[16] was not used.

1.4. Data Availability

The idling survey data collected is available in an organized electronic format that can be readily incorporated into on-road inventory development with the MOVES model. It is expected that the results of any extended idling data collection effort will be used by the Texas Transportation Institute for development of on-road emission inventories with the MOVES model.

[16] EPA, January 2004. "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity". EPA420-B-04-001. Transportation and Regional Programs Division Office of Transportation and Air Quality and Air Quality Strategies and Standards Division Office of Air Quality Planning and Standards. Available online: http://www.epa.gov/smartway/documents/420b04001.pdf. Accessed 08/24/10.

2. LONG TERM TRUCK IDLING FACILITIES AND DATA COLLECTION

2.1. Diesel Truck Idling Locations

Drivers idle their trucks' engines at the following locations:

- Truck Stops
- Rest Stops
- Picnic Areas
- Other Idling Locations

Extensive research was conducted in an effort to identify and locate all such facilities in the San Antonio-New Braunfels MSA. All identified truck stops, rest stops, and picnic areas are included in the survey. Additional truck stops were identified during the survey and were added to the inventory of facilities surveyed.

2.1.1. Truck Stops

Information was collected to develop a geographic dataset of local truck stops, gas stations, restaurants, and travel plazas that have parking facilities for long term idling of heavy-duty trucks. Truck stop data was collected from TxDOT, Yahoo yellow pages, the trucking industry web pages, facility managers, TTI research, and the ERG reports. According to the ERG, "there is no single comprehensive list of truck stops available for Texas"[17] and, subsequently, for the San Antonio region.

Assigning geographic coordinates to the truck stops facilitated the development of a visual tool for analyzing their distribution throughout the region as well as the creation of a grid-based input file for use in the photochemical model. As indicated in figure 2-1, truck stops are primarily clustered in the eastern section of the region, along IH-10. Table 2-1 provides a list of all truck stops in the AACOG region, their addresses, and the number of parking spaces at each facility. Regional aerial images were also used to verify the accuracy of location information and determine the number of available parking spaces. During the survey, the number of truck spaces were counted and updated on the survey master list.

Several truck stops were removed from the initial survey list because they did not have adequate parking for overnight trucks or the facility is no longer in business. Three additional truck stops, Chevron in Comfort Texas on IH-10, Texaco east of San Antonio on IH-10, and Exxon Valley Mart in Hondo on U.S. 90, were identified during the survey process and included in the results. Love's is planning to open a new truck stop in Kendall County off IH-10 exit 523 at U.S. 87 with 80 parking spaces for trucks.[18] Love's is also planning to build a new truck stop off IH-10 in Seguin at exit 603. Since these truck stops were not operating during the survey, they were not included in the emission inventory estimations. Emission inventory projections, however, should include all proposed new truck stops.

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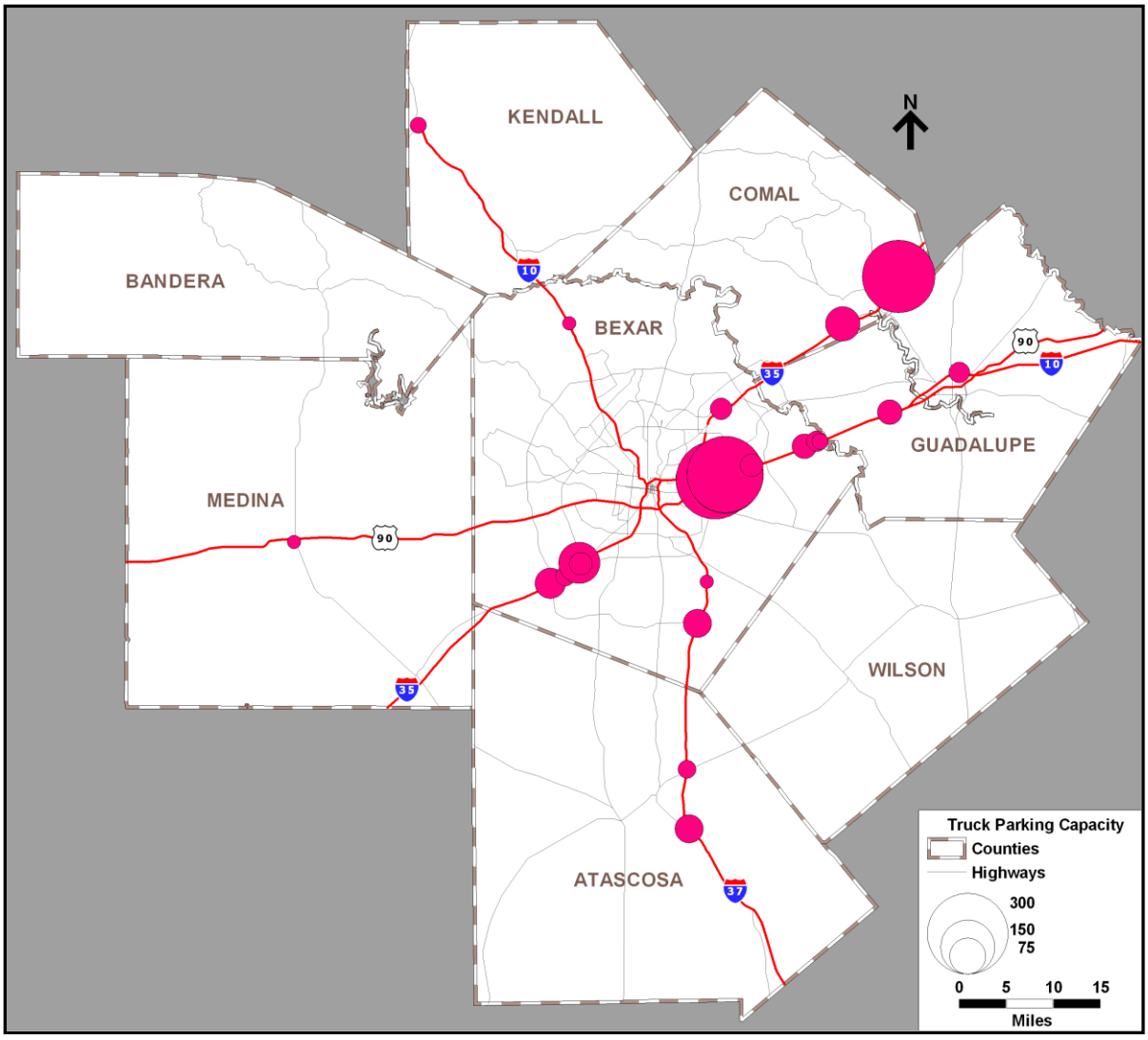
[17] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. p 3-1. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

[18] MacCormack, Published 12:00 a.m., Thursday, February 3, 2011. "Zeke Love's Travel Stop coming to Comfort". San Antonio Express News. San Antonio, Texas. Available online: http://www.mysanantonio.com/default/article/Love-s-Travel-Stop-coming-to-Comfort-990371.php. Accessed 04/06/11.

Figure 2-1: Location and Parking Capacity of Truck Stops in the San Antonio-New Braunfels MSA



Plot Date: April 8, 2011
Map Compilation: April 8, 2011
Source: Truck stop surveys, 2000 TIGER files

Table 2-1: Truck Stops in the San Antonio-New Braunfels MSA

Truck Stop	Address	Exit Number	County	Parking Spaces*
Kuntry Korner Steak & Eggs	IH 37 / Jim Brite Rd, Pleasanton	104	Atascosa	45
ZS Super Stop	IH 37 / FM 97, Pleasanton	109	Atascosa	24
EZ Mart	15537 IH 37, Elmendorf	125	Bexar	25
Tex Best Travel Center	20290 IH 37, Elmendorf	125	Bexar	30
Valero Ram Travel Center	IH 37, Elmendorf	130	Bexar	12
Texas Best Fuel Stop (Exxon)	14650 IH 35, Von Ormy	140	Bexar	15
Valero AAA Travel Center	14555 IH 35, Von Ormy	140	Bexar	70
Shell Time Wise Landmark	13437 IH 35, Von Ormy	141	Bexar	24
Love's Country Store	11361 IH 35, S Von Ormy	145	Bexar	108
Valero	IH 35, S Von Ormy	145	Bexar	50
Shell Truck Stop	11607 N IH 35, San Antonio	169	Bexar	45
PICO	25284 IH 10, San Antonio	550	Bexar	15
Petro Travel Plaza	1112 Ackerman Rd, San Antonio	582	Bexar	320
Pilot Travel Center	5619 IH 10 E, San Antonio	582	Bexar	50
Flying J Travel Plaza	1815 Foster Rd., San Antonio	583	Bexar	283
TA Travel Center	6170 IH 10 E, San Antonio	583	Bexar	258
Shell Truck Stop	8755 IH 10 E, Converse	585	Bexar	60
Alamo Travel Center	13183 IH 10, Converse	591	Bexar	40
Texaco	IH 10, Converse	593	Bexar	30
Trainer Hale Truck Stop	14462 IH 10, Converse	593	Bexar	25
Pilot Travel Center	4142 Loop 337, New Braunfels	184	Comal	80
Tex Best Travel Center	2735 N IH 35, New Braunfels	191	Comal	28
TA Truck Stop	4817 IH 35, New Braunfels	193	Comal	250
Sunmart No 167	6150 W IH 10, Seguin	601	Guadalupe	40
Jud's Food and Fuel - Shell	IH10/Hwy 123, Seguin	610	Guadalupe	40
Chevron	IH 10, Comfort	523	Kendall	20
Exxon Valley Mart	US 90, Hondo	533	Medina	10
Total				1,997

*****Data on number of parking spaces are from truck stop surveys

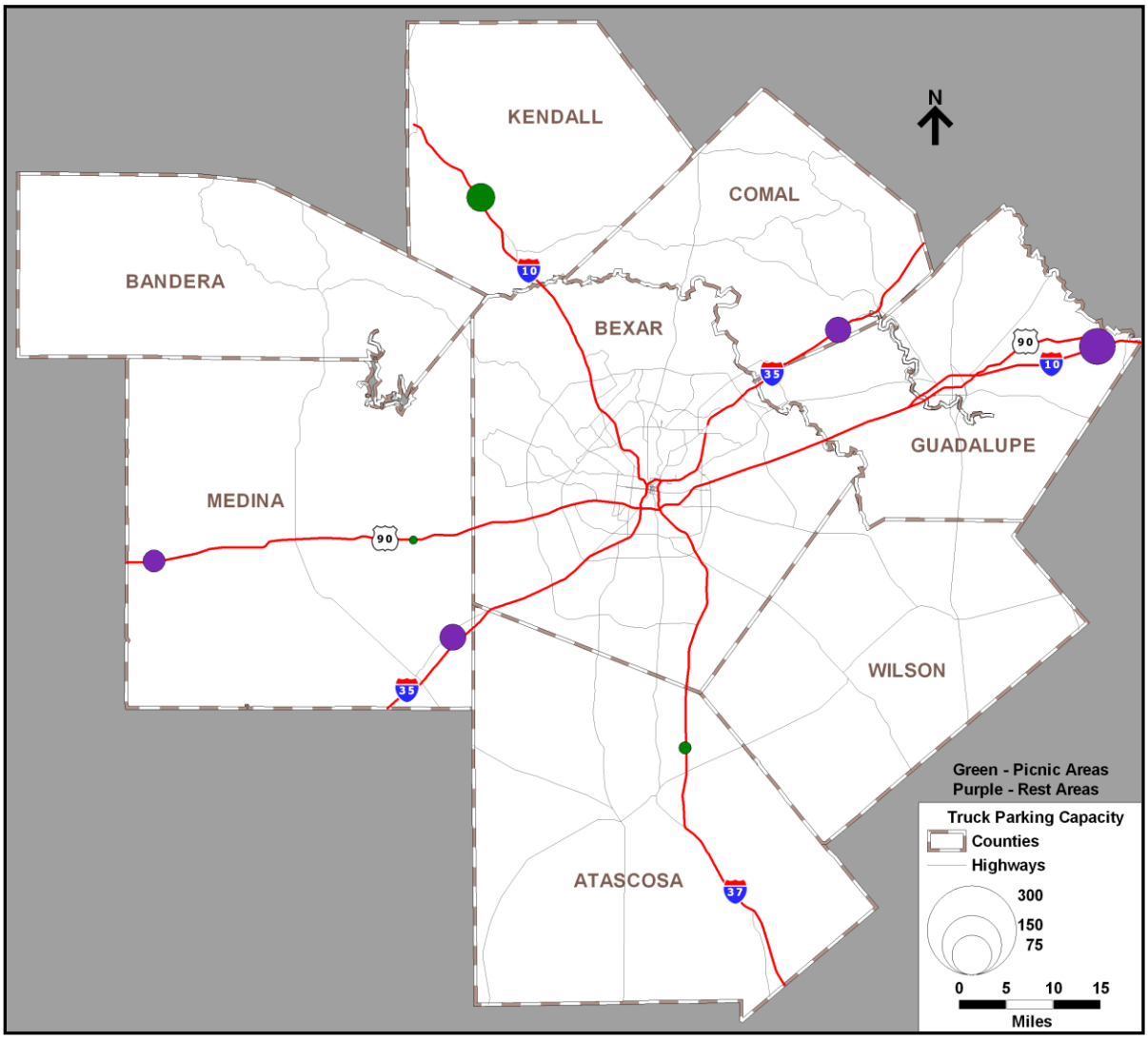
2.1.2. Rest Stops and Picnic Areas

TxDOT was contacted for information on the location of rest stops and to answer questions about newly built or renovated facilities in the AACOG region.[19] An official Texas Travel Map was also acquired to locate regional picnic areas. TxDOT is sponsoring a program whereby modern safety rest stops are being built to encourage drivers to stop more frequently. These facilities help drivers fight driving-related fatigue, which is a major cause of serious accidents: "attractive, safe, and clean rest area facilities are invitations to entice travelers to stop and rest. TxDOT's new generation of Safety Rest Areas feature regional designs, modern restrooms, interpretive displays, exhibits of local features, separate parking for cars and trucks, and wireless Internet access."[20] Construction of new rest stops with designated truck parking spaces and better amenities, such as air conditioned rooms and

[19] TxDOT Expressway, "Safety Rest Area Maps". Austin, Texas. Available online: http://www.dot.state.tx.us/mnt/sra/map.htm. Accessed 07/11/11.
[20] TxDOT, Sept. 2009. "Texas Safety Rest Area Program". Available online: ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/travel/sra_brochure.pdf. Accessed 07/11/11.

wireless Internet access, have made rest stops suitable resting places for long-haul truckers. A geographic database was created with information collected on rest stops and large picnic areas in the region (figure 2-2).

Figure 2-2: Location and Parking Capacity of Rest Areas and Picnic Areas in the San Antonio-New Braunfels MSA



Plot Date: April 8, 2011
Map Compilation: April 8, 2011
Source: Truck surveys, 2000 TIGER files

There are several smaller picnic areas located in the 8-county San Antonio-New Braunfels MSA but they are not located on major highways and have a parking area for no more than 5 trucks. Random visual inspections of these picnic areas during the survey indicate that no truck idling was occurring and these sites are not included in the emission inventory. All the rest stops and picnic areas that were surveyed, with the number of estimated parking spaces, are provided in table 2-2.

Table 2-2: Rest Areas and Picnic Areas in the San Antonio Region

Type	Location	Mile Marker	County	Parking Spaces*
Rest Areas	Northbound - IH 35	180	Comal	18
	Southbound - IH 35	180	Comal	18
	Eastbound - IH 10	619	Guadalupe	26
	Westbound - IH 10	619	Guadalupe	32
	Northbound - IH 35	130	Medina	17
	Southbound - IH 35	130	Medina	20
	Eastbound - US 90	518	Medina	15
	Westbound - US 90	518	Medina	13
Picnic Areas	Northbound - IH 37	112	Atascosa	28
	Southbound - IH 37	111	Atascosa	28
	Eastbound - IH 10	529	Kendall	17
	Westbound - IH 10	531	Kendall	25
	US 90	548	Medina	6

*****Data on number of parking spaces are from truck surveys

2.1.3. Other Idling Locations

Long term heavy-duty diesel truck idling occurs at other sites not included in the truck stops, rest areas, and picnic areas databases. Since long-haul truck idling is less predictable and tends to be minimal at these other locations due to limitations on space and facilities, they were not included in the idling survey. Other local sites where long term truck idling was observed included:

- Weigh stations
- Grain elevators
- Intersections of highways and local roads
- Highway service roads
- Warehouses
- Large department stores
- Food stands
- Office buildings

These sites did not have more than 4 trucks idling at any location during the survey and emissions were not included in the results. During the survey, extended idling was even observed by one long haul combination truck in AACOG's parking lot. However, the impacts of these sites are small compared to the large truck stops operating in the San Antonio-New Braunfels MSA.

2.2. Data Collection Methodology for Idling Emissions at Truck Stops

The goal of the truck idling survey in the San Antonio-New Braunfels MSA was to obtain information ~~that is~~ needed to develop temporal and spatial profiles used for estimating emissions. Data collection will included survey location, facility type, date of survey, time of survey, and meteorological conditions. The number of parking spaces, truck spaces filled, the number of trucks idling, condition of the parking lot, data on any electrification system, and any other information relevant to truck idling was collected at each location. Amenities at each location were noted including:

- Truck stop electrification facilities
- Pavement surface of parking lot
- Restrooms
- Information center
- Diesel truck fuel station
- Showers
- Public phone
- Vending machine

- Convenience store
- Fast food restaurants
- Movie rental
- Sit down restaurant
- Hotel
- Certified scales
- Wireless Internet
- Truck wash
- ATM
- Money order
- Tire repair facilities
- Laundry facilities
- Truck repair facilities

Each surveyor spent at least half an hour at each location to verify the identified trucks idled for sustained periods.

2.3. Quality Assurance and Quality Control Checks

A survey protocol was developed by AACOG (Appendix A) and reviewed by TCEQ before any surveys were conducted. All personnel conducting the surveys were provided with information on the survey purposes and procedures. Surveys by the various staff where checked to determine if surveys were being filled out using the same procedures and methodology.

Results were reviewed during the survey process to check for consistency and accuracy. The survey collection template had several minor updates after the first few samples were collected to increase the accuracy of the data collection during the surveying process. The updated survey template is provided in appendix B. Results were checked to make sure there were no errors on the survey responses and there were no outliers. Additionally, thirty three random surveys were conducted at locations that were already surveyed. After the random surveys were conducted, the confidence level was calculated to determine if additional sampling was required.

2.4. Data Collection Schedule

Each truck stop, rest area, and picnic area in the San Antonio-New Braunfels MSA was surveyed at least 6 times: 3 times on the weekday and 3 times on the weekend and for each time period. Since every site was surveyed multiple times, the results are statistically significant.

2.4.1. Time of Day Data Collection

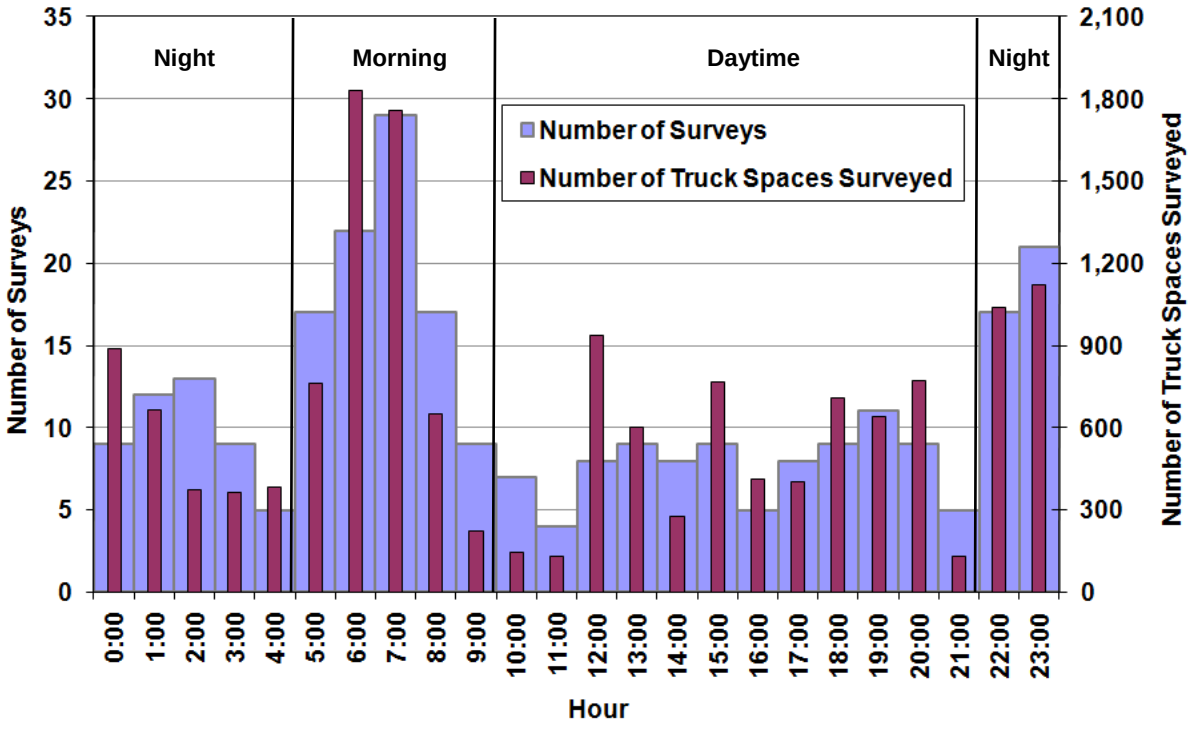
Based on the time periods determined by ERG to be statistically significant,[21] observations of truck engine idling were collected during the following three time periods:

- Morning (5 am – 10 am)
- Daytime (10 am – 10 pm)
- Evening/Night (10 pm – 5 am)

For data collected on weekdays, the morning and daytime periods included observations during local “rush hours” for consistency with how travel demand modeling is conducted. The number of surveys and the truck parking spot observations are provided by hour in figure 2-3. The largest number of surveys occurred between 5 am to 9 am and from 10 pm to midnight, but at least 4 surveys were collected for each hour of the day. The results of the survey were grouped into the three time periods.

[21] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. “Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report”. Sponsored by TCEQ. Austin, Texas. p. 6-15. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

Figure 2-3: Number of Surveys and Number of Truck Spots Surveyed by Hour of the Day



2.4.2. Day of the Week Data Collection

The extended idling database includes the number of idling trucks at each location for the two day-of-the week categories: weekday (Monday-Friday) and weekend (Saturday-Sunday). As shown in figure 2-4, every day of the week was covered by the survey with each day having between 19 to 78 surveys that covered 1,233 to 4,766 truck parking spaces.

2.4.3. Monthly Data Collection

Data collection occurred during San Antonio's fall and spring ozone season peaks (figure 2-5). Ozone season peaks in San Antonio occur from early April to late June and from August to October.[22] The number of surveys conducted per month is located below.

- October 2010 - 57 surveys
- November 2010 - 9 surveys
- March 2011 - 48 surveys
- April 2011 - 38 surveys
- May 2011 - 61 surveys
- June 2011 - 59 surveys

[22] Alamo Area Council of Governments, July 15th, 2011."Conceptual Model: Ozone Analysis of the San Antonio Region Updates through Year 2010". San Antonio, Texas.

Figure 2-4: Number of Surveys and Number of Truck Parking Spaces Surveyed by Day of the Week

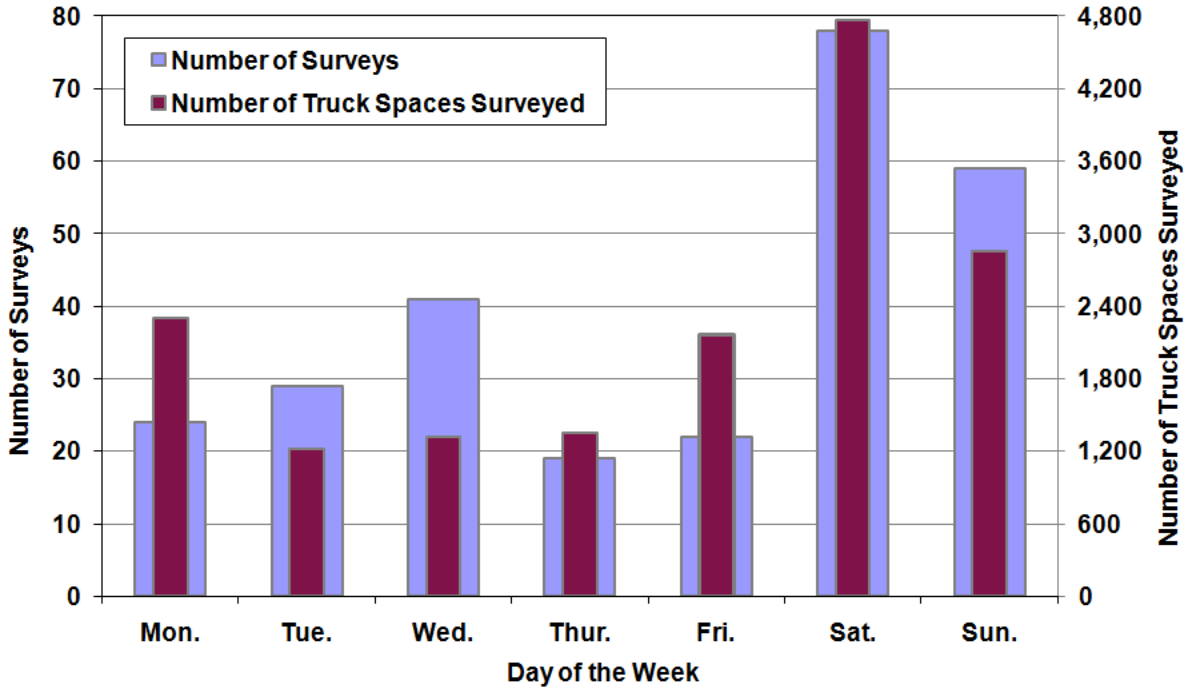
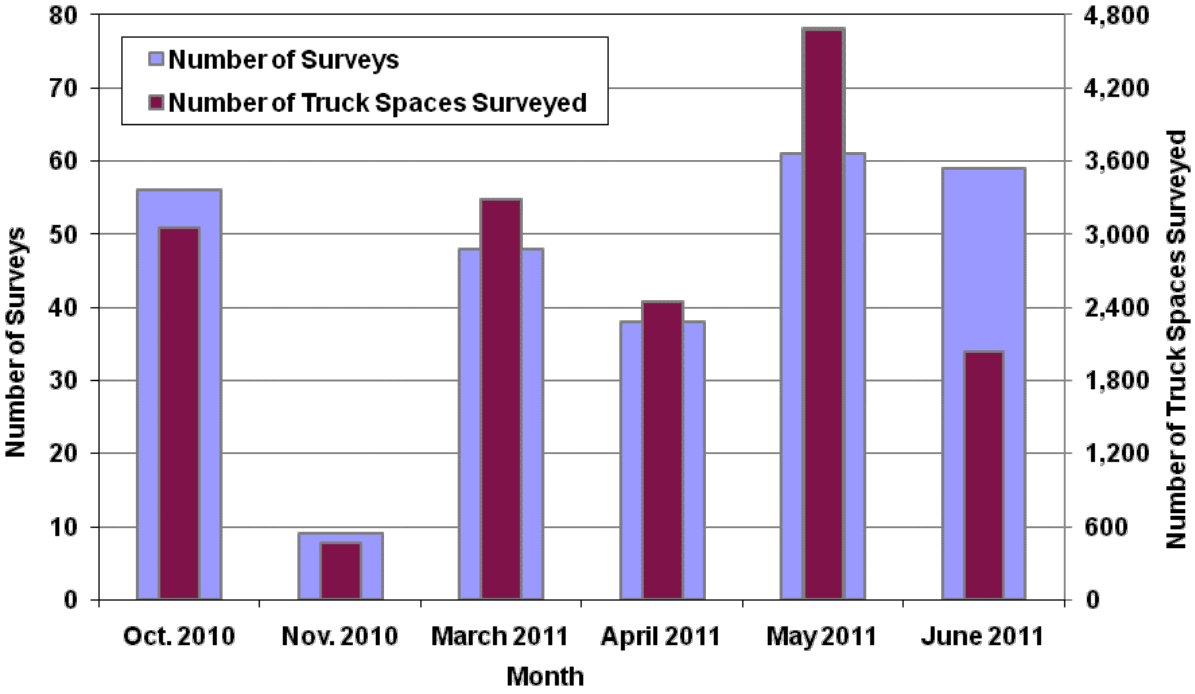


Figure 2-5: Number of Surveys and Number of Truck Parking Spaces Surveyed by Month



2.4.4. Facility Type Data Collection

Each facility type was surveyed multiple times: 184 truck stop surveys, 57 rest area surveys, and 31 picnic area surveys. The number of sites and parking spaces surveyed by time period are provided in table 2-3. Each facility was surveyed during the weekdays, weekends, morning, daytime, and nighttime.

Table 2-3: Data Collection Summary by Facility Type

Type	Time Period	Number of Surveys Conducted			Truck Parking Spaces Surveyed		
		Weekday	Weekend	Total	Weekday	Weekend	Total
Truck Stops	Morning	34	30	64	2,543	2,063	4,606
	Day	32	30	62	2,940	2,390	5,330
	Night	27	31	58	2,017	2,234	4,251
Rest Areas	Morning	10	8	18	195	159	354
	Day	10	11	21	196	201	397
	Night	8	10	18	180	196	376
Picnic Areas	Morning	5	7	12	104	160	264
	Day	5	4	9	104	90	194
	Night	4	6	10	76	132	208
Total		135	137	272	8,355	7,625	15,980

3. DATA ANALYSIS AND EMISSION INVENTORY

3.1. Amenities at Truck Idling Locations

Amenities at fuel/rest stops available to truck drivers vary greatly. Many amenities are not visibly advertised and are only apparent by entering the facilities of the truck stop. Furthermore, some amenities such as hotels or restaurants might not be located on the grounds of the truck stop but located nearby and are well known to visiting drivers. Therefore every effort was made by AACOG staff to locate these amenities that may impact utilization and idling rates. A list of amenities and the percentage of locations with each amenity are listed in table 3-1 and a detail list by facility is provided in appendix C.

Table 3-1: Facility Amenity Distribution for All Inventoried Locations

Amenity	*Percentage of Locations with Amenity*
Paved	98%
Truck Electrification	0%
Restrooms	88%
Fuel	65%
Showers	28%
Public Phone	58%
Vending Machine	38%
Convenience Store	68%
Fast Food	53%
Sit Down Restaurant	35%
Hotel	25%
Certified Scales	25%
Wireless Internet	35%
Truck Wash	15%
ATM	63%
Money Order	25%
DVD Rental	10%
Tire/Truck Repair	25%
Laundry Facilities	10%

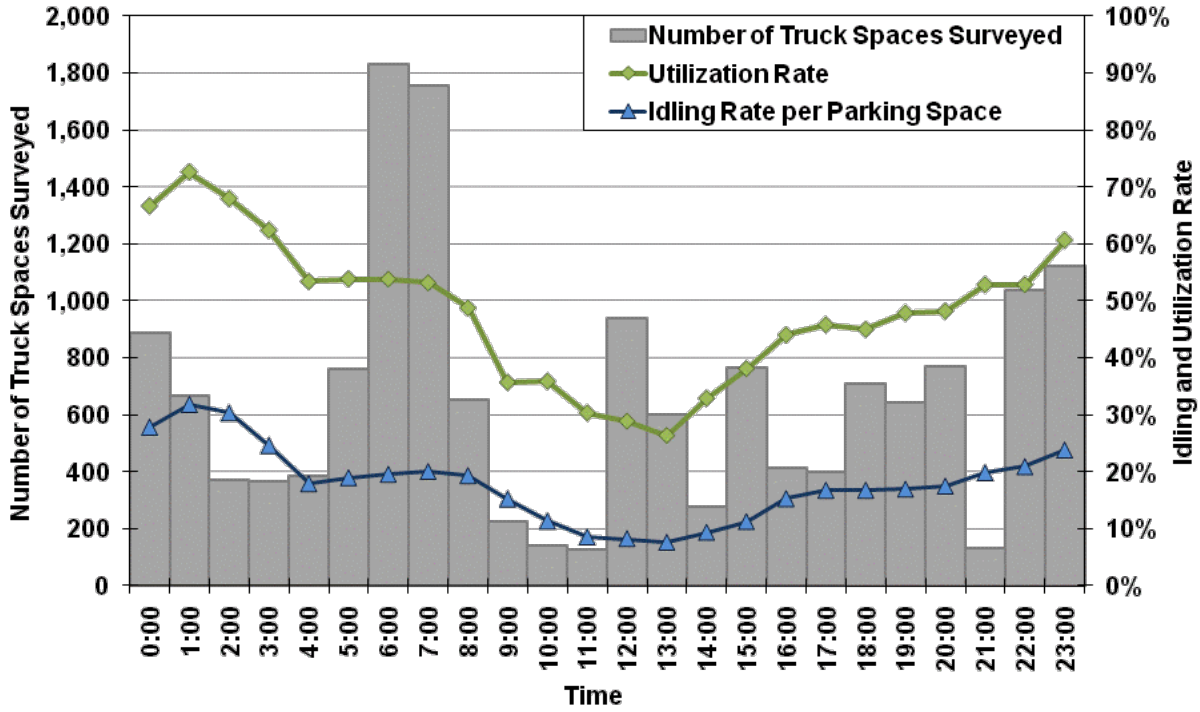
3.2. Time of Day patterns

3.2.1. Time of Day Variation

Three time periods, morning, daytime, and nighttime, were surveyed multiple times. Utilization rates varied between 26 percent at 1:00 pm in the afternoon to 73 percent at 1:00 am in the morning (figure 3-1). Average idling rate per parking space was between 8 and 32 percent throughout the day with the highest values occurring between 11:00 pm and 3:00 am. By 8:00 am, idling rates per parking space decreased with rates starting to increase again around 5:00 pm. Future studies should examine the impact of extending the nighttime period a few hours earlier to between 6:00 pm and 5:00 am.

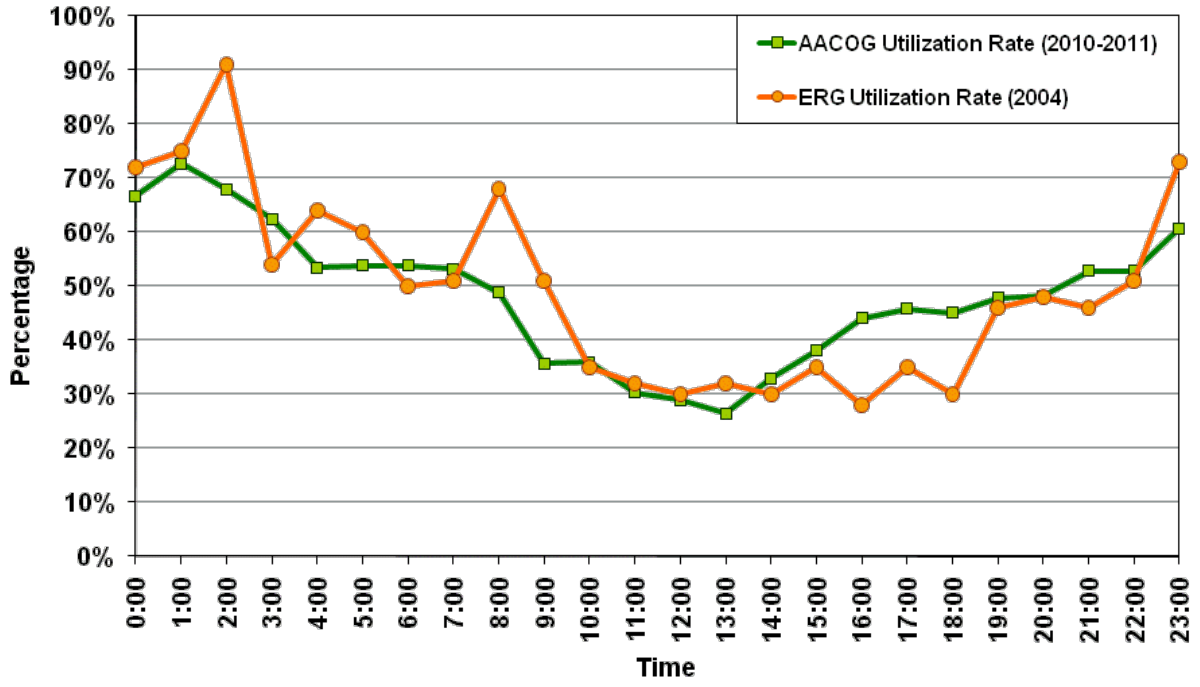
Comparison of hourly utilization and idling rates per parking space between ERG and AACOG survey results are provided in figures 3-2 and 3-3. For most time periods, there was not statistically significant difference between ERG's and AACOG's surveys. AACOG survey results showed a slightly higher utilization rate in the early evening between 4:00 pm and 6:00 pm

Figure 3-1: Utilization Rate and Idling Rate per Parking Space by Hour*



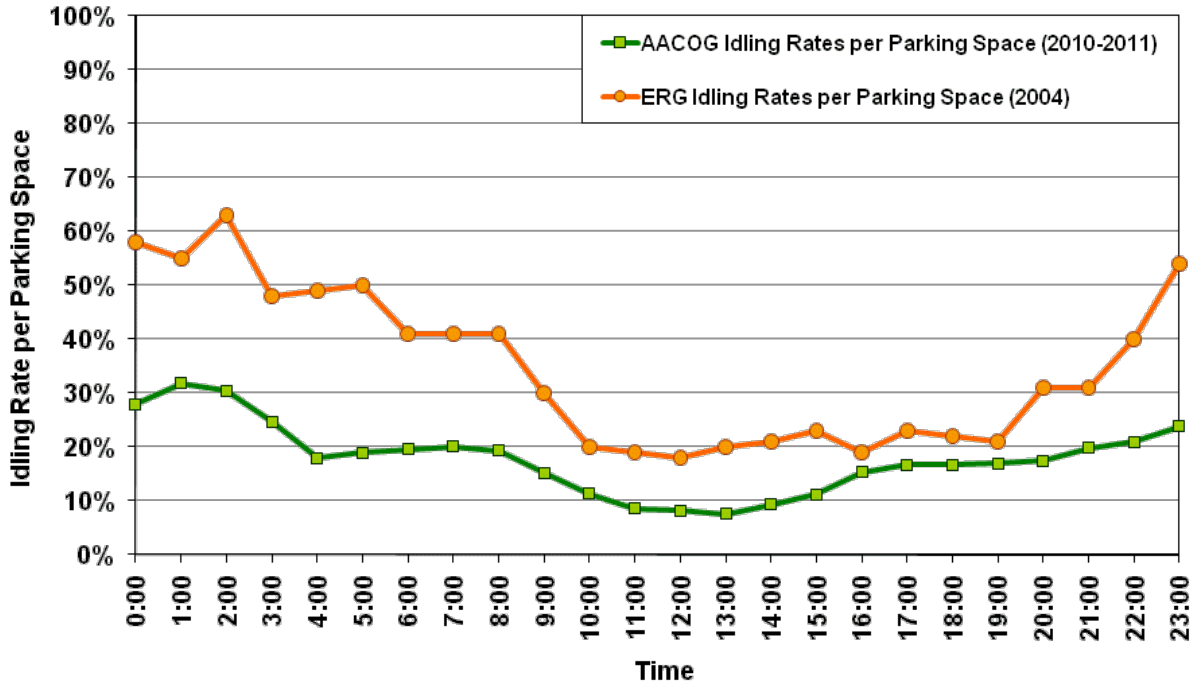
* Averaged over 3-hour periods

Figure 3-2: Comparison between AACOG and ERG Observed Hourly Utilization Rates



Although utilization rates were similar between the two studies, results from AACOG's survey showed significantly lower idling rates per parking space. While, ERG reported idling rates per parking space between 18 and 63 percent, AACOG results were only between 8 and 32 percent. The greatest difference between the studies occurred during the nighttime survey period. Overall, ERG's average survey results are 86% higher than idling rates observed during AACOG's survey.

Figure 3-3: Comparison between AACOG and ERG Observed Hourly Idling Rates



As shown in table 3-2, AACOG's results are significantly lower during the weekday mornings and evenings compared to ERG findings. Although weekend morning and daytime idling rates per parking space were lower than the ERG survey, the results are within the 95% confidence level. ERG did not provide data for weekend nights for the San Antonio-New Braunfels MSA or Texas. ERG results for weekday daytime, weekday night, and weekend daytime were for the San Antonio area because ERG found that idling rates during these time periods are statistically different in San Antonio compared to the rest of the state.[23]

Some of the difference in observed idling rates could be caused by the rapid increase in diesel prices from 2004 to 2011 and the use of auxiliary power unit (APU) to provide power during idle periods for such features as heating and air conditioning rather than rely on truck engines to provide that power. ERG's surveys concentrated on larger truck stops, while AACOG conducted observations at all trucks stops, rest areas, and picnic areas in the region. However, the small truck stops and picnic areas would not change the idling rates per parking spaces significantly because the larger truck stops had significantly more truck parking spaces.

[23] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. p. 6-16. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

Table 3-2: Comparison between AACOG and ERG Observed Idling Rates by Parking Space for each Day Type and Time Period

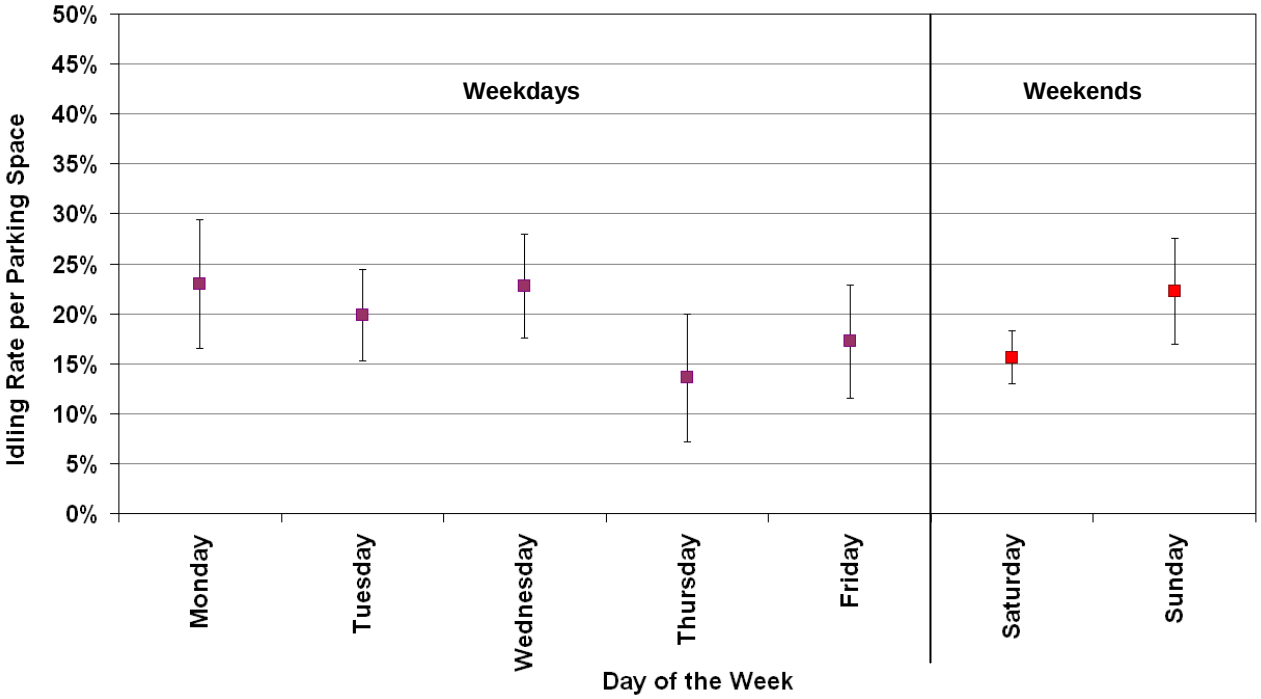
Type of Day	Statistic Test	Morning		Daytime		Evening/Night	
		ERG (Texas)	AACOG	ERG (SA MSA)	AACOG	ERG (SA MSA)	AACOG
Weekday	Low	28%	14%	10%	9%	35%	15%
	Mean	33%	18%	14%	12%	64%	21%
	High	38%	21%	17%	16%	93%	26%
	Standard Dev.	18%	14%	13%	12%	51%	18%
	Number	58	49	49	47	14	39
	Confidence Level	5%	4%	4%	3%	29%	6%
Weekend	Low	18%	10%	12%	6%	-	14%
	Mean	25%	14%	20%	9%	-	21%
	High	31%	18%	27%	12%	-	27%
	Standard Dev.	17%	13%	26%	10%	-	22%
	Number	26	45	48	45	-	47
	Confidence Level	7%	4%	8%	3%	-	6%

Based on 95 % confidence level

3.2.2. Day of the Week Variation

The extended idling data set includes the number of idling trucks at each location for the two day-of-the week categories: weekday (Monday-Friday) and weekend (Saturday-Sunday). From the data displayed in figure 3-4, idling rates are within the 95% confidence level for every day of the week. The weekend idling rates were similar to the weekday idling rates with an average idling rate of 19 percent (table 3-3). Daily variations in the sampling can be influenced by the type of facility and time periods the data was collected. Uniform data for weekday and weekend periods was collected, but there was no attempt to collect uniform data by day during the survey process.

Figure 3-4: Idling Rate per Parking Space, Day of the Week



Error bars are based on the 95 % confidence level

Table 3-3: Statistical Analysis of Idling Rates per Parking Space, by Day of the Week

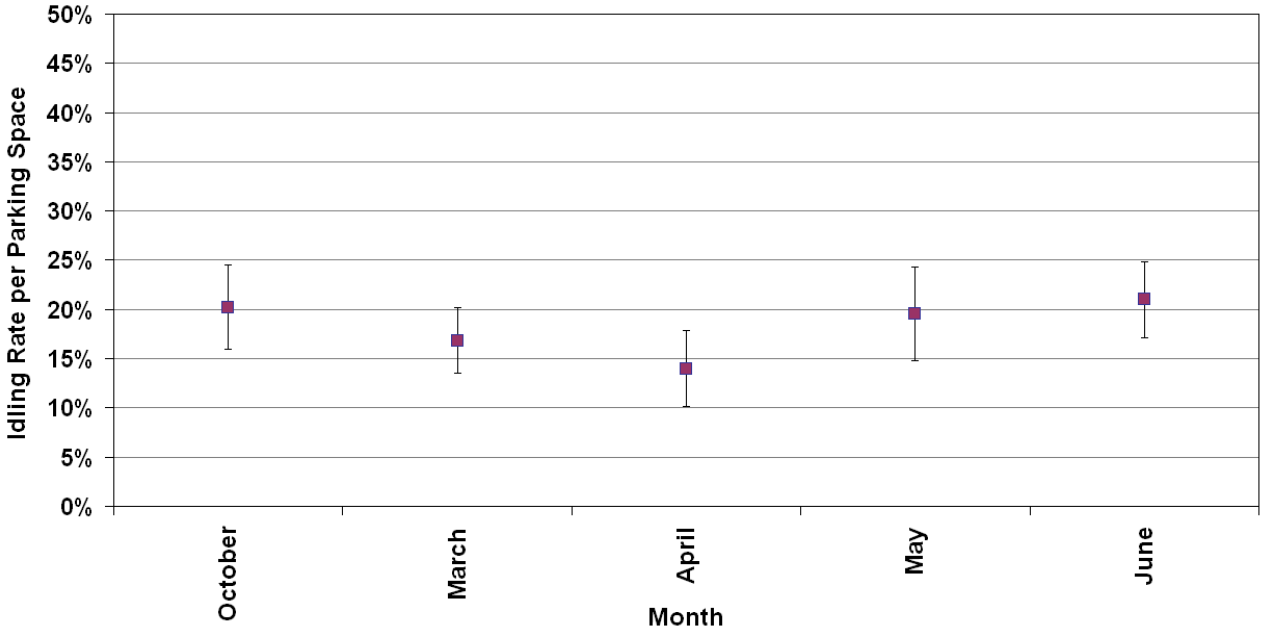
Parameter	Mon.	Tue	Wed	Thu	Fri	Sat	Sun	Total
Number of Surveys	24	29	41	19	22	78	59	272
Number of Truck Spaces	2,297	1,223	1,321	1,354	2,160	4,766	2,859	15,980
Number of Trucks Idling	1,281	677	485	594	1,392	2,113	1,497	8,039
Idling Rate per Parking Space	527	243	301	184	372	745	635	3,007
Standard Deviation	16%	13%	17%	14%	13%	12%	21%	16%
Low	17%	15%	18%	7%	12%	13%	17%	17%
Mean	23%	20%	23%	14%	17%	16%	22%	19%
High	29%	24%	28%	20%	23%	18%	28%	21%
Confidence Level	6%	5%	5%	6%	6%	3%	5%	2%

3.2.3. Monthly Variation

Data was collected for the following months: October, November, March, April, May, and June. November survey results were removed from the monthly variation comparison because there were not enough data points for an accurate analysis: only 9 surveys were conducted during November. The month with the highest number of surveys and parking space observations was May, 2011, while the month with the fewest surveys included in the analysis was April (figure 3-5).

The data provided in table 3-4 demonstrates that variation in idling rates between months was within the 95% confidence level. October, May, and June had almost identical results for idling rates per parking space. April had slightly lower idling rates then the other months during the survey, but this may be due to variations in truck idling locations and time periods surveyed. Monthly variations in the sampling can be influenced by the type of facility and the time periods for data collection. There was no attempt to collect uniform data by month during the survey process.

Figure 3-5: Idling Rate per Parking Space, by Month



Error bars are based on the 95 % confidence level

Table 3-4: Statistical Analysis of Idling Rates per Parking Space, by Month

Parameter	October	March	April	May	June	Total
Number of Surveys	57	48	38	61	59	263
Number of Truck Spaces	3,060	3,282	2,449	4,682	2,034	15,507
Number of Trucks Idling	617	553	343	917	427	2,857
Standard Deviation	17%	12%	12%	19%	15%	18%
Low	16%	13%	10%	15%	17%	17%
Mean	20%	17%	14%	20%	21%	18%
High	24%	20%	18%	24%	25%	20%
Confidence Level	4%	3%	4%	5%	4%	2%

3.2.4. Facility Type Variation

Utilization rates and idling rates varied by facility type, while idling rates per parking space were similar for each facility type (figure 3-6). Utilization rates were 53 percent for truck stops, 35 percent for rest areas, and 21 percent for picnic areas. Although picnic areas had low utilization rates, idling rates at these facilities were highest (67%). The opposite was observed for truck stops, which had high utilization rates, but low idling rates (35%).

Idling rates per parking space were similar for all facility types: 14% to 19% (see table 3-5). The results for idling rate per parking space by facility type were within the 95% confidence level. The 95% confidence level was smaller at truck stops, 2 percent, compared to the other facility types because more surveys were conducted at truck stops compared to rest areas and picnic areas.

Figure 3-6: Utilization Rate, Idling Rate, and Idling Rate per Parking Space, by Facility

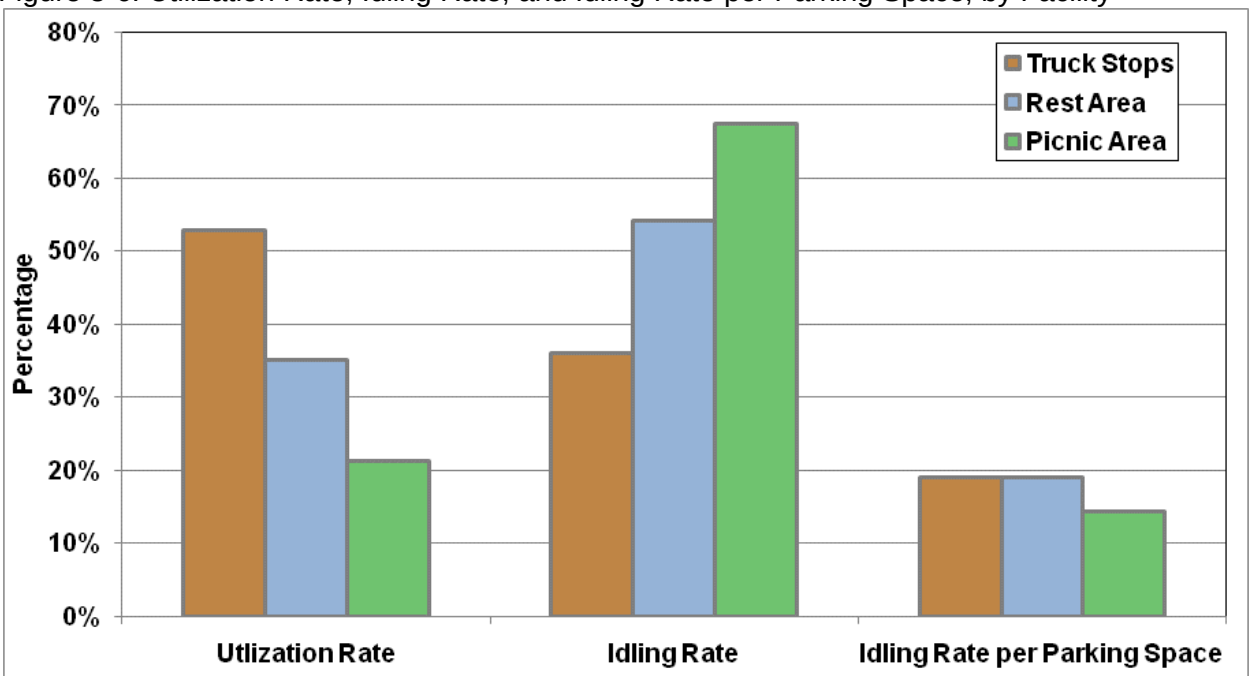


Table 3-5: Statistical Analysis of Idling Rates per Parking Space, by Facility Type

Factors		Truck Stops	Rest Area	Picnic Area
Number of Surveys		184	57	31
Number of Truck Spaces		14,187	1,120	666
Number of Spaces Filled		7,502	393	141
Number of Trucks Idling		2,698	213	95
Utilization Rate		53%	35%	21%
Idling Rate		36%	54%	67%
Idling Rate per Parking Space	Low	17%	15%	10%
	Mean	19%	19%	14%
	High	21%	23%	19%
	Standard Deviation	16%	16%	13%
	Confidence Level	2%	4%	5%

3.3. Random Survey Results

To ensure that results from the survey were statistically accurate, additional random surveys were conducted at the same locations included in the main survey. During the process, 33 random surveys were performed during the following months:

- March 2011 - 7 surveys
- April 2011 - 4 surveys
- May 2011 - 16 surveys
- June 2011 - 6 surveys

As provided in table 3-6, the random survey consisted of observations at 2,383 parking spaces, of which 1,312 were occupied by trucks. The confidence level for the main survey was between 16 and 20 percent while the random survey was between 16 and 32 percent for idling rate per parking space. The results of the random survey were within the 95% confidence level for utilization rate, idling rate, and idling rate per parking space.

Table 3-6: Statistical Analysis of Random Survey Observations

Factors		Main Survey	Random Survey
Number of Surveys		239	33
Number of Truck Spaces		13,597	2,383
Number of Spaces Filled		6,727	1,312
Number of Trucks Idling		2,438	569
Utilization Rate	Low	46%	45%
	Mean	49%	55%
	High	53%	65%
	Standard Deviation	28%	30%
	Confidence Level	4%	10%
Idling Rate	Low	32%	34%
	Mean	36%	43%
	High	40%	53%
	Standard Deviation	31%	27%
	Confidence Level	4%	9%
Idling Rate per Parking Space	Low	16%	16%
	Mean	18%	24%
	High	20%	32%
	Standard Deviation	14%	23%
	Confidence Level	2%	8%

Based on 95 % confidence level

3.4. Statistical Analysis

Since particular amenities may be more attractive to truck drivers than others, statistical analyses were performed to determine if there was significant variation in idling rates due to the availability of amenities, as well as other factors such ambient temperature. Table 3-7, 3-8, and 3-9 provides the correlations between truck stops amenities, utilization rates, idling rates, and idling rates per parking space. Facility size and the availability of showers, certified scales, and fast food restaurants had the strongest correlation with utilization rates. The weakest correlations with utilization rates were the month when the survey took place, weekend or weekday, and the presence of a hotel. Observed utilization rates were not dependent on the day of the week and month of the survey. Factors having the lowest

correlation to idling rates were temperature, weekend/weekday, and the availability of a repair shop or laundry facility.

Idling rates did not vary significantly with the time of day, while time of day had the strongest relationship with the idling rate per parking space. Idling rate per parking space was not impacted by the type of facility and day of the week. Also, the presence of a truck wash, fuel supply, and convenience store had no impact on idling rate per parking space. As shown on the scatter plots provided in figure 3.7, there was no relationship between facility size and idling rates (R^2 = 0.01) and idling rates per parking space (R^2 = 0.03). There was only a weak relationship between utilization rate and facility size (R^2 = 0.16). There was no relationship between temperature and utilization rates, idling rates, and idling rates per parking space (figure 3.8). Temperatures recorded during the survey ranged between 36ºF and 95ºF, however the percentage of trucks idling remained constant.

Table 3-7: Relationship between Truck Stop Amenities and Utilization Rates

Factor	Utilization Rate			
	n	χ2	P-value	φc
Showers	272	810	0.000	1.22
Certified Scales	272	580	0.000	1.03
Size of the Facility#	272	474	0.000	0.93
Fast food restaurants	272	370	0.000	0.82
Tire Repair / Repair Shop	272	315	0.000	0.76
Laundry	272	315	0.000	0.76
Time of Day	272	283	0.000	0.72
Temperature#	272	218	0.000	0.63
Truck Wash	272	212	0.000	0.62
Type of Facility	272	183	0.000	0.58
Fuel	272	176	0.000	0.57
Convenience store	272	166	0.000	0.55
Sit down restaurant	272	154	0.000	0.53
Restrooms	272	120	0.000	0.47
Month**	263	94	0.000	0.42
Weekend / Weekday	272	25	0.000	0.22
Hotel	272	21	0.000	0.20

Table 3-8: Relationship between Truck Stop Amenities and Idling Rates

Factor	Idling Rate			
	n	χ2	P-value	Φc
Sit down restaurant	272	166	0.000	0.55
Fast food restaurants	272	129	0.000	0.49
Truck Wash	272	123	0.000	0.48
Size of the Facility[#]	272	103	0.000	0.44
Showers	272	95	0.000	0.42
Type of Facility	272	67	0.000	0.35
Fuel	272	65	0.000	0.35
Convenience store	272	62	0.000	0.34
Hotel	272	61	0.000	0.33
Month**	263	51	0.000	0.31
Certified Scales	272	41	0.000	0.27
Restrooms	272	34	0.000	0.25
Temperature[#]	272	31	0.000	0.24
Tire Repair / Repair Shop	272	23	0.000	0.20
Laundry	272	23	0.000	0.20
Time of Day	272	19	0.000	0.19
Weekend / Weekday	272	1	0.277	0.05

Table 3-9: Relationship between Truck Stop Amenities and Idling Rate per Parking Space

Factor	Idling Rate per Parking Space			
	n	χ2	P-value	φc
Time of Day	272	212	0.000	0.62
Hotel	272	108	0.000	0.44
Showers	272	91	0.000	0.41
Certified Scales	272	86	0.000	0.40
Size of the Facility[#]	272	69	0.000	0.36
Temperature[#]	272	65	0.000	0.35
Tire Repair / Repair Shop	272	36	0.000	0.26
Laundry	272	36	0.000	0.26
Sit down restaurant	272	20	0.000	0.19
Month**	263	16	0.000	0.17
Restrooms	272	8	0.004	0.12
Fast food restaurants	272	8	0.004	0.12
Type of Facility	272	8	0.022	0.12
Weekend / Weekday	272	4	0.045	0.09
Truck Wash	272	4	0.057	0.08
Fuel	272	3	0.081	0.07
Convenience store	272	3	0.101	0.07

**Not Including November 2010 because there was not enough survey data

[#]Split into four equal size categories (36°F-67°F, 68°F-72°F, 73°F-77°F, 78°F-95°F)

Figure 3-7: Comparison between Truck Stop Size and Utilization Rate, Idling Rate, and Idling Rate per Parking Space

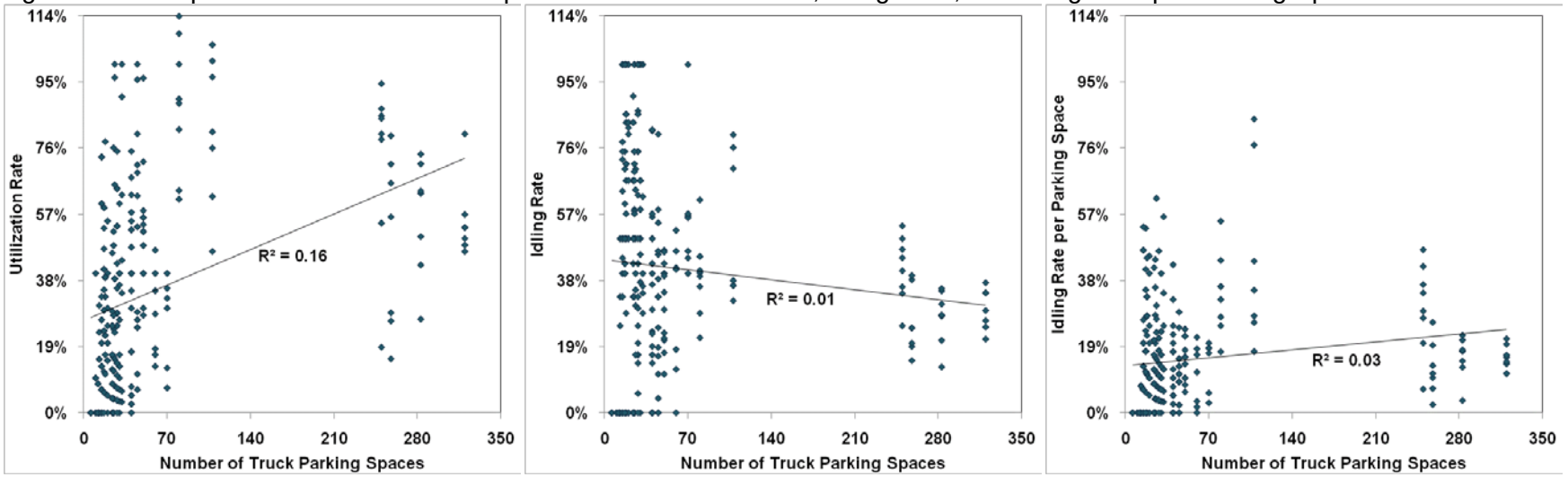
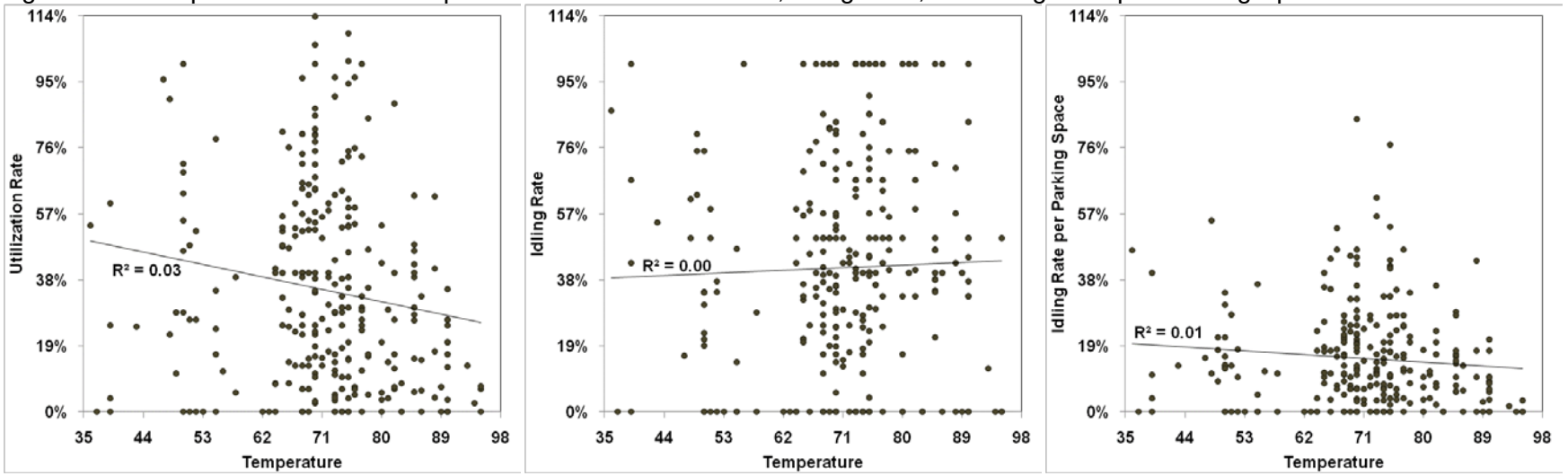


Figure 3-8: Comparison between Temperature and Utilization Rate, Idling Rate, and Idling Rate per Parking Space



3.5. Truck Stop Electrification Programs

In May 2001, President Bush signed the *National Energy Policy* directing the EPA and the Department of Transportation (DOT) to work with the trucking industry to establish a program to reduce emissions and fuel consumption from the use of long-haul trucks. Responding to this directive, the EPA initiated a comprehensive program to reduce idling and exhaust emissions.[24] This effort included promotion of electrified parking spaces (EPS) to replace the need for engine idling. Although the initiative helped establish EPS at a very limited number of facilities in the AACOG region, the electrification equipment has since been removed. Surveyors verified the absence of any electrification equipment at truck stops in the AACOG region; therefore, emission reductions from EPS are not included in the results.

3.6. Emission Factors

Data collection from the truck idling survey provided data used to estimate extended idling emissions for the combination (tractor/trailer) long-haul truck category. This is the only source use type within the current version of the Motor Vehicle Emission Simulator model (MOVES)[25] for which extended idling emissions can be estimated. The vehicle category is more commonly referred to as diesel-powered five-axle "eighteen-wheelers", but other four-axle and six-axle configurations are also included in this category. Combination long-haul trucks are classified in MOVES as trucks primarily operated outside of 200 miles of home base.[26]

The primary inputs needed by MOVES to estimate idling emissions are the number of hours operating (SHO) in extended idling mode, which was provided by the survey. Other local inputs into the MOVES model are from Texas Transportation Institute's (TTI) 2008 report "On-Road Mobile Source Emissions Trends for all 254 Texas Counties: 1990 through 2040".[27] Idling emission factors for heavy duty long-haul trucks are provided in table 3-10.

Table 3-10: Heavy Duty Truck Idling Emission Factors from the MOVES Model

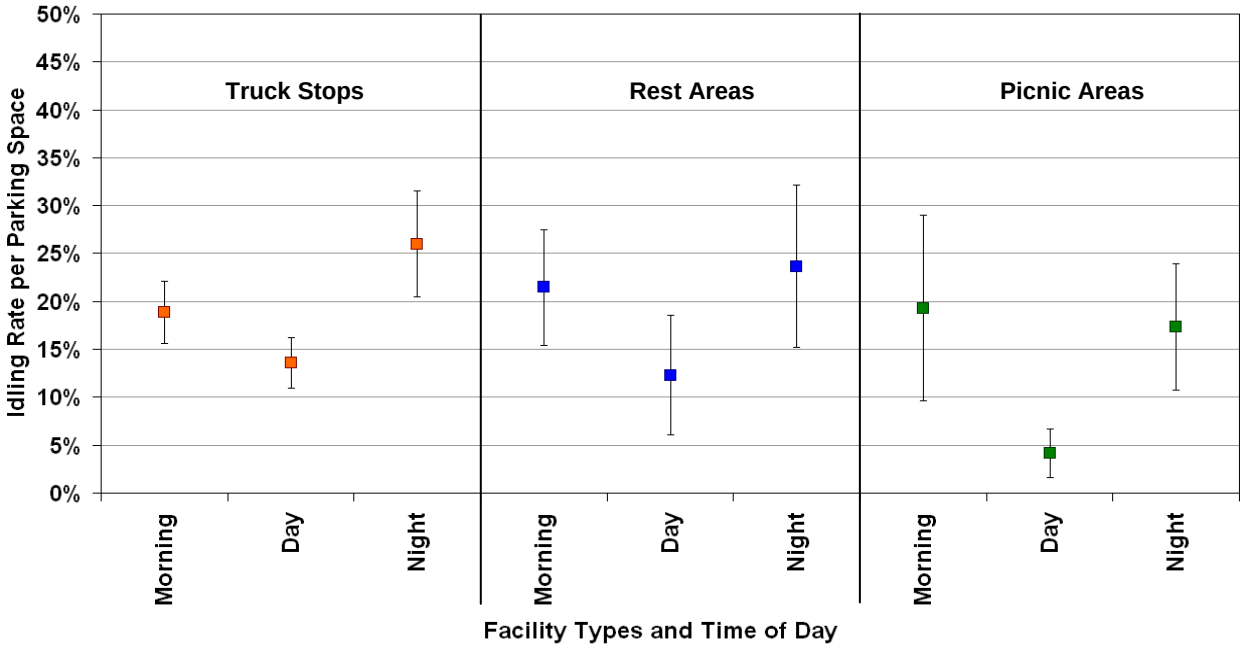
Year	NOx	VOC
2006	226.01 grams/hour	57.90 grams/hour

3.7. Emission Calculation Methodology

Truck parking spaces in the San Antonio-New Braunfels MSA include a total of 1,997 parking spaces at truck stops, 159 parking spaces at rest areas, and 104 parking spaces at picnic areas. Idling rates used to calculate emissions per parking space by facility type and time of the day are provided in figure 3-9 and table 3-10. Data for picnic areas are limited because there are only five picnic areas on major highways in the San Antonio-New Braunfels MSA.

[24] EPA. "SmartWay Transport". Office of Transportation and Air Quality (OTAQ). Available online: http://nsdi.epa.gov/otaq/smartway/transport/index.htm. Accessed 07/1/11.
[25] U.S. EPA, December 2009. Office of Transportation and Air Quality Washington, DC. Motor Vehicle Emission Simulator. Available online: http://www.epa.gov/otaq/models/moves/index.htm. Accessed 07/07/11.
[26] John Koupal, Mitch Cumberworth, and Megan Beardsley, June 9, 2004. "Introducing MOVES2004, the initial release of EPA's new generation mobile source emission model". U.S. EPA Office of Transportation and Air Quality, Assessment and Standards Division. Ann Arbor, MI. Available online: http://www.epa.gov/ttn/chief/conference/ei13/ghg/koupal.pdf. Accessed 07/11/11.
[27] TCEQ, August 2008. "On-Road Mobile Source Emissions Trends for all 254 Texas Counties: 1990 Through 2040". TTI. College Station, Texas.

Figure 3-9: Idling Rate per Parking Space for Each facility and Time Period



Error bars are based on the 95 % confidence level

Table 3-11: Idling Rates per Parking Space by Day Type, Facility Type, and Time Period

Day Type	Statistical Test	Weekday			Weekend		
		Truck Stops	Rest Areas	Picnic Areas	Truck Stops	Rest Areas	Picnic Areas
Total Morning	Low	17%	15%	1%	11%	11%	11%
	Mean	22%	24%	11%	15%	19%	25%
	High	27%	33%	20%	19%	27%	39%
	Standard Dev.	14%	14%	11%	11%	12%	19%
	N	34	10	5	30	8	7
	Confidence Level	5%	9%	10%	4%	8%	14%
Total Day	Low	9%	6%	2%	10%	3%	0%
	Mean	13%	17%	6%	14%	8%	2%
	High	17%	28%	10%	18%	13%	5%
	Standard Dev.	10%	18%	5%	11%	9%	3%
	N	32	10	5	30	11	4
	Confidence Level	4%	11%	4%	4%	5%	3%
Total Night	Low	19%	17%	9%	18%	7%	8%
	Mean	25%	32%	24%	26%	16%	14%
	High	32%	46%	38%	35%	26%	19%
	Standard Dev.	17%	21%	15%	25%	15%	7%
	N	27	8	4	31	10	6
	Confidence Level	7%	14%	15%	9%	9%	6%

Based on 95 % confidence level

The following equations were used to calculate county total daily and annual emissions for extended truck idling at each facility type.

Equation (1) – Daily emissions for each facility type and time period per county

DE_{ABC} = $RATE_{BC}$ x SP_{AC} x HRS x EF / 907,184.74 grams/ton

Where,

DE_{ABC} = Daily Emissions from County A for Time Period B and Facility Type C (tons)

$RATE_{BC}$ = Idling Rates per Parking Space for Time Period B and Facility Type C (from survey data located in Table 3-6)

SP_{AC} = Number of Truck Parking Spaces in County A for Facility Type C (from survey data located in Table 2-1 and 2-2)

HRS = Number of Hours per Time Period B (Morning – 5 hrs, Daytime – 12 hrs, and Nighttime – 12 hrs)

EF = Idling Emissions factor for Combination Long-Haul Trucks in 2006, 226.01 grams of NOx-hr and 57.90 grams of VOC-hr (from the MOVES model)

Sample equation for morning NOx emissions from truck stops in Bexar County

DE_{ABC} = 22.02% Idling Rate per Parking Space During Weekday Mornings x 1,434 Truck Stop Parking Spaces x 5 hours x 226.01 grams of NOx-hr / 907,184.74 grams/ton

= 0.39 tons of NOx/weekday morning emissions from truck stops in Bexar County

Equation (2) – Annual emissions per county for each facility type

AE_{AC} = [(DME_{AC} + DDE_{AC} + DNE_{AC}) x 261 weekdays/year] + [(EME_{AC} + EDE_{AC} + ENE_{AC}) x 104 weekend days/year]

Where,

AE_{AC} = Annual Emissions from County A for Facility Type C (tons/year)

DME_{ABC} = Idling Emissions for Weekday Morning for Facility Type C (from equation 1)

DDE_{ABC} = Idling Emissions for Weekday Daytime for Facility Type C (from equation 1)

DNE_{ABC} = Idling Emissions for Weekday Nighttime for Facility Type C (from equation 1)

EME_{ABC} = Idling Emissions for Weekend Morning for Facility Type C (from equation 1)

EDE_{ABC} = Idling Emissions for Weekend Daytime for Facility Type C (from equation 1)

ENE_{ABC} = Idling Emissions for Weekend Nighttime for Facility Type C (from equation 1)

Sample Equation for annual NOx emissions from truck stops in Bexar County

DE_{ABC} = [(0.39 tons + 0.56 tons + 0.64 tons) x 261] + [(0.27 tons + 0.61 tons + 0.66 tons) x 104]

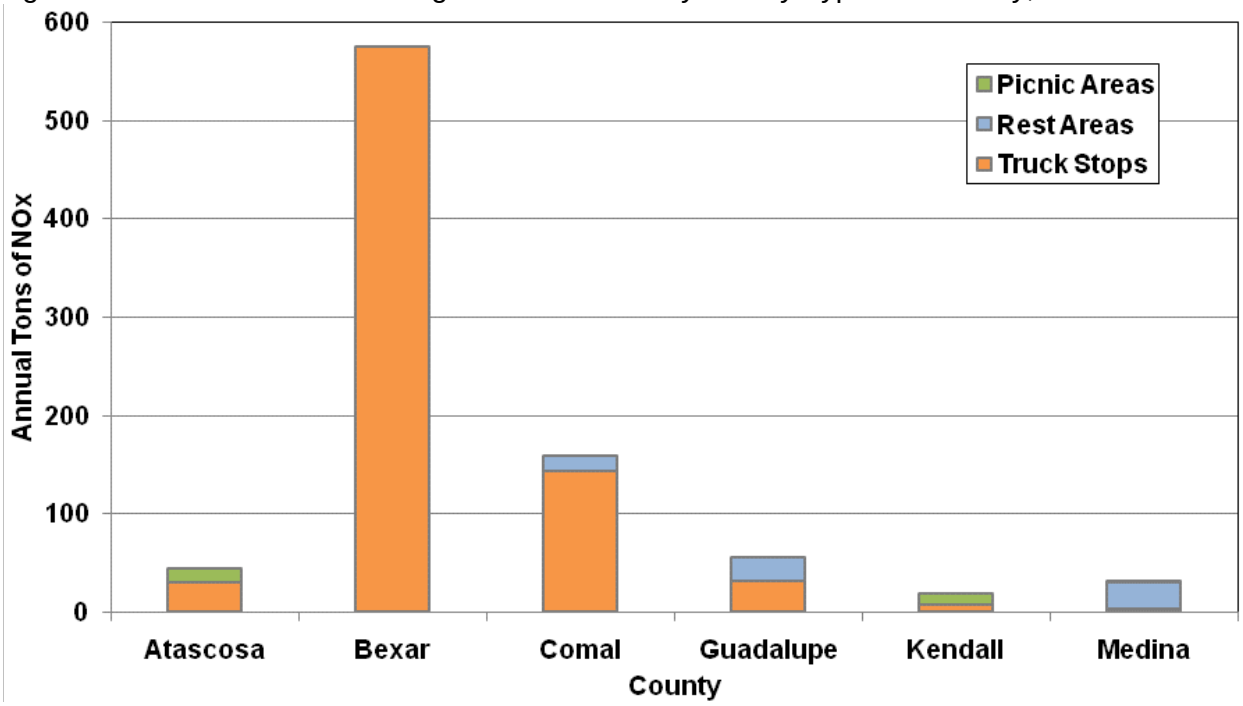
= 574.80 tons of NOx/year from truck stops in Bexar County

3.8. Heavy Duty Truck Idling Emission Totals

Extended truck idling emission totals for each facility type and county is provided in figure 3-10. Total annual NOx emissions from extended truck idling in the San Antonio-New Braunfels MSA were estimated to be 883 tons per year while total VOC emissions were estimated to be 226 tons per year (table 3-12). Bexar County dominates emissions, 575 tons of NOx a year, from extended truck idling facilities because there is a concentration of large truck stops on the east side of the city near the IH-410 and IH-10 interchange. In addition, there are concentrations of truck stops on IH-35 in the southwest part of the county and on IH-37 in south Bexar County.

Comal County also has several large truck stops where significant amounts of NOx emissions, 144 tons of NOx a year, are generated from idling truck engines. These truck stops are concentrated along IH-35 between San Antonio and Austin. Rest areas are located in Comal, Guadalupe, and Medina counties. Truck idling also occurs at picnic areas, which are located in Atascosa and Kendall counties.

Figure 3-10: Extended Truck Idling NOx Emissions by Facility Type and County, 2006*



*Bandera County and Medina County are not included because they do not have any significant truck idling facilities

Table 3-12: AACOG Ozone Season Daily and Annual Truck Idling NO_x and VOC Emissions by County, 2006

County	FIPS	Ozone Season Day Tons		Annual Tons	
		NOx	VOC	NOx	VOC
Atascosa	48013	0.12	0.03	44	11
Bandera	48019	-	-	-	-
Bexar	48029	1.57	0.40	575	147
Comal	48091	0.43	0.11	159	41
Guadalupe	48187	0.15	0.04	56	14
Kendall	48259	0.05	0.01	18	5
Medina	48325	0.09	0.02	32	8
Wilson	48493	-	-	-	-
Total		2.42	0.62	883	226

A comparison between ERG's and AACOG's 2006 estimates of NOx emissions for extended truck idling are provided in table 3-13. AACOG's results, 883 tons of NOx per year, are 64% higher than ERG's estimation of 539 tons of NOx per year in the San Antonio-New Braunfels MSA. ERG did not survey picnic areas and did not include emissions from these facilities in the total. Emission totals from ERG's report were based on a 2006 projection using 2004 survey data. EPA's average of 144 grams of NO_x per hour[28] was used in the ERG report; while the MOVES model estimates used in this study have higher NO_x emission rates per hour for extended idling.

Table 3-13: AACOG and ERG Annual Truck Idling NO_x Emissions by County, 2006

COUNTY	FIPS	ERG				AACOG			
		Truck Stops	Rest Areas	Picnic Areas	Total	Truck Stops	Rest Areas	Picnic Areas	Total
Atascosa	48013	25	0	-	25	30	0	14	44
Bandera	48019	0	0	-	0	0	0	0	0
Bexar	48029	375	11	-	386	575	0	0	575
Comal	48091	76	6	-	82	144	15	0	159
Guadalupe	48187	13	8	-	21	32	24	0	56
Kendall	48259	10	0	-	10	8	0	10	18
Medina	48325	1	13	-	14	4	26	1	32
Wilson	48493	1	0	-	1	0	0	0	0
Total		501	38	-	539	793	65	25	883

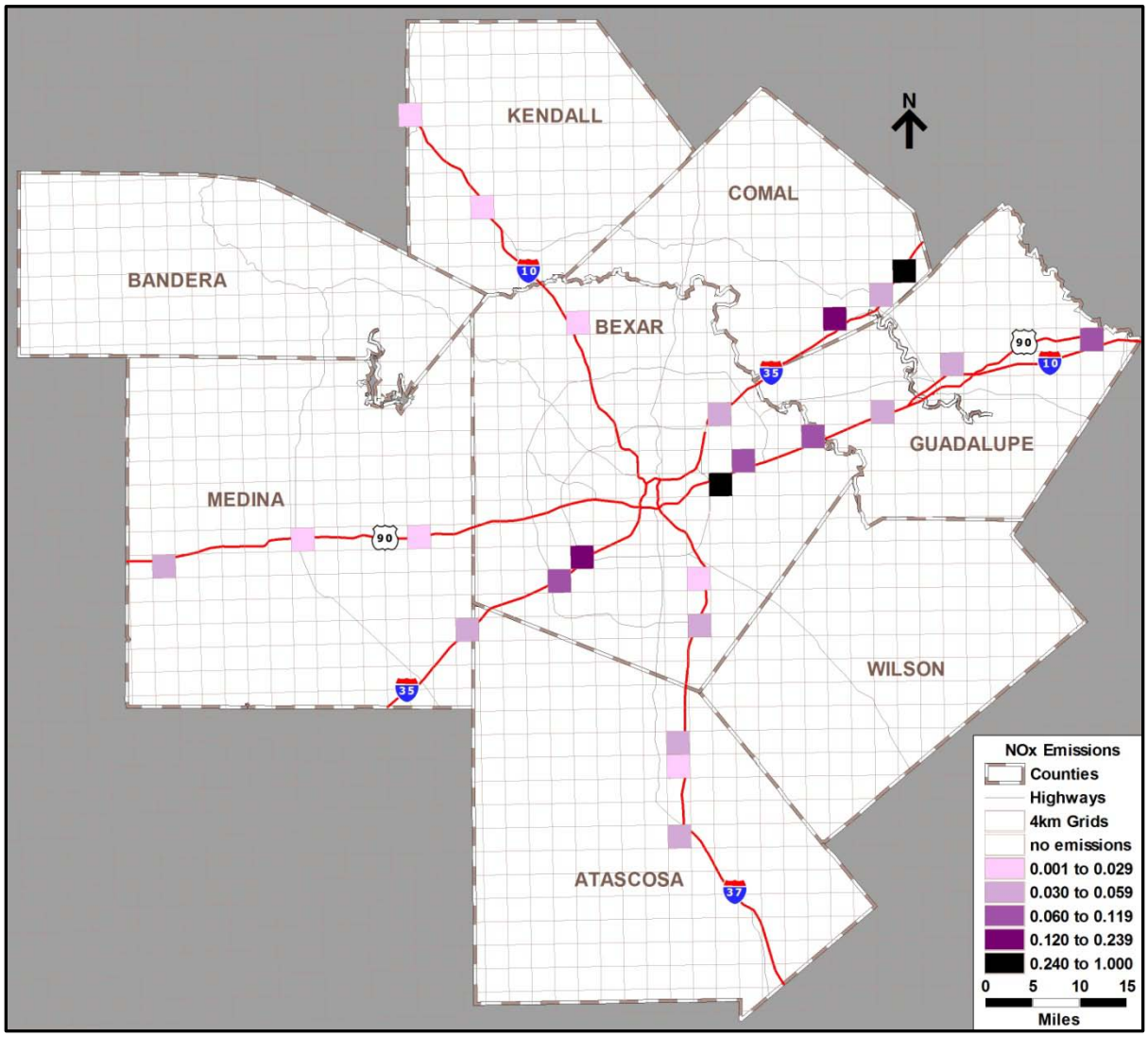
3.9. Development of Modeling Files for Truck Idling Emissions

Photochemical models are used to simulate ozone formation during high ozone events. These events consist of elevated ozone concentrations which prevail over several days. Photochemical models serve as valuable tools that allow air quality planners to develop attainment demonstrations and evaluate emission control strategies. A modeling episode based on the time period May 29 to July 3, 2006 was developed for the San Antonio, Austin, and Dallas regions that included several periods of high ozone.[29]

Photochemical models require spatially and temporally allocated emission inputs to accurately simulate ozone formation. The truck idling emission inventory data files created as the result of the 2010-2011 survey were converted to Emissions Preprocessor System (EPS3) format used in the photochemical model (figure 3-11). Temporal allocation of truck idling emissions in the photochemical model is based on the three time periods used for data collection: morning, daytime, and nighttime. The seasonal and weekly adjustment factors used in the model was set to one because there was no statistically significant difference in idling rates per parking space by month or day of the week.

[28] Environmental Protection Agency. October 2002. "Study of Exhaust Emissions from Idling Heavy-Duty Diesel Trucks and Commercially Available Idle-Reducing Devices". EPA410-R-02-025.
[29] TCEQ. "Daily Maximum Eight-Hour Ozone Averages." Austin, Texas. Available online: http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr_monthly.pl. Accessed 04/06/11.

Figure 3-11: Truck Idling NOx Emissions Geo-Coded to the June 2006 Photochemical Model 4 km Grids



Plot Date: July 5, 2011
Map Compilation: June 29, 2011
Source: Truck surveys, MOVES model

4. SUMMARY OF EXTENDED TRUCK IDLING EMISSIONS

The goal of the truck survey was to develop temporal and spatial profiles of idling used for estimating emissions. Every truck stop, rest area, and picnic area in the San Antonio-New Braunfels MSA was surveyed multiple times and every time period, morning, daytime, and nighttime, was covered during the survey. All facilities were surveyed on both weekdays and weekends. Survey collection occurred during San Antonio's fall and spring ozone season peaks. Truck idling data was collected during the months of October, November, March, April, May, and June.

Extensive research has been conducted in an effort to identify and locate all truck idling facilities in the San Antonio-New Braunfels MSA. There are 27 truck stops with a total of 1,997 parking spaces, 8 rest areas with 159 parking spaces, and 5 picnic areas with 104 parking spaces in the San Antonio-New Braunfels MSA. Average utilization rate varied between 26 percent at 1:00 pm to 73 percent at 1:00 am. The average idling rate per parking space was between 8 and 32 percent throughout the day with the highest values occurring between 11:00 pm and 3:00 am. There was a drop in idling rate per parking space around 8:00 am and idling rates started to increase again around 5:00 pm.

For most time periods, there was not a statistically significant difference between utilization rates between ERG's survey and AACOG's survey. AACOG's survey results showed a slightly higher utilization rate in the early evening between 4:00 pm and 6:00 pm. Although utilization rates were similar between the two studies, idling rates per parking space was significantly lower in AACOG's survey results. While, ERG reported idling rates per parking space between 18 and 63 percent, AACOG's survey results ranged only between 8 and 32 percent. The greatest difference in idling rates per parking space between the two surveys occurred during the nighttime. Overall, ERG observed rates were 86% higher than results from AACOG's survey. Some of the difference in idling rate per parking space may have resulted from the rapid increase in diesel prices from 2004 to 2011 and an increase in the use of APU units for electricity instead of idling.

Idling rates per parking space are within the 95% confidence level for every day of the week and for every month during the survey. Utilization and idling rates vary greatly by facility type, while idling rates per parking space was similar for every facility type (14% to 19%). Observed utilization rates were 53 percent for truck stops, 35 percent for rest areas, and 21 percent for picnic areas. Although picnic areas had low utilization rates, idling rates at these facilities were high (67%). The opposite was observed for truck stops with high utilization rates, but low idling rates (35%).

Since particular amenities could be more attractive to truck drivers than others, statistical analyses were performed to determine if there was significant variation in utilization and idling rates due to the availability of amenities. Size of the facility and the presence of showers, certified scales, and fast food restaurants had the strongest correlation with utilization rates. The weakest correlation with utilization rates were the month when the survey took place, weekend or weekday, and the presence of a hotel. Observed utilization rates were not dependent on the day of the week and month. The amenities exhibiting the lowest correlation with idling rates were temperature, weekend/weekday, and presence of repair shops and laundry facilities. Idling rate did not correlate with time of the day, while time of day had the strongest relationship with idling rate per parking space.

There was no correlation between facility size and idling rates and idling rates per parking space. Idling rate per parking space was not impacted by the type of facility, day of the

week, and presence of truck washes, fuel supplies, and convenience stores. There was no correlation between temperature and utilization rates, idling rates, and idling rates per parking space. Recorded temperature during the survey ranged between 36ºF and 95ºF; however the average percentage of trucks idling remained constant.

Total annual NOx emissions from extended truck idling in the San Antonio-New Braunfels MSA were estimated at 883 tons per year while total VOC emissions were estimated at 226 tons per year. Bexar County dominates emissions, 575 tons of NOx a year, from truck idling locations because there is a concentration of large truck stops on the east side of the city near the IH-410 and IH-10 interchange. In addition, there are a number of truck stops on IH-35 in the southwest area part the county and on IH-37 in south Bexar County. Comal County also has several large truck stops where significant amounts of NOx emissions, 144 tons per year, are generated by idling trucks. These truck stops are concentrated along IH-35 between San Antonio and Austin.

A geographic dataset of extended idling facilities was developed for photochemical modeling purposes. All truck idling emission inventory data files were converted to Emissions Preprocessor System (EPS3) format. Temporal allocation of truck idling emissions in the photochemical model is based on the three time periods used for data collection: morning, daytime, and nighttime. The seasonal and weekly adjustment factors used in the model was set to one because there was no statistically significant difference in idling rates per parking space by month or day of the week.

4.1. Future Improvements

Recommendations for future improvements in data collection and emission inventory results include:

- Future surveys should include more data collection during the early evening, between 5:00 pm and 10:00 pm. Survey results indicate the overnight idling time period starts earlier in the San Antonio-New Braunfels MSA than the 10:00 pm start time used by other truck idling studies.
- Additional surveys should be conducted in late summer and early fall. Although there was no significant variation in utilization/idling rates per parking space by month, additional surveys should be conducted during the late summer ozone season peak in August and September to confirm the results.
- When new truck idling facilities are built in San Antonio, they should be surveyed and added to the emission inventory. New facilities planned in the San Antonio-New Braunfels MSA include Love's in Kendall County on IH-10 exit 523 and Love's in Guadalupe County on IH-10 at exit 603.
- When truck idling electrification facilities are built in the San Antonio-New Braunfels MSA, they should be surveyed and included in the emission inventory results.
- Additional 24-hour or 48-hour samples at selected truck idling locations should be conducted to determine how long each truck idles.
- Once future photochemical modeling base cases are determined, extended truck idling emissions need to be projected.

APPENDIX A: HEAVY-DUTY IDLING ACTIVITY CHARACTERIZATION AND EMISSIONS INVENTORY SURVEY PROTOCOL

Truck Stops, Rest Stops, and Picnic Areas

Purpose

The trucking industry is a major part of North America's economy, transporting over 80% of the nation's goods, and it is growing rapidly.[30] The population of large trucks is estimated at 4.2 million, 1.3 million of which are "long haul" trucks equipped with sleeper cabs and powered by diesel engines.[31] Due to increases in truck traffic on IH-35 and the requirement to identify emission sources for modeling, an inventory of truck stops is a necessity.

The Department of Transportation requires rest of 10 hours after every 11 hours driving for property-carrying commercial motor vehicle (CMV) drivers.[32] Interstate 35, Interstate 10, and other major highways converge in San Antonio, so drivers frequently use truck stops and other facilities in the San Antonio area to comply with mandatory rest breaks. It is not uncommon for truck drivers to idle their engines throughout their rest periods to provide electricity for cooling and heating their cabins, or to keep their engine fluids warm.[33] This extended idling consumes fuel, creates air and noise pollution, and is an inefficient use of the nation's energy supply. According to an estimate by the US Department of Energy, each year in the U.S., trucks consume over 25 million barrels of fuel a year for overnight truck idling.[34]

The Texas Commission on Environmental Quality (TCEQ), in an interagency contract with the Texas Transportation Institute (TTI), conducted phase 1 of a statewide study on the magnitude of emissions from heavy-duty truck idling in 2003. The report provides an account of the heavy-duty (long-haul) trucks using truck stops and a review of methodologies to calculate the truck idling emission factors.[35] This report paved the way for the second TCEQ report prepared by the Eastern Research Group Inc., which provided annual truck idling emission estimates for the base year 2004 through 2030 on a county-based level.[36] The latter study expanded the truck stop database by determining their

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[30] IdleAire Technologies Corp., August 2007. "Diesel Idling and the IdleAire Solution Fact Sheet". Available online: http://www.idleaire.com/images/Users/1/pdf/Diesel%20Idling%20Fact%20Sheet.pdf. Accessed 08/23/10.

[31] *Ibid*.

[32] Department of Transportation Federal Motor Car Safety Administration, November 18, 2008. "Hours-of-Service Regulations". 49 CFR Parts 385 and 395. Washington D.C. Available online: http://www.fmcsa.dot.gov/rules-regulations/topics/hos/HOS-2005.htm. Accessed 08/23/10.

[33] EPA, January 2004. "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity". Research Triangle Park, North Carolina. p. 2. Available online: http://www.epa.gov/otaq/smartway/documents/420b04001.pdf. Accessed 08/23/10.

[34] Dr. Linda Gaines and Terry Levinson Argonne National Laboratory September 23, 2009. "Idling Reduction Makes $ense". U.S. Department of Energy, Energy Efficiency and Renewable Energy. Available online: http://www1.eere.energy.gov/cleancities/pdfs/idle_reduction.pdf. Accessed 08/23/10.

[35] TTI, Aug. 2003. "HDDV Idling Activity and Emissions, Study: Phase 1, Study Design and Estimation of Magnitude of the Problem". Sponsored by TCEQ. College Station, Texas. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase1-tti.pdf. Accessed 08/23/10.

[36] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. Available online:

locations and capacities and calculating existing and future emissions. Both these reports lack a complete survey of all the truck idling facilities in the San Antonio area and the reports are out of date because of changes in locations of truck stops, idling characteristics, and fuel prices.

Because San Antonio may become a non-attainment region in the near future, the importance of assessing idling emissions from heavy-duty diesel trucks is evident. This assessment should provide key information on the impact of increased truck traffic and the impact on local ozone readings. The goal of this protocol is to establish a foundation for a comprehensive visual survey of truck idling activities at truck stops, rest stops, and picnic areas. The spatial and temporal allocation of long term heavy duty truck idling will be collected through the survey to provide data needed to calculate emissions.

Study Area

The survey will encompass the 8 county area of the San Antonio MSA, which includes Bexar, the most populous county of the region, and the 7 adjacent counties of Atascosa, Bandera, Comal, Guadalupe, Kendall, Medina and Wilson.

Definition of Heavy-Duty Trucks

The focus of this protocol is a visual survey of engine idling practices by long-haul truck drivers. The survey will provide inputs that can be used to estimate extended idling emissions for the combination (tractor/trailer) long-haul truck category, which is the only source use type within the current version of the Motor Vehicle Emission Simulator model (MOVES)[37] for which extended idling emissions can be estimated. This vehicle category is more commonly referred to as diesel-powered five-axle "eighteen-wheelers", but other four-axle and six-axle configurations are also included in this category. Combination Long-haul Truck are classified in MOVES as trucks with majority of operation outside of 200 miles of home base[38]

The primary inputs needed by MOVES to estimate idling emissions are the number of hours operating (SHO) in extended idling mode by source type. Since EPA has required that states begin using the MOVES model for on-road inventory development, this report will not use any on-road emission inventories developed with the MOBILE6.2 model. Likewise, the simplified extended idling emission estimation procedure outlined by EPA for use with MOBILE6.2 in the January 2004 "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity"[39] will not be used.

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http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

[37] U.S. EPA, December 2009. Office of Transportation and Air Quality Washington, DC. Motor Vehicle Emission Simulator. Available online: http://www.epa.gov/otaq/models/moves/index.htm. Accessed 07/21/10.

[38] John Koupal, Mitch Cumberworth, and Megan Beardsley, June 9, 2004. "Introducing MOVES2004, the initial release of EPA's new generation mobile source emission model". U.S. EPA Office of Transportation and Air Quality, Assessment and Standards Division. Ann Arbor, MI. Available online: http://www.epa.gov/ttn/chief/conference/ei13/ghg/koupal.pdf. Accessed 08/20/10.

[39] EPA, January 2004. "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity". EPA420-B-04-001. Transportation and Regional Programs Division Office of Transportation and Air Quality and Air Quality Strategies and Standards Division Office of Air Quality Planning and Standards. Available online: http://www.epa.gov/smartway/documents/420b04001.pdf. Accessed 08/24/10.

Location of Long Term Truck Idling Facilities
Drivers typically idle their trucks' engines at the following locations:

- Truck Stops
- Rest Stops
- Picnic Areas
- Other Idling Locations

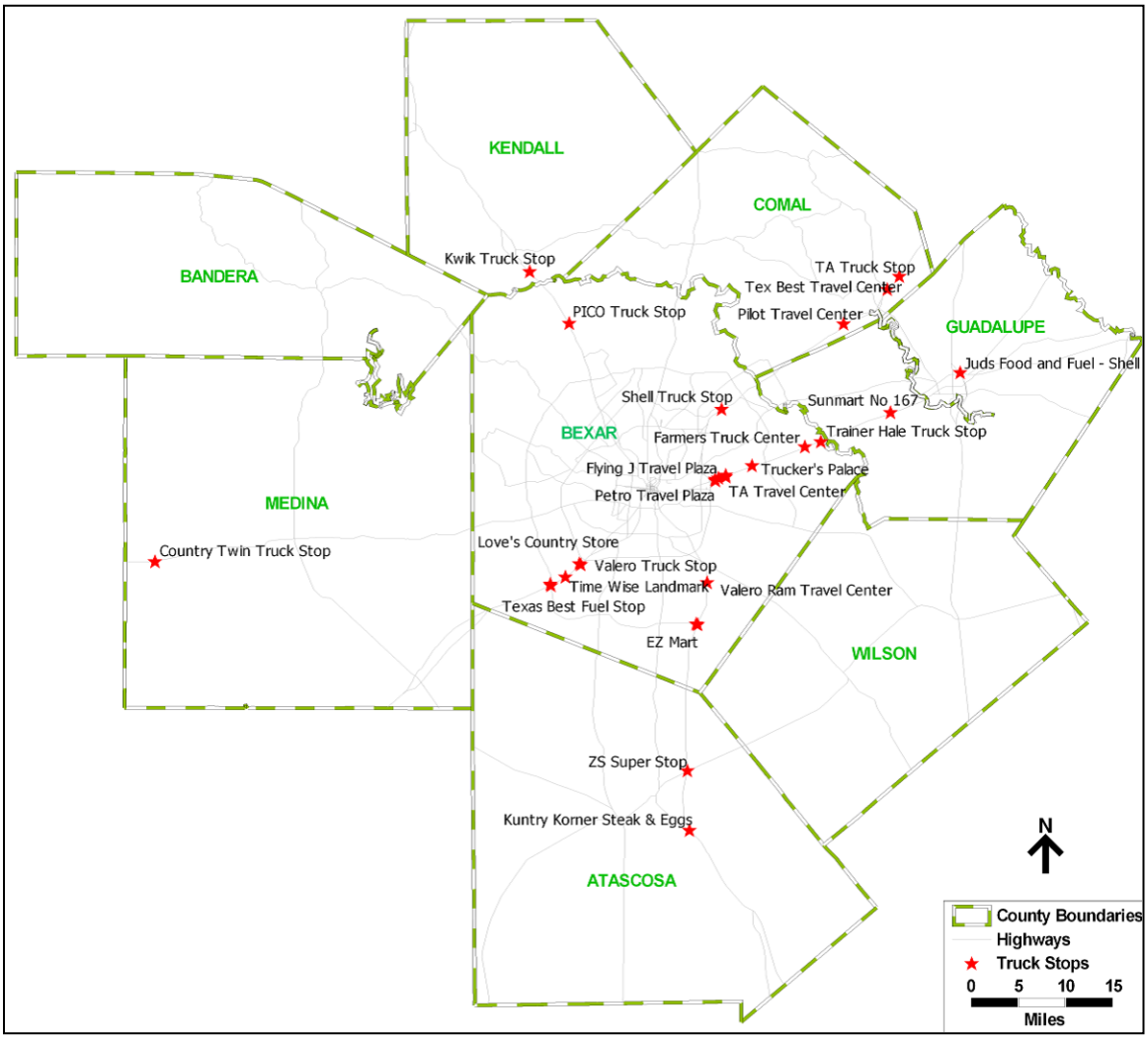
Extensive research has been conducted in an effort to identify and locate all such facilities in the San Antonio MSA. Should additional truck stops, rest stops, and picnic areas be identified during the course of conducting the truck idling surveys, however, they will be added to the inventory of facilities for further review. All identified truck stops, rest stops, and picnic areas will be included in the survey.

Truck Stops
AACOG staff compared information collected from the sources mentioned above to develop a geographic dataset of local truck stops, gas stations, restaurants, and travel plazas that have parking facilities for long term idling of heavy-duty trucks. Truck stop data was collected from TxDOT, Yahoo yellow pages, trucking industry web pages, facility managers, TTI research, and the ERG reports. According to the ERG, "there is no single comprehensive list of truck stops available for Texas" and, subsequently, for the San Antonio region.[40]

Regional aerial images were also used to verify the accuracy of location information and determine the number of available parking spaces. Assigning geographic coordinates to the truck stops facilitated the development of a visual tool for analyzing their dispersion throughout the region as well as the creation of a grid-based input file for use in the photochemical model. As indicated in figure 1, truck stops are primarily clustered in the eastern section of the region, off IH-10. However, comparisons of collected data indicated that the parking capacity of existing truck stops located off IH-35 and IH-37 has increased recently. Table 1 provides a list of all truck stops in the AACOG region and the number of estimated parking spaces at each facility.

[40] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. p 3-1. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.

Figure A-1: Locations of Truck Stops in the San Antonio Region



Plot Date: September 2, 2010
Map Compilation: September 2, 2010
Source: Yahoo Yellow Pages, truck industry web sites, aerial images, 2000 TIGER files

Table A-1: Truck Stops in the San Antonio MSA

Truck Stop	Address	County	Exit Number	Parking Spaces*
Trucker's Palace	5855 IH 10 E, San Antonio	Bexar	581	60
Petro Travel Plaza	1112 Ackerman Rd, San Antonio	Bexar	582	250
Pilot Travel Center	5619 IH 10 E, San Antonio	Bexar	582	50
TA Travel Center	6170 IH 10 E, San Antonio	Bexar	583	198
Flying J Travel Plaza	1815 Foster Rd., San Antonio	Bexar	583	228
Shell Truck Stop	8755 IH 10 E, Converse	Bexar	585	50
Farmers Truck Center	13183 IH 10, Converse	Bexar	591	50
Trainer Hale Truck Stop	14462 IH 10, Converse	Bexar	593	15
Texas Best Fuel Stop (Exxon)	14650 IH 35, Von Ormy	Bexar	140	10
Valero AAA Travel Center	14555 IH 35, Von Ormy	Bexar	140	57
Shell Time Wise Landmark	13437 IH 35, IH 35, Von Ormy	Bexar	141	28
Love's Country Store	11361 IH 35, S Von Ormy	Bexar	144	95
Valero	IH 35, S Von Ormy	Bexar	144	35
Shell Truck Stop	11607 N IH 35, San Antonio	Bexar	169	150
EZ Mart	15537 IH 37, Elmendorf	Bexar	125	10
Tex Best Travel Center	20290 IH 37, Elmendorf	Bexar	125	50
Valero Ram Travel Center	IH 37, Elmendorf	Bexar	130	15
PICO	25284 IH 10, San Antonio	Bexar	550	15
Pilot Travel Center	4142 Loop 337, New Braunfels	Comal	184	70
Tex Best Travel Center	2735 N IH 35, New Braunfels	Comal	191	18
TA Truck Stop	4817 IH 35, New Braunfels	Comal	193	123
Sunmart No 167	6150 W IH 10, Seguin	Guadalupe	601	40
Juds Food and Fuel - Shell	IH10/Hwy 123, Seguin	Guadalupe	610	30
Kuntry Korner Steak & Eggs	IH 37 / Jim Brite Rd, Pleasanton	Atascosa	104	50
ZS Super Stop	IH 37 / FM 97, Pleasanton	Atascosa	109	24
Country Twin Truck Stop	C.R 411 & US HWY 90, D'Hanis	Medina		15
Kwik Truck Stop	31700 IH 10 W, Boerne	Kendall	543	11
Total				1,747

*****Data on number of parking spaces were collected by means of studying aerial images, phoning the managers, Internet, and published reports.

Rest Stops and Picnic Areas

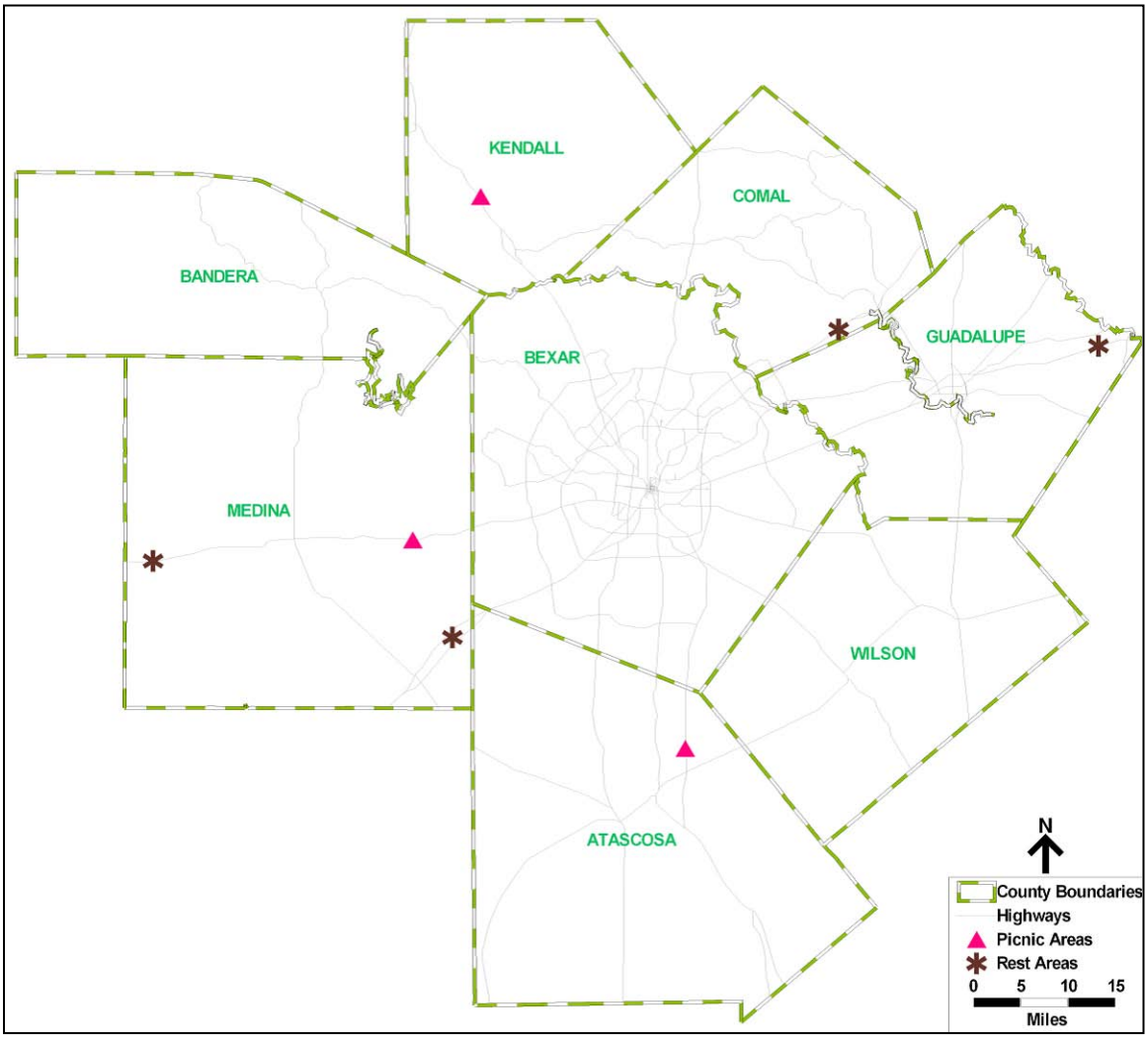
TxDOT was contacted for information on the location of rest stops and to answer questions about newly built or renovated facilities in the AACOG region.[41] An official Texas Travel Map was also acquired to locate regional picnic areas. TxDOT is sponsoring a program whereby modern safety rest stops are being built to encourage drivers to stop more frequently. These facilities help drivers fight driving-related fatigue, which is a major cause of serious accidents: "attractive, safe, and clean rest area facilities are invitations to entice travelers to stop and rest. TxDOT's new generation of Safety Rest Areas feature regional designs, modern restrooms, interpretive displays, exhibits of local features, separate parking for cars and trucks, and wireless Internet access."[42] Longer mandatory resting times for

[41] TxDOT Expressway, "Safety Rest Area Maps". Austin, Texas. Available online: http://www.dot.state.tx.us/mnt/sra/map.htm. Accessed 08/23/10.
[42] TxDOT, Sept. 2009. "Texas Safety Rest Area Program". Available online: ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/travel/sra_brochure.pdf. Accessed 08/23/10.

truck drivers and construction of new rest stops with designated truck parking spaces and better amenities, such as air conditioned TV rooms and wireless Internet access, have made rest stops suitable resting places for long-haul truckers.

A geographic database was created with information collected on rest stops and picnic areas in the region (figure 2). Truck drivers frequently use picnic areas alongside major freeways for their mandatory rest periods. Large picnic areas along major highways will be included in the survey of truck idling activities. There is several smaller picnic areas located in the 8-county San Antonio MSA not on major highways, but they cannot handle more than 1 or 2 trucks and they will not be surveyed. A list of all the rest stops and picnic areas that will be surveyed, with the number of estimated parking spaces, is provided in table 2.

Figure A-2: Locations of Rest Stops and Picnic Areas in the San Antonio MSA



Plot Date: September 2, 2010
Map Compilation: September 2, 2010
Source: Texas official travel map, aerial images, 2000 TIGER files

Table A-2: Rest Areas and Picnic Areas in the San Antonio Region

Type	Location	County	Parking Spaces*
Rest Stop	Northbound - IH 35	Comal	12
	Southbound - IH 35	Comal	12
	Eastbound - IH 10	Guadalupe	42
	Westbound - IH 10	Guadalupe	39
	Northbound - IH 35	Medina	13
	Southbound - IH 35	Medina	18
	US 90	Medina	24
Picnic area	Northbound - IH 37	Atascosa	28
	Southbound - IH 37	Atascosa	28
	Eastbound - IH 10	Kendall	28
	Westbound - IH 10	Kendall	28
	US 90	Medina	6

Other Idling Locations

Long term heavy duty diesel truck idling occurs at other sites not listed above. These sites include restaurants, shopping centers, highway ramps, road shoulders, vacant properties, and facilities located near major highways. Since long-haul truck idling is less predictable and tends to be minimal at these other locations due to limited space and facilities, they will not be included in the truck idling survey. Nevertheless, truck idling at weigh stations will be checked to determine if idling rates are significant. Examples of these other local sites where long term truck idling may occur include:

- Weigh Station IH-10E, Mile Marker: 621, Seguin
- Weigh Station IH-10W, Mile Marker: 621, Seguin
- Weigh Station IH-35, Devine
- Wal-Mart Supercenter IH-10, Ex 540 (Hwy46), Boerne
- Wal-Mart US 181, Floresville
- Wal-Mart Supercenter US 90, Hondo
- Wal-Mart Supercenter IH-35 Ex 187, New Braunfels
- Wal-Mart Supercenter IH-35 Ex 172, San Antonio
- Wal-Mart Hwy 410 Ex 13b, San Antonio
- Wal-Mart Supercenter US 281, San Antonio
- Wal-Mart Supercenter Hwy 536, San Antonio
- Wal-Mart Supercenter I-10, Ex 610 (Hwy123), Seguin[43]

Data Collection Methodology for Idling Emissions at Truck Stops

The goal of conducting a truck idling survey in the San Antonio MSA is to obtain information that allows for the development of temporal and spatial profiles of truck idling and vehicle information sufficient to estimate idling emissions. The data collection template is provided at the end of this protocol. Data collected will include survey location, facility type, date of survey, time of survey, and meteorological conditions. The number of parking spaces, truck spaces filled, the number of trucks idling, condition of the parking lot, data on any electrification system, and any other information relevant to truck idling will be collected at each location. Facilities at each location will be noted including:

[43] TruckMaster Logistics Systems, Inc. 2008. "Truck Stops In Texas". Jerome, ID. Available online: http://www.truckmaster.com/truck-stop-in-tx. Accessed 09/03/10.

- Restrooms
- Information center
- Fuel
- Showers
- Public phone
- Vending machine
- Convenience store
- Fast food restaurant
- Sit down restaurant
- Hotel
- Certified scales
- Wireless Internet
- Truck wash
- ATM
- Western Union
- Money orders

The surveyor will spend at least half an hour at each location to ensure the trucks identified are idling for sustained periods.

Time of Day Variation
Based on the time periods determined by ERG to be statistically significant,[44] observations on truck idling will be collected during the following three time periods:

- Morning (5 a.m. – 10 a.m.)
- Daytime (10 a.m. – 10 p.m.)
- Evening/Night (10 p.m. – 5 a.m.)

For data collected on weekdays, the morning and daytime periods will include observations during local "rush hours" for consistency with how travel demand modeling is conducted.

Day of the Week Variation
The extended idling data set will include the number of idling trucks at each location for the two day-of-the week categories: weekday (Monday-Friday) and weekend (Saturday-Sunday).

Additional Random Sampling
Additional random surveys will be conducted at locations that were already surveyed to determine a margin of error for the collected data. After several random surveys are conducted, the margin of error will be reviewed to determine if additional sampling is required.

Truck Stop Electrification Programs
In May 2001, President Bush issued the *National Energy Policy* directing the EPA and the Department of Transportation (DOT) to work with the trucking industry to establish a program to reduce emissions and fuel consumption from the use of long-haul trucks. Responding to this directive, the EPA initiated a comprehensive program to reduce idling and exhaust emissions from long haul trucks.[45] The IdleAire Technologies Corporation is one of the companies that provide truck stop electrification (TSE) technology throughout the nation. IdleAire has determined that their "…system removes 100% of emissions associated with extended diesel idling, including nitrogen oxides (NOx), and volatile organic compounds

[44] Eastern Research Group, Inc., Cambridge Systematics, Inc., and Alliance Transportation Group, Inc., August 31, 2004. "Heavy-Duty Vehicle Idle Activity and Emissions Characterization Study, Final Report". Sponsored by TCEQ. Austin, Texas. p. 6-15. Available online: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/mob/HDDV_Idle_Activity_and_EI_Phase2-tti.pdf. Accessed 08/23/10.
[45] EPA. "SmartWay Transport". Office of Transportation and Air Quality (OTAQ). Available online: http://nsdi.epa.gov/otaq/smartway/transport/index.htm. Accessed 08/24/10.

(VOC). The system has a net reduction of 98% of criteria pollutants under the Clean Air Act after accounting for the electricity from the grid used to power the system."[46]

In the San Antonio region, IdleAire provides individual electrical service for 60 parking spaces at the Travel Centers of America (TA) truck stop #147, located at the intersection of Foster Road and IH-10 East, and 72 parking spaces at TA #232, at the intersection of Conrads Road and IH-35 North in New Braunfels. These sites will be surveyed as part of the project to determine utilization rates.

Table A-3: Location of IdleAire facilities in San Antonio

County	Location	IdleAire Parking Space
Comal	TA #232, Conrads Rd at I-35, New Braunfels	72
Bexar	TA #147, Foster Rd at IH-10, San Antonio	60
Total		132

Data Availability

The idling survey data collected will be provided in an organized electronic format that can be readily incorporated into on-road inventory development with the MOVES model. It is expected that the results of any extended idling data collection effort will be used by the Texas Transportation Institute for development of on-road emission inventories with the MOVES model.

[46] IdleAire Technologies Corp., August 2007. "Diesel Idling and the IdleAire Solution Fact Sheet". Available online: http://www.idleaire.com/images/Users/1/pdf/Diesel%20Idling%20Fact%20Sheet.pdf. Accessed 08/23/10.

Example Survey Template

Survey Location: _____

Facility Type: _____

Adjacent Highway: _____

Mile Marker: _____

Date of Survey: _____

Time of Survey: _____

Meteorological Conditions (i.e. cloud cover, temperature, etc.):

_____

Number of Truck Spaces: _____

Number of Spaces Filled: _____

Number of Trucks Idling: _____

Parking lot: Paved: _____ **Unpaved:** _____

Is a Truck Stop Electrification facility located at the site? _____

How many trucks are using the Truck Stop Electrification Facility? _____

Amenities available at the site:

Restrooms	____	Western Union	____
Information center	____	Money order	____
Fuel	____	Sit down restaurant	____
Showers	____	Hotel	____
Public phone	____	Certified scales	____
Vending machine	____	Wireless Internet	____
Convenience store	____	Truck wash	____
Fast food restaurants	____	ATM	____

Other Comments: _____

_____

APPENDIX B: UPDATED SURVEY TEMPLATE

Make sure you spend at least 30 minutes at each site if trucks are present
Do not count trucks that arrive or leave during the survey in the total

Survey Location: _____

Facility (Truck Stop, Rest Area, Picnic Area): _____

Adjacent Highway: _____

Mile Marker / Exit: _____

Date of Survey: _____

Time of Survey: _____

Meteorological Conditions (i.e. temperature, cloud cover, etc.):

_____

Number of Truck Spaces (marked and unmarked): _____

Number of Spaces Filled: _____

Number of Trucks Idling: _____

Parking lot: Paved: _____ **Unpaved:** _____

Is a Truck Stop Electrification facility located at the site? _____

How many trucks are using the Truck Stop Electrification Facility? _____

Amenities available at the site:

Restrooms	___	Sit down restaurant	___
Information center	___	Hotel	___
Fuel	____	Certified scales	____
Showers	____	Wireless Internet	____
Public phone	____	Truck wash	____
Vending machine	____	ATM	____
Convenience store	____	Western Union	____
Fast food restaurants	___	Money order	___
Movie Rental	___	Tire Repair Facilities	___
Laundry Facilities	____	Truck Repair Facility	____

Other Comments: _____

_____

APPENDIX C: LIST OF AMENITIES AT TRUCK STOPS, REST AREAS, AND PICNIC AREAS IN THE SAN ANTONIO-NEW BRAUNFELS MSA

Type	Name	Highway	Exit Number	County	Number of Surveys	Parking Spaces	Paved	Truck Electrification	Restrooms	Information Center	Fuel	Showers	Public Phone	Vending Machine	Convenience Store	Fast Food	Sit Down Restaurant	Hotel	Certified Scales	Wireless Internet	Truck Wash	ATM	Money Order	DVD Rental	Tire/Truck Repair	Laundry
Truck Stops	Valero - Kuntry Korner	IH-37	104	Atascosa	7	45	X		X		X				X		X	X				X				
	ZS Super Stop	IH-37	109	Atascosa	7	24	X		X		X				X							X				
	Shell EZ Mart	IH-37	125	Bexar	7	25	X		X		X				X	X					X	X			X	
	Tex Best Travel Center	IH-37	125	Bexar	7	30	X		X		X	X	X		X	X						X				
	Valero Ram Travel Center	IH-37	130	Bexar	7	12	X		X		X		X		X							X				
	Texas Best Fuel Stop - Exxon	IH-35	140	Bexar	7	15	X		X		X				X	X						X				
	Valero AAA Travel Center	IH-35	140	Bexar	7	70	X		X		X				X							X				
	Shell Timewise Landmark	IH-35	141	Bexar	7	24	X		X		X				X		X									
	Loves Country Store	IH-35	145	Bexar	7	108	X		X		X	X	X		X	X			X			X	X		X	
	Tetco/Valero Travel Center	IH-35	145	Bexar	6	50	X		X		X		X		X	X		X	X			X				
	Shell Truck Stop	IH-35	169	Bexar	8	45	X		X		X	X	X	X	X	X	X	X			X	X	X			
	PICO Valero Travel Center	IH 10	550	Bexar	6	15	X		X		X				X	X						X	X			
	Petro Travel Plaza	IH 10	582	Bexar	7	320	X		X		X	X	X	X	X	X	X	X	X		X	X		X	X	X
	Pilot Travel Center	IH 10	582	Bexar	7	50	X		X		X	X	X		X	X			X	X		X	X			
	Flying J Travel Plaza	IH 10	583	Bexar	7	283	X		X		X	X	X	X	X	X	X		X		X	X	X	X	X	
	TA Travel Center	IH 10	583	Bexar	7	258	X		X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
	Shell Truck Stop	IH-10	585	Bexar	7	60			X		X		X		X	X	X	X	X			X	X	X	X	
	Farmer's (Alamo Travel Center)	IH-10	591	Bexar	7	40	X		X		X		X		X	X	X	X				X				
	Texaco (Sunmart)	IH-10	593	Bexar	6	30	X		X		X		X		X	X	X					X			X	
	Trainer Hale Truck Stop	IH-10	593	Bexar	7	25	X		X		X		X		X	X	X	X				X			X	

Type	Name	Highway	Exit Number	County	Number of Surveys	Parking Spaces	Paved	Truck Electrification	Restrooms	Information center	Fuel	Showers	Public phone	Vending machine	Convenience store	Fast food	Sit down restaurant	Hotel	Certified scales	Wireless Internet	Truck wash	ATM	Money order	DVD Rental	Tire/Truck Repair	Laundry
Truck Stops	Tex Best Travel Center	IH-35	191	Comal	8	28	X		X		X		X		X	X	X	X				X				
	TA Travel Center	IH-35	193	Comal	8	250	X		X		X	X	X	X	X	X	X		X	X	X	X	X		X	X
	Pilot Travel Center	IH-35	184	Conal	8	80	X		X		X	X	X	X	X	X	X		X	X		X	X		X	X
	Chevron (Sunmart 167)	IH-10	601	Guadalupe	7	40	X		X		X	X	X	X	X	X			X	X		X				
	Jud's Food and Fuel - Shell	IH-10	610	Guadalupe	7	40	X		X		X	X	X		X	X	X	X		X		X	X			
	Chevron	IH-10	523	Kendall	3	20	X		X				X		X	X										
	Exxon Valley Mart	US-90	533	Medina	4	10	X		X		X				X			X				X				
Rest Areas	Northbound, Comal County	IH-35	178	Comal	8	18	X		X					X						X						
	Southbound, Comal County	IH-35	180	Comal	8	18	X		X					X						X						
	Guadalupe Co., Eastbound	IH-10	619	Guadalupe	7	26	X		X	X			X	X						X						
	Guadalupe Co., Westbound	IH-10	619	Guadalupe	7	32	X		X	X			X	X						X						
	Medina County, Southbound	IH-35	129	Medina	7	20	X		X					X						X						
	Medina County, Northbound	IH-35	130	Medina	7	17	X		X					X						X						
	Medina County, Eastbound	US-90	518	Medina	6	15	X		X	X			X	X						X						
	Medina County, Westbound	US-90	518	Medina	6	13	X		X	X			X	X						X						
Picnic Areas	Atascosa Co., Southbound	IH-37	111	Atascosa	7	28	X																			
	Atascosa Co., Northbound	IH-37	112	Atascosa	7	28	X																			
	Kendall Co., Eastbound	IH-10	529	Kendall	6	17	X																			
	Kendall Co., Westbound	IH-10	531	Kendall	6	25	X																			
	Medina County, Westbound	US-90	548	Medina	6	6	X																			