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Task 3.1 and Task 3.3

Emission Inventory
San Antonio International Airport

Technical Report

July 1st, 2012

Prepared by:

Alamo Area Council of Governments

Prepared in Cooperation with the Texas Commission on Environmental Quality

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Abstract: Using local data, an emission inventory was developed for the San Antonio International Airport (SAIA) that quantifies the amount of nitrogen oxides (NOx) and volatile organic compounds (VOCs) associated with operations at the facility. To calculate NOx and VOC emissions based on a "bottom-up" approach, local data from the SAIA were collected on aircraft maintenance and operations, use of ground support equipment, use of parking garages, annual consumption of aviation fuel and natural gas, and use of other non-road equipment. Aircraft emissions were calculated based on local operations for each type of aircraft using data obtained from GCR & Associates, Inc.[1] Local aircraft operation data was entered into the EDMS model, and the resulting emission estimates were spatially and temporally allocated to the SAIA. A list of ground support equipment (GSE) was compiled from a survey that was sent to SAIA tenants. All 30 tenants responded to the survey and furnished data on GSE located at the airport. Of the total emissions from the SAIA, aircraft operations constitute the largest source, with daily emissions of1.26 tons of NO_X and 0.69 tons of VOC. GSEs constitute the second largest source followed by non-road equipment and auxiliary power units (APU). Total emissions from all sources at the SAIA were estimated to be 1.75 tons of NO_X and 0.89 tons of VOC for an average ozone season day.

Related Reports:	**Distribution Statement:**	**Permanent File:**
2005 Emission Inventory for the Alamo Area Council of Governments Region	Alamo Area Council of Governments, Natural Resources/Transportation Department	Alamo Area Council of Governments, Natural Resources/Transportation Department

[1] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 12/15/11.

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1. INTRODUCTION

1.1. **Background**

The Clean Air Act is the comprehensive federal law that regulates airborne emissions across the United States.[2] This law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. Of the many air pollutants commonly found throughout the country, EPA has recognized six “criteria” pollutants that can injure health, harm the environment, and/or cause property damage. Air quality monitors measure concentrations of these pollutants throughout the country and San Antonio is currently in attainment for every “criteria” pollutant. However, there are concerns over the high concentrations of ground level ozone, one of the “criteria” pollutants, which local monitors are recording. Ozone is produced when volatile organic compounds (VOC) and nitrogen compounds (NO_X) react in the presence of sunlight.[3]

According to the EPA, “the health effects associated with ozone exposure include respiratory health problems ranging from decreased lung function and aggravated asthma to increased emergency department visits, hospital admissions and premature death. The environmental effects associated with seasonal exposure to ground-level ozone include adverse effects on sensitive vegetation, forests, and ecosystems.”[4] Currently, the ozone primary standard, which is designed to protect human health, is set at 75 parts per billion (ppb). To meet the air quality standards, local and state air quality planners need to have an accurate account of ozone precursor emissions and their sources in the region. An emission inventory based on local data was developed for the San Antonio International Airport (SAIA). Results from the SAIA emission inventory were formatted for inclusion in the regional photochemical model.

1.2. **Procedures and Approach**

To calculate emissions from the operation of SAIA, the following steps were used:

1. Review the airport portion of the NEI for San Antonio and provide supplemental data for enhancement of the NEI.
2. Identify any significant source categories that are under or over estimated or where additional or more detailed emissions inventory inputs at a sub-county level could be provided.
3. Identify emission sources and carry out “bottom-up” research that provided improved emissions inventory inputs.
4. Generate raw local inputs such as equipment population, local activity profiles, and spatial surrogates.
5. Provide all electronic data sets to TCEQ, including but not limited to: EDMS input and output files, EPS3 input files, EPS3 spatial and temporal surrogates, etc.

The airport emissions inventory in the TCEQ’s Texas Air Emissions Repository (TexAER) and the supporting documentation published by the Eastern Research Group, Inc. (ERG)[5] were

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[2] US Congress, 1990. Clean Air Act. Available online: http://www.epa.gov/air/caa/. Accessed 12/09/11.
[3] EPA, Sept. 23, 2011, “Ground-level Ozone”. Available online: http://www.epa.gov/air/ozonepollution/. Accessed 10/31/11.
[4] EPA, September 16, 2009. “Fact Sheet: EPA to Reconsider Ozone Pollution Standards”, p. 1. Available online: http://www.epa.gov/air/ozonepollution/pdfs/O3_Reconsideration_FACT%20SHEET_091609.pdf. Accessed 12/09/11.
[5] Eastern Research Group, Inc., July 17, 2009, “Compilation of Activity Data and the Development of Criteria Pollutant Emission Estimates for Aircraft”. TCEQ, Austin, TX. Available online: ftp://amdaftp.tceq.texas.gov/pub/NEI/2008/Aircraft/. Accessed 12/15/11.

reviewed. After this task, AACOG identified areas where improvements could be made to input data, at a sub-county level of analysis, for developing a "bottom-up" detailed emissions inventory. The focus of these improvements was to collect accurate raw local input data such as equipment population sizes, local activity profiles, spatial surrogates, temporal profiles, and other data.

1.3. **Geographic Area**

Emissions were calculated for the SAIA, which is the only commercial airport within the AACOG region.

1.4. **Inventoried Pollutants**

The amount of Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOC), and Carbon Monoxide (CO) were calculated for this emission inventory.

1.5. **Data Sources**

Emissions source categories were calculated using approved procedures developed by EPA and TCEQ. All current federal and state regulations were taken into account when calculating emissions. Empirical data on annual aircraft landings and take-offs at SAIA by specific aircraft type were obtained from GCR & Associates, Inc.[6] For consistency and accuracy, this data were compared with data from other sources such as the Federal Aviation Administration's Terminal Area Forecast (TAF) reports[7] and the SAIA's annual reports published by the City of San Antonio (COSA)'s Department of Aviation[8]. Comprehensive research, using the aircrafts' user's manuals and data from the Emission & Dispersion Modeling System (EDMS) model,[9] were used to determine engine specifications and emission factors for each aircraft. For non-road equipment, emission factors extracted from the Texas NONROAD (TexN) model were used.

1.6. **Refined Categories**

AACOG updated and expanded the following emission inventory categories:

- Aircraft Operations (commercial, military operations, and general aviation)
- Ground Support Equipment (GSE)
- Parking Garages
- Aircraft Evaporative Loss
    - Refueling
    - Pre-flight Safety Check
    - Diurnal Loss
- Fuel Storage & Transfer
- Stationary Sources
- Auxiliary Power Units (APU)
- Non-road Equipment (Lawn and Garden, Commercial, and Light Industrial)

To calculate emissions based on a "bottom-up" approach, local data from the above sources were collected. Emission inventory results are shown in the following table (1-1).

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[6] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 12/15/11.

[7] Federal Aviation Administration, 2009. "Terminal Area Forecast Reports". Washington, DC. Available online: http://aspm.faa.gov/main/taf.asp. Accessed 12/09/11.

[8] City of San Antonio, Dec. 2006. "Airport Statistic 2006". Department of Aviation. Available online: http://www.sanantonio.gov/Aviation/statistics.asp. Accessed 07/20/11.

[9] FAA, Nov. 2010. "Emissions & Dispersion Modeling System, Version 5.1.3". Available online: http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model . Accessed 09/22/11.

Table 1-1: Total Daily Emissions at San Antonio International Airport, tons/day 2006

Emission Source	VOC	NO_X	CO
Commercial Aircraft/Air Taxi	0.2692	1.1020	1.9249
Military Aircraft	0.0994	0.0739	0.3117
General Aviation – Jet	0.2671	0.0771	0.7354
General Aviation – Turbo-Prop	0.0333	0.0066	0.1240
General Aviation – Piston	0.0196	0.0043	0.8756
GSE	0.0947	0.4462	2.0112
Parking Lots	0.0020	0.0056	0.0228
Aircraft Refueling Loss	0.0261	-	-
Pre-flight Safety Check	0.0006	-	-
Diurnal Loss	0.0130	-	-
Fuel Storage & Transfer	0.0232	-	-
Stationary Sources	0.0001	0.0059	0.0017
APUs	0.0074	0.0480	0.1112
Non-Road Equipment	0.0320	0.0592	1.5761
Total	0.8876	1.8287	7.6946

2. AIRCRAFT EMISSIONS

Emissions from aircraft landing and take-off (LTO) cycles at SAIA are calculated using the EDMS model, version 5.1.3.[10] The EDMS model uses EPA approved emission factors and methodology to estimate emissions from aircraft operations. Emissions were calculated for the following aircraft categories:

- Commercial Aircraft/Air Taxi
- General Aviation Aircraft
  - Jet
  - Piston
  - Turbo
- Military Aircraft

Operation data at the SAIA for commercial and general aviation (GA) flights by aircraft were obtained from GCR Inc.[11] The data included information on engine type of each aircraft, arrival and departure times, and the number of landing and take-off for commercial flights. Information on military aircraft types that used SAIA were obtained from airport staff at control tower (table 2-1). There were 123,393 commercial operations, 90,517 GA operations, and 5,024 military operations in 2006.

Table 2-1: San Antonio Airport Aircraft Operation, 2005-2008[12]

Type	Category	2005	2006	2007	2008
Itinerant	Air Carrier	95,016	103,836	107,281	107,842
	Air Taxi	24,324	19,557	22,268	20,780
	General Aviation	82,864	84,313	83,819	83,858
	Military	5,415	4,328	4,279	4,014
	Total Itinerant	207,619	212,034	217,647	216,494
Local	Civil	6,464	6,204	1,568	124
	Military	688	696	222	16
	Total Local	7,152	6,900	1,790	140
Total Operation		214,771	218,934	219,437	216,634

The following steps were used to calculate emissions from aircraft LTO cycles at SAIA:

1. Collect activity data for commercial, GA, and military aircraft
2. Calculate emissions using the EDMS 5.1.3 model
3. Temporally allocate emissions from aircraft operations
4. Spatially allocate emissions from aircraft operations
5. Provide raw local input data such as population size, local activity profiles, and spatial surrogates to TCEQ.

This "bottom-up" approach enhanced the accuracy of emission estimations and spatial allocation.

[10] FAA, Nov. 2010. "Emissions & Dispersion Modeling System". Available online: http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/. Accessed 09/21/11.

[11] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 09/21/11.

[12] City of San Antonio, Aviation Department, San Antonio International Airport, Annual Statistics. Available online: http://www.sanantonio.gov/Aviation/statistics.asp . Accessed 09/21/11.

2.1. **Collect Activity Data for Military, GA, and Commercial Aircrafts**

Data obtained from GCR Inc. included a total of 151,572 operations for all non-military aircrafts from 07/22/2007 to 07/22/2008. There was 119,014 operations for air carrier and air taxi flights, and 32,558 operations for GA flights. For commercial aircraft, the database provided airline name and number of operation for each aircraft type. The general aviation database was broken down into piston, turboprop, and jet aircraft. The general aviation records contained FAA number, make, model, itinerary, dates, and time for each aircraft. Detailed annual operations for all aircraft types, including military aircraft, are provided in Appendix A.

Since GCR's database only contained records for 70% of the flights, adjustments were made to increase the number of operations by aircraft type to total 2006 operations recorded by the COSA. To calculate emissions**,** aircraft operation data were adjusted to total 2006 recorded aircraft operations using the following equation:

Equation 2-1, Number of operations for each aircraft type

$$NUM_A = OPS_A \times TAOP / TGCR$$

Where,

NUM_A = Number of operations for aircraft type A at airport in 2006
OPS_A = Number of recorded operations of aircraft type A (from GCR Inc.)
TAOP = Total annual operations in 2006 at SAIA (COSA's reports shown in Table 2-1)
TGCR = Total number of recorded operations by GCR Inc. at SAIA

Sample Calculation - Number of Raytheon Beechjet 400 aircraft commercial operations using a JT15D engine in 2006.

NUM_{AB} = 456 operations for Raytheon Beech 400 Baron aircraft recorded by GCR x 123,393 total 2006 commercial operations at SAIA / 119,024 total commercial operations recorded by GCR
= 473 total operations of Raytheon Beechjet 400

2.2. **Calculate Emissions Using EDMS Model**

Annual LTO and the exact engine types for each recorded aircraft were entered into the EDMS model. The EDMS model was used to generate NO_X, VOC, and CO emissions from landing and take-off cycles for each aircraft type. NO_X and VOC emissions were broken down into take off, climb out, approach, and ground level emissions (Table 2-2). The largest source of emissions was from commercial flights, 1.10 tons of NO_X per day, followed by GA Jet (0.077 tons of NO_X per day), military aircraft (0.074 tons of NO_X per day), GA turbo prop (0.006 tons of NO_X per day), and GA piston (0.004 tons of NO_X per day). Majority of aircraft emissions occurs during takeoff (0.543 tons of NO_X). Significant emissions also occurred during taxi/idling (0.368 tons of NO_X) and climb out (0.323 tons of NO_X).

Table 2-2: Aircraft Emissions by Flight Cycle at SAIA, 2006

Aircraft Category	Geo-coding Location	Mode	VOC (tons/day)	NO_X (tons/day)
Commercial	Elevated	Take Off	0.0028	0.4746
		Climb Out	0.0015	0.2907
		Approach	0.0136	0.0036
	Ground	Taxi/Idle	0.2513	0.3331
Military	Elevated	Take Off	0.0012	0.0360
		Climb Out	0.0003	0.0157
		Approach	0.0080	0.0110
	Ground	Taxi/Idle	0.0899	0.0112
GA Jet	Elevated	Take Off	0.0004	0.0306
		Climb Out	0.0002	0.0136
		Approach	0.0215	0.0116
	Ground	Taxi/Idle	0.2451	0.0213
GA – Turbo-Prop	Elevated	Take Off	0.0002	0.0011
		Climb Out	0.0002	0.0015
		Approach	0.0036	0.0018
	Ground	Taxi/Idle	0.0294	0.0022
GA – Piston	Elevated	Take Off	0.0008	0.0006
		Climb Out	0.0011	0.0010
		Approach	0.0036	0.0022
	Ground	Taxi/Idle	0.0141	0.0005
Total			0.6886	1.2637

2.3. **Temporally Allocate Emissions from Aircraft Operations**

Processing emissions in a photochemical model includes temporal and spatial allocation of emissions. These steps necessitate the allocation of aircraft emissions to the grid-cell based modeling system and conversion of daily emissions to hourly emissions required by the photochemical model.[13] For this task, October 2008 flight schedules for commercial airliners, obtained from "FlightStats"[14] and the GA flights data obtained from GCR Inc, were analyzed to determine the hourly arrival and departure patterns for commercial and GA operations at SAIA. The arrival and departure frequencies are shown in figures 2-1 and 2-2 with the detailed information located in Appendix B.

Commercial arrival and departure pattern was different compared to GA; while the peak hours for the GA Jet flights were between 4:00 pm and 5:00 pm, the peak arrival times for the commercial flights fluctuated between 10:00 am to 8:00 pm. Emissions were allocated to each hour by aircraft category based on the percentage of flights occurring during that hour. EPA's default temporal allocation was used for military aircraft because local military temporal allocation was not available.

[13] ENVIRON International Corporation, March, 2010. "CAMx: Comprehensive Air Quality Model With Extensions, Version 5.20". Novato, California, Available online: www.camx.com/files/Release_notes.v5.30.pdf . Accessed 09/21/11.
[14] FlightStats, Conducive Technology Corp, 2005. Avialble online: http://www.flightstats.com/go/FlightStatus/flightStatusByAirport.do . Accessed 12/15/11.

Figure 2-1: Hourly Distribution of General Aviation Operations by Aircraft Type at SAIA

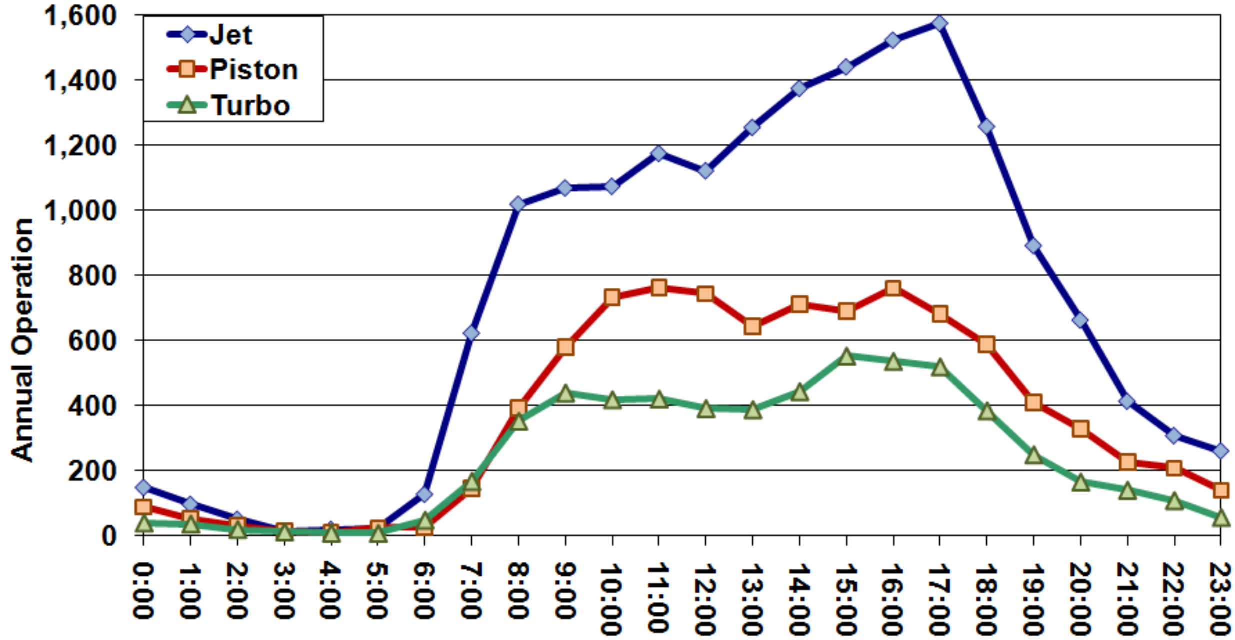
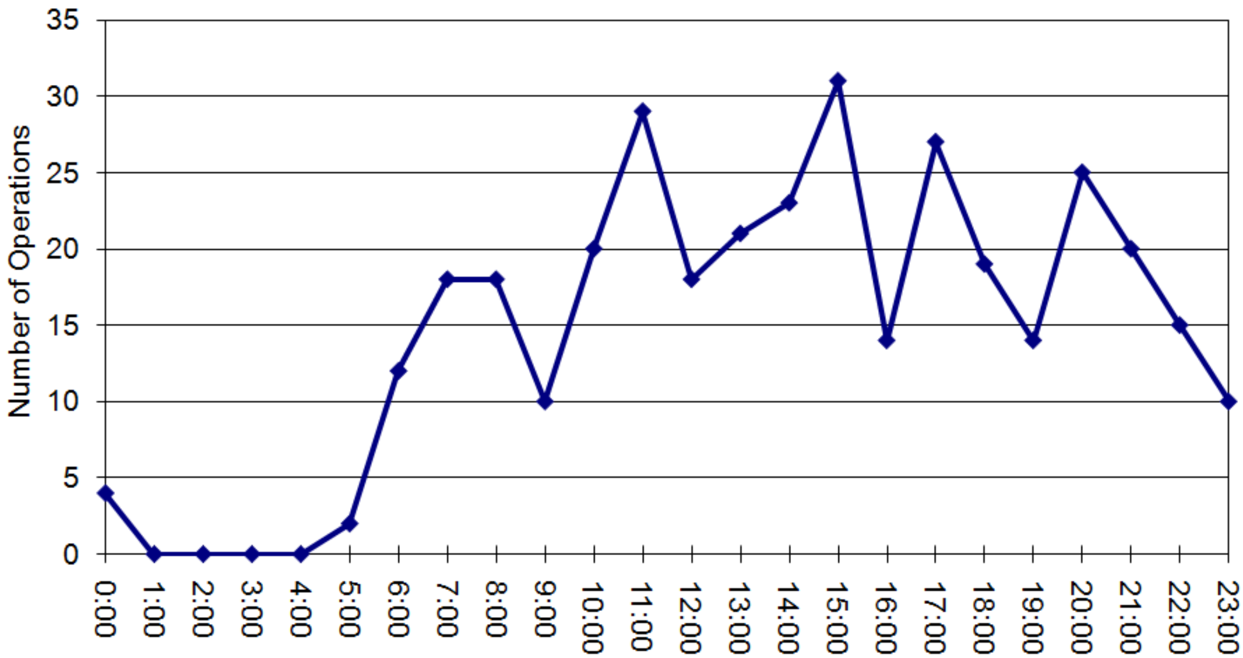


Figure 2-2: Hourly Distribution of Daily Commercial Operations at SAIA



2.4. **Spatially Allocate Aircraft Operations Emissions**

To allocate elevated and ground level emissions spatially, information on runway usage patterns for each aircraft category was obtained from the San Antonio Department of Aviation (Table 2-3). The data provides the percentage of landing and take-offs that take place at each runway annually by aircraft category. Most of the arrival flights use RW 12R (74% for commercial arrivals), while departure flights often use RW 12R (45% for commercial arrivals) or RW 3 (39% for commercial arrivals). Runways RW30R, RW12L, and RW21 had low usage rates.

Table 2-3: Percentage of Annual Aircraft Operations per Runway and Aircraft Type at SAIA

Runway	Departure				Arrival			
	Com.	GA Jet	GA Turbo	GA Piston	Com.	GA Jet	GA Turbo	GA Piston
RW 12R	45%	61%	58%	51%	74%	70%	72%	58%
RW 12L	0%	3%	1%	4%	0%	2%	5%	13%
RW 21	2%	2%	2%	4%	3%	2%	2%	4%
RW 30R	0%	0%	2%	3%	0%	0%	1%	4%
RW 30L	14%	18%	14%	11%	13%	15%	11%	10%
RW 3	39%	16%	23%	27%	10%	11%	9%	11%
Total	100%	100%	100%	100%	100%	100%	100%	100%

By using the arriving and departing data by runway, assignment of EDMS-generated aircraft emissions to each runway's end can be calculated. Figure 2-3 depicts schematics of runways that were used for allocating aircraft emissions. To calculate emissions by runway and aircraft type, the following formula was used.

Equation 2-2, Emissions by aircraft type and runway

EM_{AB} = PAO_{AB} x EM_{A}

Where,

EM_{AB} = Aircraft emissions by aircraft category A and runway B

PAO_{AB} = Percentage of aircraft operations allocated by runway B for aircraft category A (from San Antonio Department of Aviation, Table 2-3)

EM_{A} = Emission by mode for aircraft category A (from EDMS model using local data, Table 2-2)

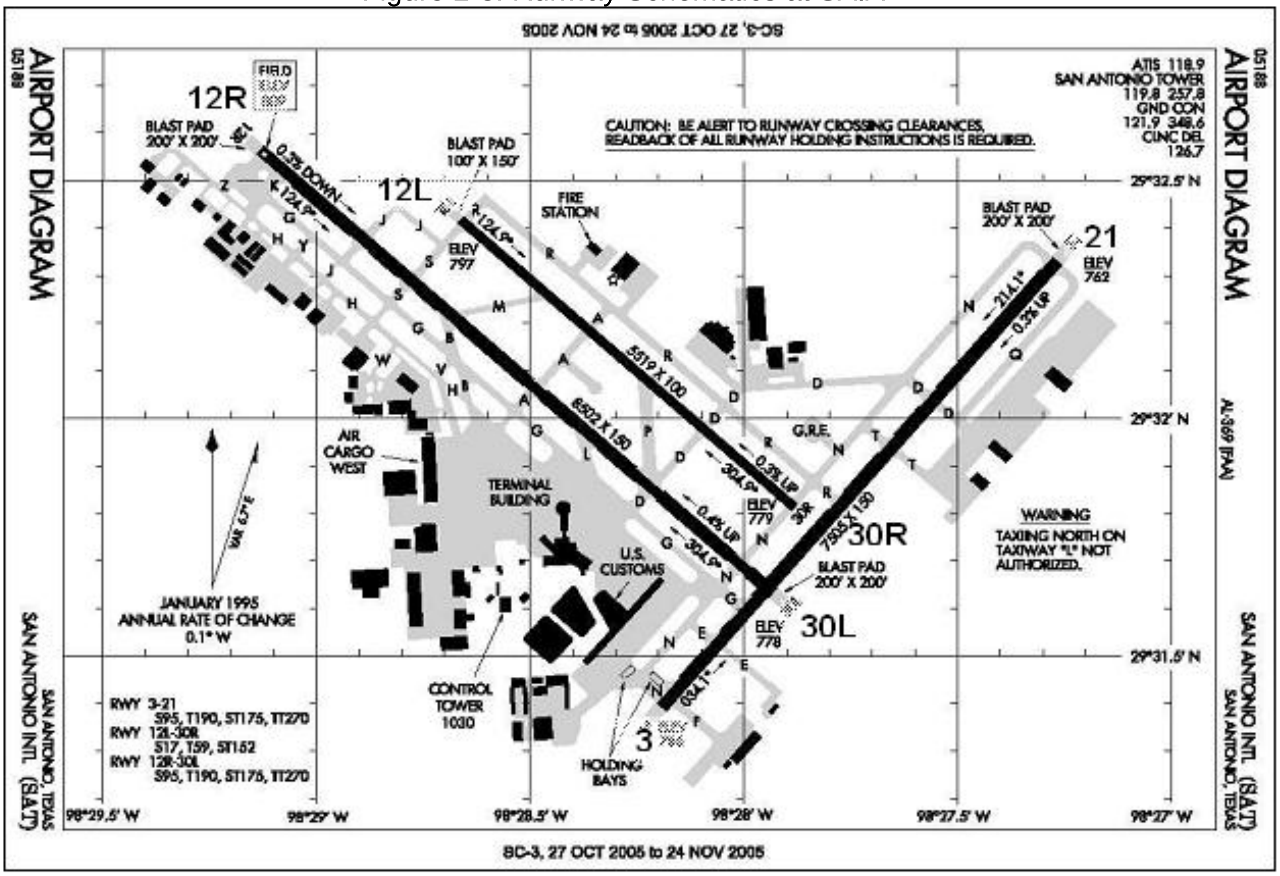
Sample Calculation - NO_X Emission at Take-off Mode from Commercial Flights for runway 12R

EM_{AB} = 45%of flights on RW 12R x 0.4746 ton/day of NO_X from commercial flights
= 0.2136 ton of NO_X from commercial aircraft for RW 12R

In the next step, aircraft emissions by flight modes, take-off (0 – 305 meters), climb out (305 – 914 meters), and approach (914 – 0 meters), were allocated to photochemical grids. Emissions from aircraft above 914 meters elevation were not calculated. Above this height, aircrafts are usually above the mixing height for San Antonio[15] and local elevated emissions would have an insignificant impact on ground-level ozone monitors in San Antonio.

[15] FAA, Nov. 2010. "Emissions & Dispersion Modeling System". Available online: http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/. Accessed 12/15/11.

Figure 2-3: Runway Schematics at SAIA



To allocate emissions to photochemical model grids, height, latitude, and longitude are calculated for 8 nodes at incremental ground distances from the ends of each runway. Figure 2-3, which provides the layout and dimensions of runways at SAIA, was used to calculate the latitude and longitude of each node. Figure 2-4 shows these nodes superimposed on an aerial photo of the airport, illustrating the horizontal location and distance of these nodes relative to both ends of each runway. In addition, 4km grid cells are displayed in a light green color.

The arrival angle of aircraft is set at 3º and departure angle at 9º. These angles are the same as those used in previous versions of the Dallas State Implementation Plan for the Dallas/Fort Worth International Airport. This information, in addition to the formula below, is used to locate eight nodes within the photochemical model horizontal and vertical grid cells to replicate the 3-dimensonal paths of aircraft.

Equation 2-3, Calculation of aircraft emission vertical locations

$$HEIGHT = DIST \times TAN\ (Angle \times \mu / 180^{o})$$

Where,

HEIGHT = height of the node
DIST = ground distance from the runway end point (from Table 2-4)
μ = mathematical constant pi (≈3.14159)
Angle = Angle of slope (3º or 9º)

Figure 2-4: Aerial View of Calculated Nodes for the SAIA and the 4km Photochemical Modeling Grid

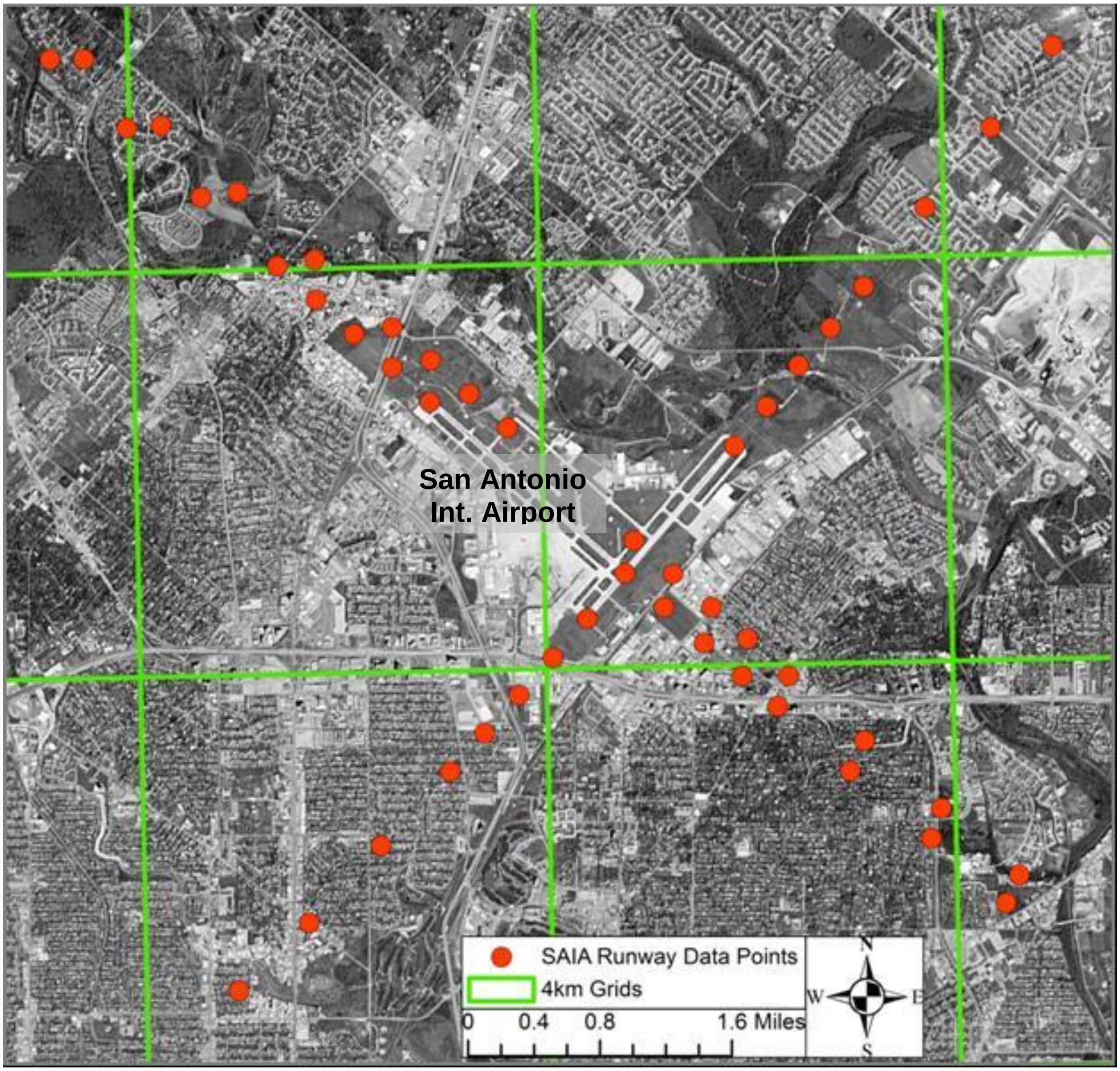


Table 2-4 contains the heights, latitudes, and longitudes of nodes for runway 3/21. Four nodes were used to allocate take off and climb out emissions. For allocation of emissions at landing/approach mode, six nodes were used. The nodes for landing/approach are spaced in 1,000-meter increments from the end of each runway. The height of first landing node is 264 meters, which is the height of the plane at 5,000 meters ground distance from the airport. Emissions were not allocated farther away from the airport because of the uncertainty of aircraft direction before it reaches this location.

Vertical heights by the different aircraft operation modes and June 2006 photochemical model vertical grid layers are shown in figure 2-5. Aircraft emissions are allocated to the first 8 vertical layers of the photochemical model grid system. Aircraft emissions by takeoff, climb out, approach, and runway are then equally distributed and allocated to each node. Once emissions are geo-coded to correct location and height, the data was converted to the Emission Preprocessing System 3 (EPS3) input format needed for the photochemical model. The following formula was use to allocate emissions to each node:

Equation 2-4, Emissions by aircraft type and by node

EM_{ABC} = PNO_C x EM_{AB}

Where,

EM_{ABC} = Aircraft emissions by aircraft category A, runway B, and node C

PNO_C = Percentage of aircraft operations allocated to node C (25% for takeoff and climb out and 16.7% for landing/approach)

EM_{AB} = Emission by mode for aircraft category A on runway B (from equation 2-2)

Sample Calculation - Runway 12R commercial flights takeoff NO_X emission at the 1,500 meters node

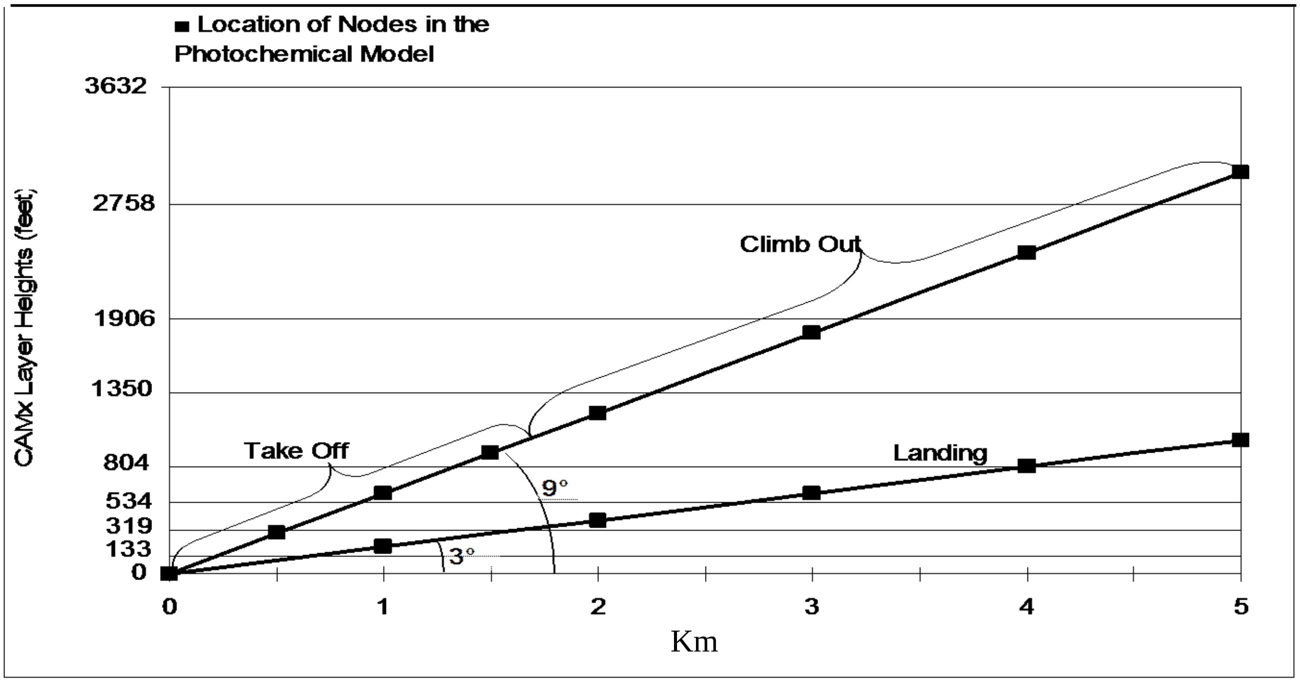
EM_{ABC} = 25% for takeoff x 0.2136 ton/day from commercial aircraft on runway RW 12R
= 0.0534 tons of NO_X from commercial aircraft for RW 12R at a node that is 1,500 meters from the runway and 238 meters in height

Table 2-4: Location of Nodes for Landing and Take-off

Runway Nodes (Direction)	Distance from End of Runway (m)	Latitude (Y coordinate)	Longitude (X Coordinate)	Node Height (m) for 9º - Take off	Node Height (m) for 9º - Climb out	Node Height (m) for 3º - Landing/ Approach
Runway 3 Nodes (Northeast)	0	-1157.69	150.96	0	N/A	0
	500	-1157.31	151.27	79	N/A	N/A
	1,000	-1156.94	151.58	158	N/A	53
	1,500	-1156.56	151.89	238	N/A	N/A
	2,000	-1156.18	152.20	N/A	317	106
	3,000	-1155.43	152.83	N/A	475	158
	4,000	-1154.68	153.45	N/A	634	211
	5,000	-1153.92	154.08	N/A	792	264
Runway 21 Nodes (Southwest)	0	-1159.41	149.53	0	N/A	0
	500	-1159.79	149.22	79	N/A	N/A
	1,000	-1160.17	148.90	158	N/A	53
	1,500	-1160.54	148.59	238	N/A	N/A
	2,000	-1160.92	148.28	N/A	317	106
	3,000	-1161.67	147.66	N/A	475	158
	4,000	-1162.43	147.03	N/A	634	211
	5,000	-1163.18	146.41	N/A	792	264

N/A: these nodes are not used for allocation of emissions

Figure 2-5: Calculated Heights of Nodes for LTO Operations at End of Each Runways



*Note: Angles in diagram are for illustration purposes only and are not to scale.

3. GROUND SUPPORT EQUIPMENT

GSE is used to support and service aircraft on the ground between flights. The equipment provides support for ground operations, aircraft power, aircraft transport, and loading operations. Local data was collected for the following types of GSE used by cargo and passenger aircrafts at SAIA:

- Aircraft Pushback Tractors
- Air Conditioner Units
- Air Start Units
- Baggage Tugs
- Belt Loaders
- Cargo Loaders
- Deicing Equipment
- Catering Trucks
- Fuel Trucks
- Lavatory Trucks
- Water Trucks
- Fork Lifts
- Lifts
- Ground Power Units

The following steps were used to calculate GSE emissions:

1. Conduct a survey to determine the GSE equipment population, usage rates, and equipment characteristics.
2. Calculate NO_X, VOC, and CO emissions.
3. Spatially allocate emissions to the grid system used in the photochemical model.

Raw local input data such as equipment population sizes, engine characteristics, and spatial surrogates were provided to TCEQ.

3.1. Conduct a Survey of Local GSE Equipment

To calculate GSE emissions, a list of GSE equipment was compiled from a survey that was sent to all tenants at SAIA. Other necessary information such as horsepower output (HP), emission factors, and load factors for the equipment were compiled from equipment user's manuals and existing data in the EDMS model. After the survey forms were completed and returned, tenants at SAIA and the COSA's Department of Aviation were contacted and consulted to determine the accuracy and completeness of the data.

The minimum number of returned survey questionnaires required was determined as described below. Since determining a suitable sample size is not always clear-cut, several major factors must be considered. Due to time and budget constraints, a 95% level of confidence, which is the risk of error the researcher is willing to accept, was chosen. Similarly, the confidence interval, which determines the level of sampling accuracy, was set at +/- 5%. Since the population is finite, the following equation was used to select the sample size.[16]

Equation 3-1, Minimum number of survey responses needed

$$RN = [CLV^2 \times 0.25 \times POP] / [CLV^2 \times 0.25 + (POP - 1) CIN^2]$$

Where,

RN	= Number of survey responses needed to accurately represent the population
CLV	= 95% confidence level (1.96)
POP	= Population size (30 airport tenants)
CIN	= ± 5% confidence interval (0.05)

Sample Calculation - For a 5% confidence interval:

[16] Rea, L. M. and Parker, R. A., 1992. "Designing and Conducting Survey Research". Jossey-Bass Publishers: San Francisco.

RN $= [(1.96)^2 \times (0.25) \times 30] / [(1.96)^2 \times (0.25) + (30 - 1) \times (0.05)^2]$
$= 27.89$ responses

Thus, 28 survey responses were needed in order to meet the 95% level of confidence, and the ±5% confidence interval for equipment population. The survey and the follow-ups with representatives of airliners/tenants and the COSA's authorities at SAIA provided a 100% count of all GSE equipment operating at SAIA. All 30 tenants responded to the survey and furnished data on 440 GSE (100 percent of the GSE population). Calculated confidence intervals for equipment are shown in the table 3-1. A 95% level of confidence (p = 0.05) was reported for equipment types with 5 or more and the results assume that the means are normally distributed.

Table 3-1: Confidence Intervals at 95% Confidence Level for Ground Support Equipment

Equipment Type	SCC	n	Parameter	Mean	Confidence Interval	Percent of Mean
Air Conditioner	2270008005	14	Hours/Year	1,173	52.6	4.5%
			Horsepower	214	36.8	17.2%
Air Start Unit	2270008005	14	Hours/Year	307	26.4	8.6%
			Horsepower	584	111.3	19.0%
Aircraft Tractor	2270008005	33	Hours/Year	215	13.6	6.3%
			Horsepower	161	42.9	26.6%
Aircraft Tractor	2265008005	12	Hours/Year	2	0.5	25.8%
			Horsepower	94	5.3	5.7%
Baggage Tug	2270008005	29	Hours/Year	539	78.5	14.6%
			Horsepower	87	7.7	8.8%
Baggage Tug	2265008005	66	Hours/Year	425	47.8	11.2%
			Horsepower	95	4.1	4.3%
Belt Loader	2270008005	34	Hours/Year	454	28.2	6.2%
			Horsepower	88	7.2	8.1%
Belt Loader	2265008005	27	Hours/Year	476	23.8	5.0%
			Horsepower	90	6.7	7.5%
Cargo Loader	2270008005	20	Hours/Year	789	286.5	36.3%
			Horsepower	109	11.9	10.9%
Deicing Unit	2265008005	8	Hours/Year	27	23.1	86.1%
			Horsepower	268	2.3	0.8%
Fuel Truck	2270002051	31	Hours/Year	788	17.0	2.2%
			Horsepower	231	6.2	2.7%
Ground Power Unit	2270008005	27	Hours/Year	954	177.7	18.6%
			Horsepower	155	13.5	8.7%
Lavatory Truck	2265002051	6	Hours/Year	685	84.9	12.4%
			Horsepower	235	0.0	0.0%
Service Truck	2265002051	14	Hours/Year	562	0.0	0.0%
			Horsepower	214	37.5	17.5%
Portable Air Stairs	2265008005	7	Hours/Year	70	54.1	77.3%
			Horsepower	180	63.5	35.2%

The cover letter and the questionnaire are located on the following pages and a detailed list of equipment is provided in Appendix C.

Alamo Area Council Of Governments

Operations Manager,

Re: San Antonio Emissions Inventory

The Alamo Area Council of Governments (AACOG) requests your assistance in developing the emission inventory for San Antonio International Airport. AACOG is conducting this inventory in order to assess local air quality and quantify pollutants within the San Antonio metropolitan area and contiguous counties. This inventory is especially significant because the San Antonio region currently risks being declared in non-attainment of federal air quality standards.

With this survey, we are requesting information on ground support equipment (GSE) used in your operations. The purpose of this survey is to provide better information and services to the region, as well as help minimize additional regulation on the community.

Your input is vital to this process and will serve to affect a true emission inventory, which will eventually be delivered to the U.S. Environmental Protection Agency. Please provide your responses by the date indicated. The information you provide will be considered strictly confidential and unavailable to public information requests.

Thank you for your time and participation. If you have any questions or comments please feel free to contact Parviz Nazem at (210) 362-5317.

Sincerely yours,

Gloria Arriaga
Executive Director

Enclosures (1)

Airport Ground Support Equipment (GSE) Survey

Tenant Name:

GSE Type	Fuel Type (diesel, gasoline, LNG, electric)	Number of Units (how many)	Model Name	Model Year (if known)	Horse Power (if known)	Average Minutes per Airplane (if known)
Aircraft Pushback Tractor						
Air Conditioner Unit						
Air Start Unit						
Baggage Tug						
Belt Loader						
Cargo Loader						
Catering Truck						
Deicing Equipment						
Fuel Truck						
Lavatory Truck						
Water Truck						
Fork Lift						
Lift						
Ground Power Unit						
Other Trucks:						

3.2. **Estimate Ozone Precursor Emissions**

Information on equipment, such as fuel type, horsepower, load factor, average operation time per aircraft, and emission factors, were collected using the surveys, existing data in the EDMS model, and equipment user's manuals. Since data on model year and model name are collected through the survey, user manuals were used to obtain missing information needed to calculate emissions.

Local survey data, annual operations for each aircraft type by airline, and the EDMS model were used to determined activity rates for GSE. GSE needed for each aircraft arrival or departure was determined by studying features, size, and function of the aircraft, as well as data provided in the EDMS model. If an aircraft did not need service of a catering truck, for example, the catering truck was not assigned to the aircraft. This procedure required grouping of equipment by their types, functions, and airlines to determine the correct aircraft matches among the list of commercial aircrafts that landed at SAIA.

Once data was collected on GSE needed for each commercial aircraft by airline, the following equation was used to calculate emissions from GSE equipment.

Equation 3-2, Emissions for each GSE equipment for commercial flights

$DE_{GSE.AB}$ = (EP_{AB} x MIN_{AB} / 60 minutes/hour x HP_A x LF_A x EF_A x LTO_B) / 907,184.74 grams/ton / 365 days/year

Where,

$DE_{GSE.AB}$ = Emissions for each type of equipment A for aircraft type B
EP_{AB} = Equipment population of equipment A used for each departure or arrival by aircraft type B (based on survey)
MIN_{AB} = Minutes per aircraft for equipment A by aircraft type B (from survey data and EDMS model)
HP_A = Horsepower for equipment A (from survey data, user's manuals, EDMS model, and TexN model)
LF_A = Load factor for equipment A (from EDMS and TexN model)
EF_A = Emission factor for equipment A, g/hp-hr (from EDMS model and TexN model)
LTO_B = Annual number of LTO for aircraft type B (from GCR's aircraft operations data)

Sample Calculation - Daily VOC emissions for a 1994 model ACE 802 Air Conditioner unit

$DE_{GSE.AB}$ = (1 x 30 minutes / 60 minutes/hour x 300 hp x 0.75 x 0.82 g/hp-hr x 2,563 LTO) / 907,184.74 grams/ton / 365 days/year
= 0.0007 ton VOC/day

To calculate GSE related emissions for military and GA flights, existing data in the EDMS model was used. The data listed in the Table 3-2 and the following Figure 3-1 and Figure 3-2 shows daily ozone season emissions from GSE's at SAIA. Since deicing equipment is not used during the ozone season, emissions are zero during average ozone season day. Diesel fueled air start units (0.0668 tons of NO_X per day), air conditioners (0.0611 tons of NO_X per day), and ground power units (0.0569 tons of NO_X per day) emit the highest amounts of NO_X. Gasoline baggage tugs (0.0395 tons of NO_X per day) and fuels trucks (0.0223 tons of NO_X per day) also emit significant amount of NO_X emissions, while portable air stairs, conveyors, and lights plants are insignificant sources of emissions.

Table 3-2: GSE Emissions at SAIA, Tons per Ozone Season Day in 2006

GSE Type	Fuel Type	SCC	VOC	NO_X	CO
Air Conditioner	Diesel	2270008005	0.0050	0.0611	0.0188
Air Start Unit	Gas	2265008005	0.0018	0.0037	0.0454
Air Start Unit	Diesel	2270008005	0.0055	0.0668	0.0227
Aircraft Tractor	Gas	2265008005	0.0034	0.0050	0.1132
Aircraft Tractor	Diesel	2270008005	0.0018	0.0195	0.0093
Baggage Tug	Gas	2265008005	0.0222	0.0395	0.7247
Baggage Tug	LPG	2267008005	0.0010	0.0062	0.0169
Baggage Tug	Diesel	2270008005	0.0026	0.0163	0.0102
Belt Loader	Gas	2265008005	0.0070	0.0151	0.2137
Belt Loader	LPG	2267008005	0.0001	0.0004	0.0016
Belt Loader	Diesel	2270008005	0.0018	0.0141	0.0067
Cargo Loader	Diesel	2270008005	0.0015	0.0103	0.0070
Deicing Unit	Gas	2265008005	0.0000	0.0000	0.0000
Deicing Unit	Diesel	2270008005	0.0000	0.0000	0.0000
Ground Power Unit	Gas	2265008005	0.0012	0.0029	0.0347
Ground Power Unit	Diesel	2270008005	0.0067	0.0569	0.0170
Portable Air Stairs	Gas	2265008005	0.0001	0.0003	0.0020
Portable Air Stairs	Diesel	2270008005	0.0000	0.0000	0.0000
Conveyor	Diesel	2270008005	0.0001	0.0006	0.0003
Catering Truck	Gas	2265002051	0.0013	0.0027	0.0155
Catering Truck	Diesel	2270002051	0.0008	0.0092	0.0022
Fuel Truck	Gas	2265002051	0.0004	0.0007	0.0054
Fuel Truck	Diesel	2270002051	0.0015	0.0223	0.0052
Lavatory Truck	Gas	2265002051	0.0014	0.0037	0.0113
Lavatory Truck	Diesel	2270002051	0.0000	0.0005	0.0001
Service Truck	Gas	2265002051	0.0027	0.0068	0.0375
Service Truck	Diesel	2270002051	0.0001	0.0009	0.0005
Lift	Gas	2265003010	0.0041	0.0074	0.1314
Lift	Diesel	2270003010	0.0002	0.0014	0.0009
Elevator Lift Platform	Diesel	2270003010	0.0005	0.0027	0.0018
Fork Lift	LNG	2267006020	0.0001	0.0006	0.0027
Light Plant	Diesel	2270002027	0.0000	0.0002	0.0001
Light Cart	Diesel	2270002027	0.0000	0.0001	0.0001
Other GSE Equipment used by Military and GA Aircraft			0.0198	0.0682	0.5523
Total			0.0947	0.4462	2.0112

3.3. **Spatially Allocate GSE Emissions**

Emissions were spatially allocated to the 4 km grid system used in the June 2006 photochemical model. Emissions from GSE were allocated to the location of SAIA.

Figure 3-1: Daily NO_X Emissions by Fuel and GSE Equipment Type, 2006

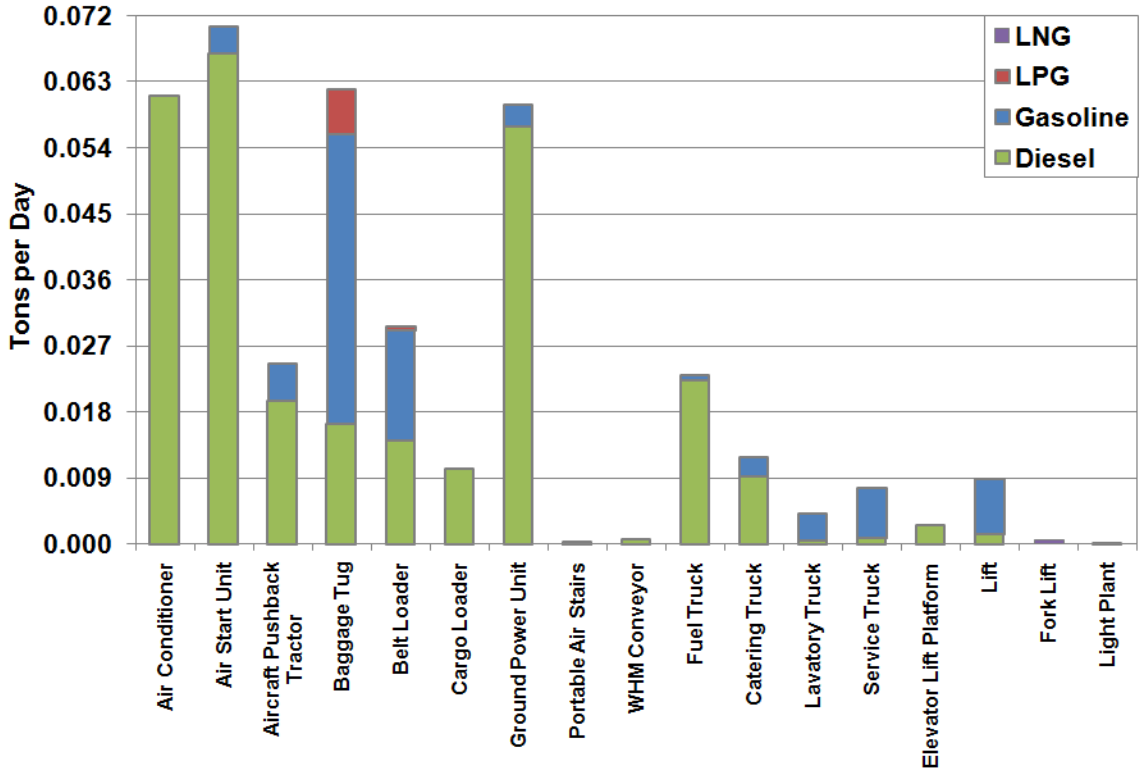
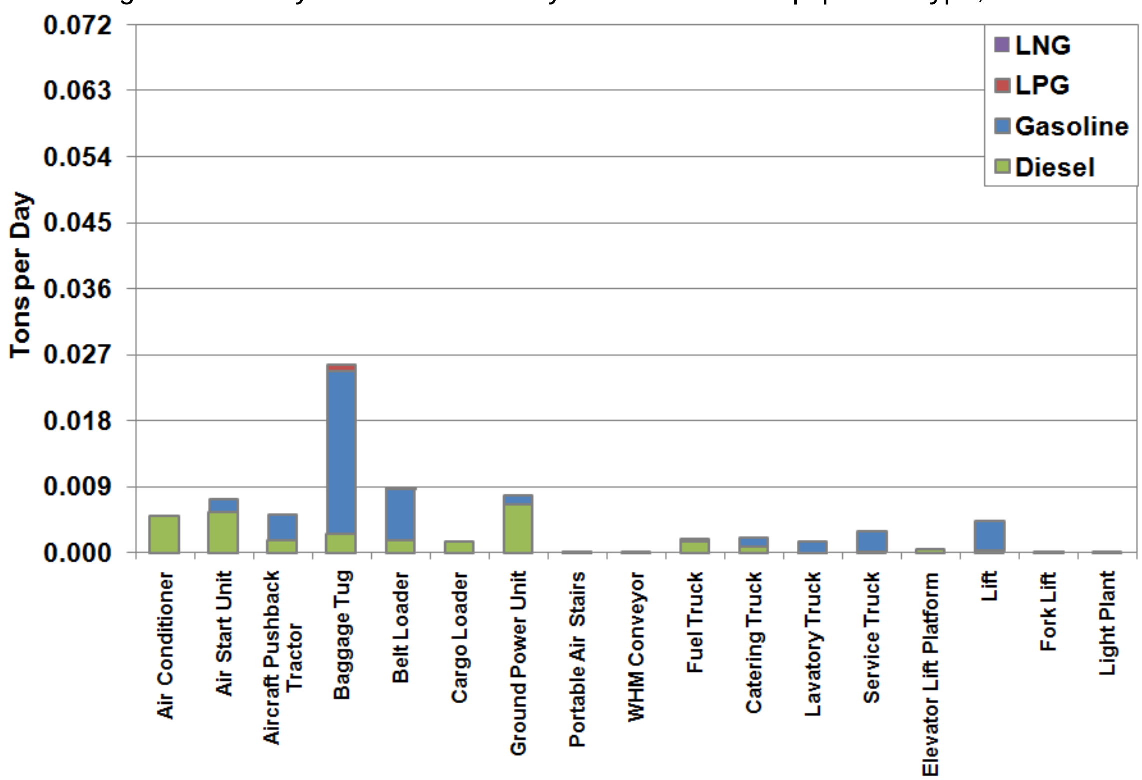


Figure 3-2: Daily VOC Emissions by Fuel and GSE Equipment Type, 2006



4. PARKING LOTS

Vehicles owned by employees, businesses, vacationers, and business travelers frequently use parking lots at SAIA. Emissions from parking lots at SAIA were calculated using on-road and idling emission factors generated by MOVES2010a[17] model and the EPA. Data on the number of vehicles using each facility, emission factors, idling time, and average distance traveled in the parking lot were used to calculate CO, NO_X, and VOC emissions. Data collected included activity rates at the following locations:

- Employee Parking
- Long Term Parking
- Hourly Parking
- Economy Parking

The following steps were followed to calculate emissions from vehicles using SAIA parking garages:

1. Collect local parking utilization data.
2. Calculate ozone precursor emissions using MOVES and EPA generated emission factors.
3. Spatially allocate emissions to the 4km grid system used in the photochemical model.

Raw local input data such as population sizes and spatial surrogates were provided to TCEQ.

4.1. **Collect Local Input Data**

The average lengths of trips inside each parking lot were calculated using local COSA data[18] and schematics of the parking lots. A 2-minute idle time per car was used based on observations during site visits to the airport.

4.2. **Estimate Ozone Precursor Emissions**

To calculate emissions, information regarding usage frequency, idling time, emission factors, and trip lengths (Table 4-1) were used along with emissions factors for motorcycles, passenger cars, and passenger trucks generated by the MOVES model and EPA[19]. The average 2006 on-road VOC, NO_X, and CO emission factors for motorcycles, passenger cars, and passenger trucks were 0.35, 0.95, and 5.48 grams/mile, while the average 2006 idling emissions factors for VOC, NO_X, and CO were 7.52, 20.99, and 66.63 grams/hour.

[17] U.S. Environmental Protection Agency, December 2009. "Motor Vehicle Emission Simulator". Office of Transportation and Air Quality Washington, DC. Available online: http://www.epa.gov/otaq/models/moves/index.htm. Accessed 12/15/11.

[18] Greg Lawrence, July 28, 2005 email, "Information on SAT Parking Activities", Parking Manager, San Antonio International Airport.

[19] David Brzezinski, EPA, Office of Transportation and Air Quality, e-mail dated 05/19/2011.

Table 4-1: Parking Facilities Vehicle Data and Total Daily Emissions, 2006

Facility	Daily Vehicle Counts	Daily Hours Idling	Average VMT/ vehicle	VMT/day	Total Emissions (tons/day)		
					VOC	NO_X	CO
Employee Parking	930	31.00	0.1553	144.47	0.0003	0.0009	0.0031
Long Term Parking	917	30.57	0.3134	287.43	0.0004	0.0010	0.0040
Hourly Parking	2,767	92.23	0.5001	1,383.86	0.0013	0.0036	0.0151
Economy Parking	125	4.17	0.3000	37.50	0.0000	0.0001	0.0005
Total	4,739	157.97	1.2690	1,853.26	0.0020	0.0056	0.0228

Equation 4-1, Daily emissions for vehicles at parking facilities

$DE_{Vehicle.A}$ = [(VP_A x IDLE / 60 minutes/hour x IEF) + (VP x AD x REF)] / 907,184.74 grams/ton

Where,

$DE_{Vehicle.A}$ = Daily emissions (VOC or NO_X)
VP_A = Vehicle population using parking lot A (from COSA)
IDLE = Idling duration (2 minutes per vehicle from site visits)
IEF = Average idling VOC or NO_X emission factors for LDVs, 7.52 grams of VOC per hour and 20.99 grams of NO_X per hour (from EPA)
AD = Average distance traveled in parking facilities (table 4-1)
REF = Average on-road VOC or NO_X emission factors for LDVs, 0.35 gram of VOC per mile and 0.95 gram of NO_X per mile (from MOVES model)

Sample Calculation - Daily NO_X emissions for employee parking facility

$DE_{Vehicle.A}$ = [(930 vehicles x 2 minutes / 60 minutes/hour x 20.99 grams of NO_X per hour) + (930 vehicles x 0.1553 x 0.95 NO_X grams/mile)] / 907,184.74 grams/ton
= 0.0009 ton of NO_X per day

4.3. **Spatially Allocate Parking Lot Emissions**

Emissions were spatially allocated to the 4km photochemical grid system used in the June 2006 photochemical model. Vehicle emissions were geo-coded to the location of SAIA.

5. EVAPORATIVE LOSSES

Evaporative emissions occur from refueling and spillage loss, diurnal losses, and pre-flight safety procedures. As described in Appendix D of "Air Quality Procedures for Civilian Airports & Air Force Bases"[20], most general aviation aircraft are powered by piston engines fueled by aviation gasoline (AvGas). Since AvGas has a much higher volatility than jet fuel and fuel tanks are vented into the atmosphere, significant amounts of VOC emissions are released. Evaporative emissions from Jet fuel are insignificant due to the low vapor pressure of the fuel and the use of quick-connect refueling nozzles.

Since the EDMS model does not estimate evaporative emissions, evaporative emissions for piston engine general aviation aircraft based at SAIA were calculated using the following steps:

4. Determine the number of local operation and number of piston aircraft based at SAIA
5. Calculate evaporative emissions for piston aircraft based at SAIA using EPA approved methodology
6. Spatially allocate emissions to the grid system used in the photochemical model

Raw local input data such as population sizes and spatial surrogates were provided to TCEQ.

5.1. **Collect Local Input Data**

Fixed Based Operators (FBOs) at SAIA report their total annual sales of aviation fuel to the COSA.[21] Total aviation fuel sales of both AvGas and Jet fuel were 8,446,075 gallons in 2006. Piston engine aircrafts consume 22.2% of the total national aviation fuel consumption according to the National Business Aviation Association (NBAA) fact book.[22] Total based aircraft at SAIA is 257 units, of which 67% or 173 units are piston-engine aircrafts.[23]

5.2. **Estimate Ozone Precursor Emissions**

EPA approved formulas were used to calculate evaporative emissions from refueling and spillage loss, diurnal losses, and pre-flight safety checks. The following methodology provides descriptions of these procedures.

5.2.1. Refueling and Spillage Loss

For refueling and spillage loss, aircraft emit 4.61 grams of Hydrocarbon (HC) per gallon of AvGas fuel consumed.[24] The 2006 fuel consumption rate for piston engine aircrafts was calculated using the 2006 SAIA total aviation fuel consumption data obtained from the COSA. VOC emissions from refueling activities were calculated using the following formula:

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[20] Federal Aviation Administration, June 2, 2005. "Air Quality Procedures for Civilian Airports and Air Force Bases, Appendix D: Aircraft Emission Methodology". Office of Environment and Energy. Washington, DC. p. D-5. Available online: http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/App_D.PDF. Accessed 08/05/11.

[21] COSA. "2009 San Antonio International Airport Fuel Report". San Antonio, TX, emailed to AACOG from the manager of Department of Aviation.

[22] NBAA, 2003 Press releases, Business Aviation Fact Book 2003. Available online: http://www.jetsalesofstuart.com/downloads/nbaa_factbook.pdf , page 34. Accessed 08/05/11.

[23] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 12/15/11.

[24] J. Borowiec, T. Qu, and C. Bell, March 2000. 1996, 1999, and 2007 Airport Emission Inventory. Texas Transportation Institute, College Station, TX.

Equation 5-1, Daily emissions from refueling piston engine aircraft

$DE_{Refueling.i}$ = (FC_i x PP x REF x CON) / 453.59 g/lbs / 2,000 lbs/ton / 365 days/year

Where,

$DE_{Refueling.i}$ = Daily refueling and spillage emissions for year i, tons VOC/day

FC_i = Total aviation fuel consumption for year i (8,446,075 gallons in 2006 from COSA)

PP = Percentage of national aviation fuel consumption by piston aircraft (22.2% from National Business Aviation Association)

REF = Emission factor for refueling loss (4.61 HC g/gal from EPA)

CON = HC to VOC conversion ratio (1.000)[25]

Sample Calculation - Daily refueling and spillage emissions from SAIA

$DE_{Refueling.06}$ = (8,446,075 gal. x 0.222 x 4.61 HC g/gal. x 1.000) / 453.59 g/lbs / 2,000 lbs/ton / 365 days/year

= 0.02610 tons VOC/day

5.2.2. Diurnal Losses

Evaporation is associated with fuel venting from the aircraft due to diurnal temperature changes. Airport based piston aircraft, while parked, are subject to ambient temperature variation which causes AvGas fuel to evaporate from vents installed on the piston engine. The following equation, introduced in Appendix D of the EPA publication entitled, "Air Quality Procedures for Civilian Airports & Air Force Bases,"[26] was used to quantifying evaporative emissions from SAIA based piston aircraft.

Equation 5-2, Daily emissions from aircraft diurnal losses

$DE_{Durinal.i}$ = (NUM_i x EF x CON) / 2,000 lbs/ton

Where,

$DE_{Durinal.i}$ = Daily diurnal emissions, tons VOC/day

NUM_i = Number of piston-engine based aircraft for year i (173 in 2006 from COSA)

EF = Emission factor (0.15 lbs/day/based aircraft from EPA)

CON = HC to VOC conversion ratio (1.000)

Sample Calculation - Daily diurnal emissions at the SAIA

$DE_{Durinal.06}$ = (173 x 0.15 lbs/day/based aircraft x 1.000) / 2,000 lbs/ton

= 0.01298 tons VOC/day

5.2.3. Pre-flight Safety

When calculating evaporative emissions from safety checks, the number of aircraft stationed at airports, the percentage of aircraft with piston engines, and total "local" aircraft operations are needed. In 2006, total "local" operations at SAIA for all aircraft types were 6,900 flights

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[25] U.S. Environmental Protection Agency, December 2005. "Conversion Factors for Hydrocarbon Emission Components". Office of Transportation and Air Quality Washington, DC. p. 3. Available online: http://www.epa.gov/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf. Accessed 08/05/11.

[26] Federal Aviation Administration, June 2, 2005. "Air Quality Procedures for Civilian Airports and Air Force Bases, Appendix D: Aircraft Emission Methodology". Office of Environment and Energy. Washington, DC. p. D-5. Available online: http://www.faa.gov/regulations_policies/policy_guidance/envir_policy/airquality_handbook/media/App_D.PDF. Accessed 10/10/11.

annually, attributed to 257 based aircraft[27], of which 173 aircraft have piston-engines (67%)[28]. The following equation was used to calculate pre-flight safety check emissions.

Equation 5-3, Daily pre-flight safety check emissions

$DE_{Pre\text{-}flight.i}$ = [(OPS_i / 2) x PERP x EF x CON] / 2,000 lbs/ton / 365 days/year

Where,

$DE_{Pre\text{-}flight.i}$ = Daily pre-flight safety checks emissions for year i, tons VOC/day

OPS_i = Number of operations for all aircraft types for year i (6,900 operations, 2 ops per LTO cycle in 2006 from COSA's Annual Report)

PERP = Percentage of piston aircraft (67% from GCR aircraft operation data)

EF = Emission factor (0.20 lbs per LTO cycle from EPA)

CON = HC to VOC conversion ratio (1.000, EPA)

Sample Calculation - Daily pre-flight safety checks emissions at the SAIA

$DE_{Pre\text{-}flight.06}$ = [(6,900 ops / 2) x 0.67 x 0.20 lbs per LTO cycle x 1.000] / 2,000 lbs/ton / 365 days/year

= 0.00064 tons VOC/day

Total emissions for aircraft refueling loss, diurnal loss, and pre-flight safety checks are provided in table 5-1. The largest evaporate daily emissions come from aircraft refueling loss (0.02610 tons/day of VOC), followed by diurnal loss (0.01298 tons of VOC/day).

Table 5-1: Daily Evaporate Emissions at SAIA, 2006

Evaporative	VOC (tons/day)
Aircraft Refueling Loss	0.02610
Diurnal Loss	0.01298
Pre-flight Safety Checks	0.00064
TOTAL	0.03972

5.3. **Spatially Allocate Evaporative Loss Emissions**

Evaporative emissions were spatially allocated to the 4km photochemical grid system used in the June 2006 photochemical model. Evaporate emissions were geo-coded to the location of SAIA.

[27] City of San Antonio, Dec. 2006, "Airport Statistic 2006", Department of Aviation. Available online: http://www.sanantonio.gov/Aviation/statistics.asp. Accessed 07/20/11.

[28] GCR and Associates, Inc. 2006. Airport IQ Data Center. Available online: http://www.gcr1.com/5010WEB/airport.cfm?Site=SAT . Accessed 07/20/11.

6. FUEL STORAGE

Fuel storage emissions occur due to the transfer of fuel from and to storage tanks or bulk terminals by tanker trucks. The methodology to estimate emissions from fuel storage uses local data and emission factors from the EPA. The following steps were used to calculate emissions from fuel storage:

1. Collect local data on fuel consumption from the SAIA
2. Calculate ozone precursor emissions
3. Spatially allocate emissions to the grid system used in the photochemical model

Raw local input data were provided to TCEQ.

6.1. Collect Local Data on Fuel Consumption

To calculate emissions, information on the total fuel consumption by general aviation flights was obtained from the COSA's Aviation Department. Total aviation fuel consumption for 2006 was 8,446,075 gallons, which included consumption of both AvGas and jet fuel.[29]

6.2. Estimate Emissions of Ozone Precursors

Piston-powered aircrafts consume virtually all of the national AvGas consumed each year, approximately 22.2 percent of the general aviation fuel consumption.[30] Therefore, 22.2 percent of 8,446,075 gallons of fuel consumed at the SAIA in 2006 (1,875,029 liters) was used to estimate evaporative emissions from storage tanks. According to the methodology described by the EPA[31], non-fugitive VOC emission factor for storage tank filling is 1,081 mg/Liter. The formula provided below was used to calculate VOC emissions from fuel storage:

Equation 6-1, Annual emissions from fuel storage

$$DE_{Storage} = (FUEL \times 3.78\ L/gal. \times PERF \times EF \ / \ 1{,}000\ g/L) \ / \ 453.59\ g/lbs \ / \ 2{,}000\ lbs/ton \ / \ 365\ days/year$$

Where,

$DE_{Storage}$ = Fuel storage emissions, tons VOC/day
FUEL = Annual amount of aviation fuel consumed (8,446,075 gal. from SAIA)
PERF = Percentage of fuel consumed by piston aircraft (22.2% from National Business Aviation Association)
EF = Emission factor (1,081 mg/L)

[29] COSA. "2009 San Antonio International Airport Fuel Report". San Antonio, TX, emailed to AACOG from the manager of Department of Aviation.
[30] National Business Aviation Association. 2003 Press releases, Business Aviation Fact Book 2003. Available online: http://www.jetsalesofstuart.com/downloads/nbaa_factbook.pdf , page 34. Washington, DC 20036-2527. Accessed 08/05/11.
[31] EPA, July 2006. "Documentation for the Final 2002 Non-point Sector (Feb 06 Version) National Emission Inventory for Criteria and Hazardous Air Pollutants". EPA Contract No. 68-D-02-063. Prepared by: E.H. Pechan & Associates, Inc. Durham, NC, p. A-9. Available online: ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/nonpoint/2002nei_final_nonpoint_documentation0206version.pdf. Accessed 08/04/11.

Sample Calculation - Daily storage tank emissions:

$DE_{Storage}$ = (8,446,075 gal. x 3.78 L/gal. x 0.222 x 1,081 mg/L / 1,000 g/L) / 453.59 g/lbs / 2,000 lbs/ton / 365 days/year

= 0.02315 tons VOC/day

6.3. **Spatially Allocate Fuel Storage Emissions**

Fuel storage emissions were spatially allocated to the 4km photochemical grid system used in the June 2006 photochemical model. Emissions were geo-coded to the location of SAIA.

7. STATIONARY SOURCES

7.1. **Boilers**

According to the Airport Master Plan, 341,329 cubic meters of natural gas were burned in 1993.[32] The consumption of natural gas consumption is projected to increase to 504,000 cubic meters per year in 2015.[33] Annual consumption of, 437,453 cubic meters in 2006 was calculated using a straight-line interpolation. The following formula was used to calculate 2006 fuel consumption rate for the natural gas boilers at SAIA:

Equation 7-1, Annual natural gas consumption

$$NGC_i = [(HYNGC – BYNGC) / (HY– BY) \times (PR– BY)] + BYNGC$$

Where,

- NGC_i = Natural gas consumption for year i
- HYNGC = Horizon year natural gas consumption (504,000 m^3 from the Airport Master Plan)
- BYNGC = Base year natural gas consumption (341,329 m^3 from the Airport Master Plan)
- HY = Horizon year (2015)
- BY = Base year (1993)
- PR = Projection year (2006)

Sample Calculation - Annual natural gas consumption in 2006 at SAIA

$$NGC_{2006} = [(504,000\ m^3 - 341,329\ m^3) / (2015-1993) \times (2006-1993)] + 341,329\ m^3$$
$$= 437,453 \text{ cubic meters}$$

Natural gas consumption rate and type of boiler were entered into EDMS model to estimate emissions. According to the EDMS model, the boiler produced 0.00593 tons of NO_X and 0.00012 tons of VOC per day at the SAIA.

7.2. **Spatially Allocate Boiler Emissions**

Boiler emissions were spatially allocated to the 4-km photochemical grid system used in the June 2006 photochemical model. Emissions were geo-coded to the location of SAIA.

[32] Ricondo & Associates, Inc, Jan. 1998. San Antonio International Airport Master Plan Study, Volume 3.
[33] *Ibid*.

8. AUXILIARY POWER UNITS

"An APU is basically a small turbine engine that generates electricity and compressed air to operate aircraft instruments, lights, and ventilation when the main aircraft engines are not operational, for instance when aircraft are parked at the gate. APUs can also be used to provide power for starting the main aircraft engines. APUs burn jet fuel and create exhaust emissions."[34] APU's included in this report are installed on large, medium, small jet aircraft and turboprops and they are not included in the list of SAIA GSE's that was collected through the survey.

8.1. Estimate Emissions of Ozone Precursors

Local landing and take-off data for commercial and GA flights, by specific aircraft type, were obtained from GCR Inc.[35] Data in the EDMS model was used to assign an APU to each local aircraft operation. The EDMS model uses EPA recommended methodology for calculating emissions from EPA's Procedures for Emission Inventory Preparation, Volume IV, Chapter 5.[36] As shown in Table 8-1, emissions were 0.048 tons/day of NO_X and 0.007 tons per day of VOC from APUs.

Table 8-1: Daily Emissions from APU's by Flight Category at SAIA, 2006

Flight Type	VOC (tons/day)	NO_X (tons/day)	CO (tons/day)
Commercial	0.00671	0.04356	0.09564
General Aviation	0.00044	0.00363	0.01261
Military	0.00020	0.00079	0.00299
Total	0.00735	0.04798	0.11123

8.2. Spatially Allocate Auxiliary Power Units Emissions

APU emissions were spatially allocated to the 4-km photochemical grid system used in the June 2006 photochemical model. Emissions were geo-coded to the location of SAIA.

[34] Airport Emissions Inventory Denver International Airport, Ricondo & Associates, Inc. June 29, 2005. Available online: http://www.colorado.gov/airquality/documents/deno308/diaDenver_SIPemissionsinventory_finaldraft.pdf . p. II-9. Accessed 12/12/2011.

[35] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 09/21/11.

[36] FAA, EDMS User's Manual, CSSI, Inc., Washington, DC, Jan. 2007. Available online: http://nnsa.energy.gov/sites/default/files/nv_sweis/appendixD/FAA%202009.pdf . p.2-5. Access 12/12/2011.

9. NON-ROAD EQUIPMENT

Non-road commercial, industrial, and lawn and garden equipment located at commercial airports emit ozone precursor emissions. The following non-road equipment types are used at SAIA:

- Generators
- Compressors
- Paint Machines
- Light Plants
- Welding Machines
- Water Pumps
- Pressure Washers
- Concrete Saws
- Carts
- Fork Lifts
- Aerial Lifts
- Sweepers
- Off-Highway Trucks
- Rotary Tillers
- Chainsaws
- Trimmer/Edger/Brush Cutters
- Leaf Blowers
- Lawn Mowers
- Rear Engine Riding Mowers
- Lawn & Garden Tractors
- Turf Equipment

To estimate emissions from non-road equipment, a survey was conducted to determine population, equipment type, and activity data for equipment used by tenants and the COSA at SAIA. The following steps were used to calculate emissions from non-road equipment:

1. Conduct a local survey of equipment used by tenants and the COSA at the Airport to determine equipment use rates and other characteristics
2. Calculate VOC and NO_X emissions using TexN emission factors and usage rates for each equipment
3. Spatially allocated emissions to 4km photochemical modeling grid
4. Provide updated data in electronic format that can be readily included in TexN Model.

Raw local input data such as population sizes and local activity rates were provided to TCEQ.

9.1. Collect Local Data by Surveying Non-road Equipment at SAIA

COSA was contacted to obtain a list of non-road equipment used at the SAIA by all tenants. As shown in the next two pages, the survey form requested information on the following:

- Equipment type and quantity
- Activity rates – total annual hours of use
- Temporal profiles – hours of use on weekdays and weekends
- Horse-power (HP)
- Fuel type

Alamo Area Council Of Governments

Operations Manager,

Re: San Antonio Emissions Inventory

The Alamo Area Council of Governments (AACOG) requests your assistance in developing the emission inventory for San Antonio International Airport. AACOG is conducting this inventory in order to assess local air quality and quantify pollutants within the San Antonio metropolitan area and contiguous counties. This inventory is especially significant because the San Antonio region currently risks being declared in non-attainment of federal air quality standards.

With this survey, we are requesting information on equipment used in your operations. The purpose of this survey is to provide better information and services to the region, as well as help minimize additional regulation on the community.

Your input is vital to this process and will serve to develop a true emission inventory. Please provide your responses by the date indicated. The information you provide will be considered strictly confidential and unavailable to public information requests.

Thank you for your time and participation. If you have any questions or comments please feel free to contact Parviz Nazem at (210) 362-5317.

Sincerely yours,

Gloria Arriaga
Executive Director

Enclosures (1)

Equipment Survey

Equipment Type	**Fuel Type** (diesel, 2-cycle, 4-cycle, electric)	**Number of Units** (how many)	Horsepower	**Average number of Hours Each Unit Operates** (Weekdays)	**Average number of Hours Each Unit Operates** (Weekends)
Generators					
Compressors					
Paint Machines					
Light Plants					
Welding Machines					
Water Pumps					
Pressure Washers					
Concrete Saws					
Fork Lifts					
Aerial Lifts					
Sweepers					
Off-Highway Trucks					
Rotary Tillers					
Chainsaws					
Trimmer/Edger/ Brush Cutters					
Leaf Blowers					
Lawn Mowers					
Rear Engine Riding Mowers					
Lawn & Garden Tractors					
Turf Equipment					
Leaf Blowers					
Other Equipment					

The survey had a 100 percent response rate and it included all the equipment used by COSA and tenants at SAIA and the survey was statistically significant. Collected data were organized and equipment user manuals where used to determine hp when the data was not included in the survey response. The following table (9-1) lists the equipment types along with information on population fuel type, horsepower, and activity rates.

Table 9-1: Surveyed Non-Road Equipment at SAIA

Equipment Type	SCC	Engine Type	Horse-power	No. of Units	Total Hours per Year
Rotary Tiller	2260004016	2-Stroke	2	1	131
Chainsaw	2260004021	2-Stroke	2	2	261
Trimmer/Edger/Brush Cutter	2260004026	2-Stroke	1.5	14	3,654
Trimmer/Edger/Brush Cutter	2260004026	2-Stroke	2.2	4	1,044
Leaf Blower/Vacuum	2260004031	2-Stroke	4.5	6	1,566
Cart	2265001060	4-Stroke	25	8	399
Concrete Saws	2265002039	4-Stroke	30	2	261
Off-Highway Trucks	2265002081	4-Stroke	175	18	6,678
Lift	2265003010	4-Stroke	37	6	2,166
Fork Lift	2265003020	4-Stroke	73	9	16,200
Paint Machine	2265003040	4-Stroke	5	1	261
Paint Machine	2265003040	4-Stroke	3	2	1,148
Lawn Mower	2265004011	4-Stroke	14	2	2,088
Rear Engine Riding Mower	2265004041	4-Stroke	25	6	4,698
Generator	2265006005	4-Stroke	3.5	2	522
Generator	2265006005	4-Stroke	15	2	522
Water/trash pump	2265006010	4-Stroke	5.5	3	157
Planners	2265006010	4-Stroke	8	2	261
Planners	2265006010	4-Stroke	35	1	131
Compressor	2265006015	4-Stroke	10	3	78
Pressure Washers	2265006030	4-Stroke	20	1	261
Fork Lift	2267003020	LPG	55	7	9,010
Sweeper	2267003030	LPG	49	1	516
Light Plants	2270002027	Diesel	23.5	2	104
Off-Highway Trucks	2270002051	Diesel	175	2	900
Lift	2270003010	Diesel	49	5	1,920
Fork Lift	2270003020	Diesel	71	6	10,800
Sweeper	2270003030	Diesel	96	5	6,100
Lawn & Garden Tractor	2270004076	Diesel	18	1	261
Comm. Turf Equip.	2270004071	Diesel	86	5	7,565
Comm. Turf Equip.	2270004071	Diesel	105	5	7,565
Generator	2270006005	Diesel	8	3	392
Compressor	2270006015	Diesel	80	2	104
Welding Machines	2270006025	Diesel	42	1	52
Pressure Washers	2270006030	Diesel	116	1	131
Total				141	87,905

9.2. **Estimate Emissions of Ozone Precursors**

Bexar County emission and load factors from the TexN model's database were used to calculate emissions from non-road equipment at SAIA. In case of missing data, such as activity data for some equipment, existing data from the TexN model was used. To determine emission factors, the TexN model was used with the following specifications:

- Analysis Year = 2006
- Max Tech. Year = 2006
- Met Year = Typical Year
- Period = Annual
- Summation Type = Annual
- Post Processing Adjustments = All
- Rules Enabled = All
- Regions = Bexar County
- Sources = Equipment from SAIA Equipment Survey

Table 9-2 lists TexN model's emission and load factors along with calculated daily VOC and NO_X emissions for each equipment category. The following equation was used to calculate emissions:

Equation 9-1, Daily emissions for each non-road equipment type

$$DE_{Nonroad.A} = (EP_A \times HRS_A \times HP_A \times LF_A \times EF_A) / 907{,}184.74 \text{ grams/ton} / 365 \text{ days/year}$$

Where:

$DE_{Nonroad.A}$ = Daily emissions for equipment type A (tons/day)
EP_A = equipment population for equipment type A (from survey)
HRS_A = Annual operating hours for equipment type A (from survey)
HP_A = Average horsepower for equipment type A (from survey or equipment manuals)
LF_A = Load factor for equipment type A (from TexN model)
EF_A = Emissions factor for equipment type A, g/hp-hr (from TexN model)

Sample Calculation - Daily VOC emissions for a 4-stroke forklift at SAIA

$$DE_{Nonroad.A} = (9 \times 1{,}789 \text{ hours} \times 73.29 \text{ hp} \times 0.30 \times 5.64 \text{ g/hp-hour}) / 907{,}184.74 \text{ grams/ton} / 365 \text{ days/year}$$
$$= 0.006 \text{ tons of VOC/day}$$

Total emissions from non-road equipment at the SAIA were 0.03196 tons of VOC and 0.05923 tons of NO_X (table 9-2). The largest source of NO_X emissions were 4-stroke off-highway trucks, diesel commercial turf equipment, and 4-stroke forklifts.

9.3. **Spatially Allocate Non-Road Emissions**

Emissions were geo-coded to the location of SAIA in the 4km photochemical grid system used by the June 2006 photochemical model.

Table 9-2: Daily Non-Road Equipment Emissions at SAIA, 2006

Equipment Type	Engine Type	SCC	VOC EF g/hp-hour	NO_X EF g/hp-hour	Load Factor	VOC tons/day	NO_X tons/day
Rotary Tiller	2-Stroke	2260004016	154.51	1.80	0.40	0.00005	0.00000
Chainsaw	2-Stroke	2260004021	92.41	1.44	0.70	0.00010	0.00000
Trimmer/Edger/Brush Cutter	2-Stroke	2260004026	95.03	2.13	0.91	0.00202	0.00005
Leaf Blower/Vacuum	2-Stroke	2260004031	95.03	2.13	0.94	0.00190	0.00004
Cart	4-Stroke	2265001060	15.52	3.91	0.58	0.00027	0.00007
Concrete Saws	4-Stroke	2265002039	11.68	4.02	0.78	0.00022	0.00007
Off-Highway Trucks	4-Stroke	2265002081	6.67	9.69	0.48	0.01130	0.01642
Lift	4-Stroke	2265003010	7.70	7.86	0.46	0.00086	0.00087
Fork Lift	4-Stroke	2265003020	5.64	8.03	0.30	0.00606	0.00864
Paint Machine	4-Stroke	2265003040	34.09	4.10	0.54	0.00026	0.00003
Lawn Mower	4-Stroke	2265004011	67.58	5.23	0.33	0.00197	0.00015
Rear Engine Riding Mower	4-Stroke	2265004041	13.14	4.27	0.38	0.00177	0.00057
Generator	4-Stroke	2265006005	15.18	3.65	0.68	0.00030	0.00007
Water/trash pump	4-Stroke	2265006010	26.16	4.22	0.69	0.00005	0.00001
Planners	4-Stroke	2265006010	26.16	4.22	0.69	0.00036	0.00006
Compressor	4-Stroke	2265006015	17.57	4.77	0.56	0.00002	0.00001
Pressure Washers	4-Stroke	2265006030	24.83	3.65	0.85	0.00033	0.00005
Fork Lift	LPG	2267003020	2.61	11.92	0.30	0.00117	0.00535
Sweeper	LPG	2267003030	2.07	9.04	0.71	0.00011	0.00049
Light Plants	Diesel	2270002027	1.24	6.90	0.43	0.00000	0.00002
Off-Highway Trucks	Diesel	2270002051	0.31	5.23	0.59	0.00009	0.00147
Lift	Diesel	2270003010	2.54	8.15	0.21	0.00015	0.00049
Fork Lift	Diesel	2270003020	0.48	4.72	0.59	0.00065	0.00644
Sweeper	Diesel	2270003030	0.49	5.28	0.43	0.00037	0.00401
Lawn & Garden Tractor	Diesel	2270004076	1.11	5.24	0.43	0.00001	0.00003
Comm. Turf Equip.	Diesel	2270004071	0.81	7.24	0.43	0.00153	0.01358
Generator	Diesel	2270006005	0.97	6.48	0.43	0.00000	0.00003
Compressor	Diesel	2270006015	0.69	5.85	0.43	0.00001	0.00006
Welding Machines	Diesel	2270006025	2.67	7.01	0.21	0.00000	0.00001
Pressure Washers	Diesel	2270006030	0.95	6.58	0.43	0.00002	0.00013
Total						0.03196	0.05923

10. CONCLUSION

To calculate SAIA emissions based on a “bottom-up” approach, local data from all emission sources were collected; these included aircraft maintenance and operations, ground support equipment, parking garages, annual aviation fuel and natural gas consumption, and non-road equipment. Local data on annual aircraft landings and take-offs by specific aircraft type were obtained from GCR & Associates, Inc.[37] Aircrafts' user's manuals and the existing data in the EDMS model were used to determine engine type, specifications, and emission factors for each aircraft. Emissions calculated by the EMDS model were spatially and temporally allocated to the SAIA.

GSE provides support for ground operations, aircraft power, aircraft transport, and loading operations (for both cargo and passenger aircrafts). To calculate GSE emissions, a list of local GSE equipment was compiled from a survey sent to all tenants at SAIA. After the survey forms were completed and returned to AACOG, tenants at SAIA and the COSA's Department of Aviation were contacted and consulted to assure the accuracy and completeness of the data. Other necessary information, such as horsepower, emission factors, and load factors, were compiled from user's manuals and existing data in the EDMS model. All 30 tenants responded to the survey and furnished data on 440 GSE (100 percent of the GSE population). Diesel fueled air start units, air conditioners, and ground power units emit the highest amounts of NO_X. Gasoline baggage tugs and fuels trucks also emit significant amount of NO_X emissions, while portable air stairs, conveyors, and lights plants are insignificant sources of emissions.

Vehicles owned by employees, businesses, vacationers, and business travelers frequently use parking lots at SAIA. Parking lots at SAIA, including employee, long term, hourly, and economy lots and garages, were analyzed using on-road and idling emission factors generated by MOVES2010a[38] model and the EPA. Parking lots accounted for 0.0020 tons of VOC emissions and 0.0056 tons of NO_X emissions per day at the SAIA. Evaporative emissions are emitted from refueling and spillage loss, diurnal losses, and pre-flight safety procedures. The largest evaporate emission sources were aircraft refueling loss followed by diurnal loss. Fuel storage emissions include evaporative VOC emissions due to the transfer of fuel from and to storage tanks or bulk terminals by tanker trucks. Emissions from fuel storage were 0.0232 tons VOC/day.

“An APU is basically a small turbine engine that generates electricity and compressed air to operate aircraft instruments, lights, and ventilation when the main aircraft engines are not operational, for instance when aircraft are parked at the gate.”[39] Landing and take-off data for commercial and GA flights by aircraft type were used to calculate APU emissions.[40] EDMS

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[37] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 12/15/11.

[38] U.S. Environmental Protection Agency, December 2009. “Motor Vehicle Emission Simulator”. Office of Transportation and Air Quality Washington, DC. Available online: http://www.epa.gov/otaq/models/moves/index.htm. Accessed 12/15/11.

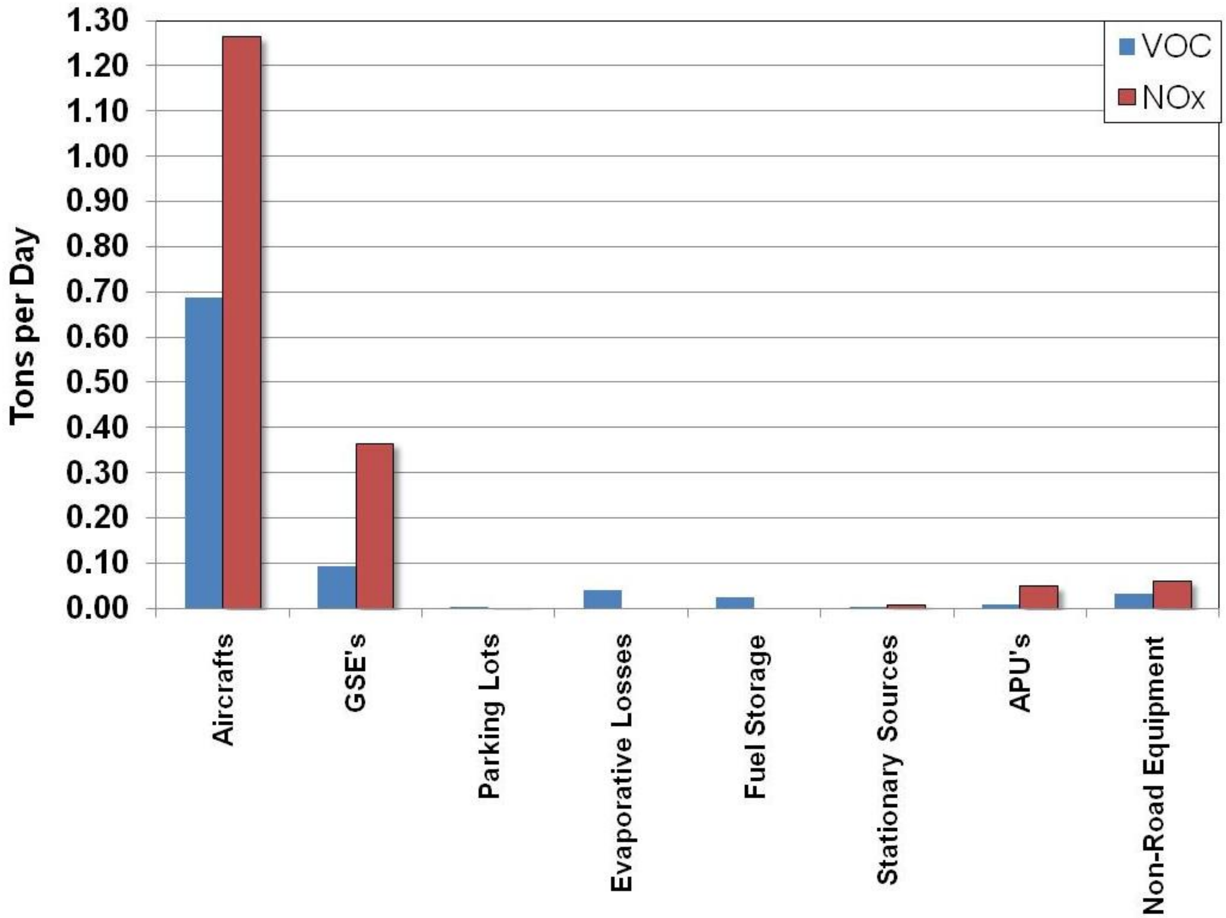
[39] Airport Emissions Inventory Denver International Airport, Ricondo & Associates, Inc. June 29, 2005. Available online: http://www.colorado.gov/airquality/documents/deno308/diaDenver_SIPemissionsinventory_finaldraft.pdf . p. II-9. Accessed 12/12/2011.

[40] GCR and Associates, Inc. 2005. Airport IQ Data Center. Available online: http://www.airportiq.com/ Accessed 09/21/11.

model was used to assign APUs to each aircraft to calculate total NO_X emissions of 0.0480 tons/day.

A list of commercial, industrial, and lawn and garden equipment used at the SAIA by all tenants was obtained through a local survey. The survey had a 100 percent response rate and included all non-road equipment used at the SAIA. Total emissions from non-road equipment at the SAIA were 0.0320 tons of VOC and 0.0592 tons of NO_X. The largest source of NO_X emissions were 4-stroke off-highway trucks, diesel commercial turf equipment, and 4-stroke forklifts. As shown in Figure 10-1, aircraft operations constitute the largest daily source of emissions from the SAIA with 1.26 tons of NO_X and 0.69 ton of VOC. GSE's constitute the second largest source followed by non-road equipment and APUs.

Figure 10-1: SAIA Emissions by Emission Source, Ozone Season Day, 2006



Appendix A

Aircraft Operations at SAIA

Table A-1: Commercial Aircraft Type and Arrival Activity at SAIA, 2006

ID	Aircraft Name	Engine Type	Number of Operation
1	ATR 42-300	PW120	4
2	Airbus A300F4-200 Series	CF6-50A Low emissions fuel nozzle	4
3	Airbus A300F4-600 Series	PW4158 Reduced smoke	701
4	Airbus A310-200 Series	CF6-80A3	17
5	Airbus A318-100 Series	CFM56-5B1/2P DAC-II	543
6	Airbus A319-100 Series	CFM56-5B7/P	5,710
7	Airbus A320-100 Series	CFM56-5B8/P SAC	1,099
8	Bell 206 Jet Ranger	250B17B	214
9	Boeing 717-200 Series	BR700-715A1-30 Improved fuel injector	282
10	Boeing 727-100 Series	JT8D-15 Reduced emissions	6
11	Boeing 727-200 Series	JT8D-15 Reduced emissions	1,549
12	Boeing 737-200 Series	JT8D-15A	37
13	Boeing 737-300 Series	CFM56-3	19,196
14	Boeing 737-300 Series	CFM56-3-B1	6
15	Boeing 737-400 Series	CFM56-3	104
16	Boeing 737-500 Series	CFM56-3C-1	7,141
17	Boeing 737-600 Series	CFM56-3C-1	2
18	Boeing 737-700 Series	CFM56-7B22	17,556
19	Boeing 737-800 Series	CFM56-7B26	2,171
20	Boeing 737-900 Series	CFM56-7B24	798
21	Boeing 747-200 Series	CF6-50E2 Low emissions fuel nozzle	2
22	Boeing 757-200 Series	PW2037	2,488
23	Boeing 757-200 Series	PW2037	8
24	Boeing 757-300 Series	RB211-535E4B Phase 5	332
25	Boeing 767-200 ER	CF6-80A	6
26	Boeing 767-300 ER	PW4060 Reduced emissions	15
27	Boeing DC-10-30ER	CF6-50C2B Low emissions fuel nozzle	1,095
28	Boeing DC-8 Series 50	JT3D-3B	2
29	Boeing DC-8 Series 70	CFM56-2-C5	496
30	Boeing DC-9-10 Series	JT8D-7 series Reduced emissions	25
31	Boeing DC-9-30 Series	JT8D-15 Reduced emissions	896
32	Boeing DC-9-40 Series	JT8D-11	149
33	Boeing DC-9-50 Series	JT8D-17 Reduced emissions	108
34	Boeing MD-10-30	CF6-6D	323
35	Boeing MD-11	CF6-80C2D1F 1862M39	46
36	Boeing MD-81	JT8D-217C Environmental Kit (E Kit)	35
37	Boeing MD-82	JT8D-217C Environmental Kit (E Kit)	11,470
38	Boeing MD-83	JT8D-219 Environmental Kit (E Kit)	2,965
39	Boeing MD-87	JT8D-217A Environmental Kit (E Kit)	17
40	Boeing MD-88	JT8D-219 Environmental Kit (E Kit)	3,257
41	Bombardier CRJ-700	CF34-3B	15,258
42	Bombardier CRJ-900	CF34-8C5 LEC	1,735
43	Bombardier Challenger 300	AE3007A1 Type 2	172
44	Bombardier Challenger 600	CF34-3B	139
45	Bombardier Global Express	BR700-710A2-20	4
46	Bombardier Learjet 24	CJ610-6	15
47	Bombardier Learjet 25	CJ610-6	124
48	Bombardier Learjet 31	TFE731-2-2B	12

ID	Aircraft Name	Engine Type	Number of Operation
49	Bombardier Learjet 35	TFE731-2-2B	390
50	Bombardier Learjet 40	TFE731-2-2B	46
51	Bombardier Learjet 45	TFE731-2-2B	176
52	Bombardier Learjet 55	TFE731-3	95
53	Bombardier Learjet 60	TFE731-2/2A	191
54	Cessna 172 Skyhawk	IO-320-D1AD	8
55	Cessna 182	IO-360-B	27
56	Cessna 206	IO-360-B	8
57	Cessna 208 Caravan	PT6A-114A	2,664
58	Cessna 210 Centurion	TIO-540-J2B2	68
59	Cessna 310	TIO-540-J2B2	2
60	Cessna 340	TIO-540-J2B2	6
61	Cessna 402	TIO-540-J2B2	1,213
62	Cessna 414	TIO-540-J2B2	158
63	Cessna 425 Conquest I	PT6A-60	31
64	Cessna 441 Conquest II	TPE331-10GT	2
65	Cessna 500 Citation I	JT15D-1 series	10
66	Cessna 501 Citation ISP	JT15D-1 series	10
67	Cessna 525 CitationJet	JT15D-1 series	265
68	Cessna 525 CitationJet	JT15D-1 series	44
69	Cessna 550 Citation II	JT15D-4 series	278
70	Cessna 560 Citation Excel	JT15D-5, -5A, -5B	829
71	Cessna 560 Citation Excel	JT15D-5, -5A, -5B	564
72	Cessna 560 Citation XLS	JT15D-5, -5A, -5B	19
73	Cessna 680 Citation Sovereign	PW308C Annular	245
74	Cessna 750 Citation X	AE3007C Type 2	479
75	Cessna S550 Citation S/II	PW530	2
76	Cirrus SR22	TIO-540-J2B2	15
77	Convair CV-440	R-1820	23
78	Dassault Falcon 10	TFE731-2-2B	25
79	Dassault Falcon 20-C	CF700-2D	135
80	Dassault Falcon 2000	PW308C Annular	199
81	Dassault Falcon 50	TFE731-3	29
82	Dassault Falcon 900	TFE731-3	8
83	DeHavilland DHC-6-100 Twin Otter	PT6A-20	2
84	Dornier 328 Jet	PW306B Annular	25
85	Dornier 328-100 Series	PW119B	8
86	EADS Socata TBM-700	PT6A-64	514
87	Embraer EMB110 Bandeirante	PT6A-27	2
88	Embraer EMB120 Brasilia	PW118	21
89	Embraer ERJ135	AE3007A1/3 Type 3 (reduced emissions	307
90	Embraer ERJ145	AE3007A1E Type 3	3,535
91	Embraer ERJ145	AE3007A1E Type 3	6,718
92	Embraer ERJ170	CF34-8E5 LEC	618
93	Embraer ERJ190	CF34-10E	2
94	Fairchild Hiller FH-227	RDa.7	2
95	Fairchild SA-226-T Merlin III	TPE331-3U	66
96	Fairchild SA-227-AC Metro III	TPE331-10	543

ID	Aircraft Name	Engine Type	Number of Operation
97	Fairchild SA-26-T Merlin II	PT6A-60	4
98	Grumman G-73 Mallard	TIO-540-J2B2	2
99	Gulfstream G100	TFE731-3	8
100	Gulfstream G150	TFE731-3	6
101	Gulfstream G200	PW306A Annular	178
102	Gulfstream G500	BR700-710A1-10	17
103	Gulfstream II	SPEY MK511-8	10
104	Gulfstream II	SPEY Mk511 Transply IIH	10
105	Gulfstream IV-SP	TAY Mk611-8	37
106	Helio U-10 Super Courier	TIO-540-J2B2	8
107	Israel IAI-1124 Westwind I	TFE731-3	23
108	Mitsubishi MU-2	TPE331-10U	807
109	Mitsubishi MU-300 Diamond	JT15D-5, -5A, -5B	199
110	Mooney M20-K	TSIO-360C	44
111	Mooney M20-K	TSIO-360C	4
112	Piaggio P.180 Avanti	PT6A-66	116
113	Pilatus PC-12	PT6A-67B	10
114	Piper PA-28 Cherokee Series	IO-320-D1AD	8
115	Piper PA-31T Cheyenne	PT6A-28	593
116	Piper PA-32 Cherokee Six	TIO-540-J2B2	2
117	Piper PA-34 Seneca	IO-360-B	12
118	Piper PA46-TP Meridian	PT6A-42	2
119	Raytheon Beech 1900-C	PT6A-65B	504
120	Raytheon Beech 1900-D	PT6A-67D	4
121	Raytheon Beech 55 Baron	TIO-540-J2B2	276
122	Raytheon Beech Baron 58	TIO-540-J2B2	52
123	Raytheon Beech Bonanza 36	TIO-540-J2B2	52
124	Raytheon Beechjet 400	JT15D-5, -5A, -5B	473
125	Raytheon Hawker 800	TFE731-3	491
126	Raytheon King Air 100	PT6A-28	2
127	Raytheon King Air 100	TPE331-6	4
128	Raytheon King Air 90	PT6A-135A	197
129	Raytheon Premier I	JT15D-1 series	4
130	Raytheon Super King Air 200	PT6A-42	153
131	Raytheon Super King Air 300	PT6A-60A	8
132	Raytheon Super King Air 300	PT6A-60A	37
133	Robin R 2160 Alpha Sport	O-320	2
134	Robinson R22	IO-320-D1AD	2
135	Rockwell Commander 690	TPE331-10	6
136	Rockwell Commander 700	TSIO-360C	2
137	Rockwell Sabreliner 40	CF700-2D	8
138	Saab 340-A	CT7-5	2
139	Shorts 330	PT6A-45R	4
140	Shorts 360-300 Series	PT6A-65R	15
141	T-38 Talon	J85-GE-5H (w/AB)	29
Total			123,393

Table A-2: Jet Engines General Aviation Aircraft Type and Arrival Activity at SAIA, 2006

ID	Aircraft Name	Engine Type	Number of Operation
1	Airbus A319-100 Series	CFM56-5B6/P	6
2	Airbus A340-500 Series	Trent 556-61 Phase 5 tiled	3
3	BAE 146-300	ALF 502R-5	1,722
4	Bell UH-1 Iroquois	T400-CP-400	33
5	Boeing 727-200 Series	JT8D-15 Reduced emissions	31
6	Boeing 737-200 Series	JT8D-15A	92
7	Boeing 757-200 Series	RB211-535E4 Phase 5	22
8	Boeing DC-10-30 Series	CF6-50C2 Low emissions fuel nozzle	17
9	Boeing DC-10-40 Series	JT9D-59A	3
10	Boeing DC-9-10 Series	JT8D-7 series Reduced emissions	8
11	Boeing DC-9-30 Series	JT8D-15 Reduced emissions	25
12	Boeing MD-82	JT8D-217C Environmental Kit (E Kit)	8
13	Boeing MD-83	JT8D-219 Environmental Kit (E Kit)	6
14	Bombardier Challenger 300	AE3007A1 Type 2	1,466
15	Bombardier Challenger 600	ALF 502L-2	826
16	Bombardier Challenger 604	CF34-3B	303
17	Bombardier Global Express	BR700-710A2-20	139
18	Bombardier Learjet 24	CJ610-6	153
19	Bombardier Learjet 25	CJ610-6	1,035
20	Bombardier Learjet 31	TFE731-2-2B	1,140
21	Bombardier Learjet 35	TFE731-2-2B	595
22	Bombardier Learjet 36	TFE731-2-2B	39
23	Bombardier Learjet 45	TFE731-2-2B	840
24	Bombardier Learjet 55	TFE731-3	303
25	Bombardier Learjet 60	TFE731-2/2A	1,652
26	Cessna 172 Skyhawk	TSIO-360C	47
27	Cessna 182	IO-360-B	97
28	Cessna 210 Centurion	TIO-540-J2B2	42
29	Cessna 500 Citation I	JT15D-1 series	10,221
30	Cessna 525 CitationJet	JT15D-1 series	1,863
31	Cessna 560 Citation XLS	JT15D-5, -5A, -5B	2,748
32	Cessna 680 Citation Sovereign	PW308C Annular	1,076
33	Cessna 750 Citation X	AE3007C Type 2	2,125
34	Cessna S550 Citation S/II	JT15D-4 series	965
35	Dassault Falcon 10	TAY Mk620-15	245
36	Dassault Falcon 100	TFE731-2-2B	95
37	Dassault Falcon 20-C	CF700-2D	92
38	Dassault Falcon 2000-EX	PW308C Annular	1,516
39	Dassault Falcon 50	TFE731-3	2,751
40	Dassault Falcon 900	TFE731-3	2,270
41	Dornier 328 Jet	PW306B Annular	31
42	EADS Socata TBM-700	PT6A-60	14
43	Embraer ERJ135	AE3007A1E Type 3	97

ID	Aircraft Name	Engine Type	Number of Operation
44	Grumman A-6 Intruder	J52-P-6B	8
45	Gulfstream G150	TFE731-3	39
46	Gulfstream G200	PW306A Annular	11
47	Gulfstream G550	BR700-710-C4-11 Annular	626
48	Gulfstream II	SPEY Mk511 Transply IIH	765
49	Gulfstream IV-SP	TAY 611-8C Transply IIJ	3,018
50	Gulfstream IV-SP	TAY Mk611-8	6
51	Hawker HS-125 Series 1	TFE731-3	1,363
52	Hawker HS-125 Series 600	TFE731-2-2B	1,302
53	Hawker HS-125 Series 700	TFE731-3	339
54	Israel IAI-1124 Westwind I	TFE731-3	1,074
55	Israel IAI-1125 Astra	TFE731-3	142
56	Israel IAI-1125 Astra	TFE731-3	106
57	Israel IAI-1126 Galaxy	PW306A Annular	673
58	Lancair 360	IO-360-B	8
59	Lockheed L-1329 Jetstar II	TFE731-3	14
60	Maule MT-7-235	TIO-540-J2B2	6
61	Mitsubishi MU-300 Diamond	JT15D-4 series	389
62	Mooney M20-K	TSIO-360C	58
63	Piper PA-23 Apache/Aztec	TIO-540-J2B2	3
64	Piper PA-28 Cherokee Series	IO-320-D1AD	6
65	Piper PA-30 Twin Comanche	IO-320-D1AD	50
66	Piper PA-31 Navajo	TIO-540-J2B2	8
67	Piper PA-32 Cherokee Six	TIO-540-J2B2	6
68	Piper PA-42 Cheyenne Series	TPE331-14B	53
69	Piper PA46-TP Meridian	PT6A-42	14
70	Piper PA46-TP Meridian	PT6A-42	3
71	Raytheon Beech Baron 58	TIO-540-J2B2	11
72	Raytheon Beech Bonanza 36	TIO-540-J2B2	11
73	Raytheon Beech Bonanza 36	TIO-540-J2B2	6
74	Raytheon Beechjet 400	JT15D-5, -5A, -5B	740
75	Raytheon Hawker 1000	TFE731-2/2A	11
76	Raytheon Hawker 4000 Horizon	PW308A Annular	53
77	Raytheon Hawker 800	TFE731-3	106
78	Raytheon King Air 100	TPE331-6	428
79	Raytheon King Air 90	PT6A-60	28
80	Raytheon Premier I	JT15D-1 series	22
81	Raytheon Super King Air 200	PT6A-42	17
82	Robinson R22	IO-320-D1AD	6
83	Rockwell Commander 690	TPE331-10UK	523
84	Rockwell Sabreliner 60	CF700-2D	11
Total			48,820

Table A-3: Turbo-Prop General Aviation Aircraft Type and Arrival Activity at SAIA, 2006

ID	Aircraft Name	Engine Type	Number of Operation
1	Aerospatiale N 262	PT6A-45	8
2	BAE Jetstream 1	PT6A-60	14
3	Boeing 737-100 Series	JT8D-15 Reduced emissions	3
4	Cessna 172 Skyhawk	IO-360-B	6
5	Cessna 182	IO-360-B	3
6	Cessna 206	IO-360-B	3
7	Cessna 208 Caravan	PT6A-114A	261
8	Cessna 421 Golden Eagle	TIO-540-J2B2	3
9	Cessna 425 Conquest I	PT6A-60	161
10	Cessna 441 Conquest II	TPE331-10U	178
11	DeHavilland DHC-6-300 Twin Otter	PT6A-27	25
12	Dornier 328-100 Series	PW119B	14
13	EADS Socata TBM-700	PT6A-64	225
14	Embraer EMB120 Brasilia	PW118	11
15	Fairchild Metro IVC	TPE331-12UHR	92
16	Fairchild SA-226-T Merlin III	TPE331-3U	134
17	Fairchild SA-226-T Merlin III	TPE331-3U	295
18	Fairchild SA-227-AC Metro III	TPE331-10	192
19	Fairchild SA-227-AT Expeditor	TPE331-10	114
20	Gulfstream I	RDa.7	245
21	Mitsubishi MU-2	TPE331-1	19
22	Mitsubishi MU-2	TPE331-10	33
23	Mitsubishi MU-2	TPE331-10A	11
24	Mitsubishi MU-2	TPE331-6	136
25	Piaggio P.180 Avanti	PT6A-66	50
26	Pilatus PC-12	PT6A-67B	423
27	Piper PA-31T Cheyenne	PT6A-28	754
28	Piper PA-42 Cheyenne Series	TPE331-10	117
29	Piper PA46-TP Meridian	PT6A-42	245
30	Raytheon Beech 60 Duke	TIO-540-J2B2	3
31	Raytheon Beech Bonanza 36	TIO-540-J2B2	3
32	Raytheon King Air 100	PT6A-28	676
33	Raytheon King Air 90	PT6A-135A	3,529
34	Raytheon King Air 90	PT6A-60	2,400
35	Raytheon Super King Air 200	PT6A-42	4,442
36	Raytheon Super King Air 300	PT6A-60A	1,538
37	Rockwell Commander 690	TPE331-10A	28
38	Rockwell Commander 690	TPE331-10GT	153
Total			16,574

Table A-4: Piston General Aviation Aircraft Type and Arrival Activity at SAIA, 2006

ID	Aircraft Name	Engine Type	Number of Operation
1	Aerostar PA-60	TIO-540-J2B2	100
2	Aviat Husky A1B	IO-360-B	72
3	Bell 206 JetRanger	250B17B	3
4	Cessna 150 Series	O-200	339
5	Cessna 172 Skyhawk	IO-320-D1AD	25
6	Cessna 172 Skyhawk	TSIO-360C	4,456
7	Cessna 182	IO-360-B	1,368
8	Cessna 206	IO-360-B	820
9	Cessna 208 Caravan	PT6A-114A	273
10	Cessna 210 Centurion	TIO-540-J2B2	2,339
11	Cessna 310	TIO-540-J2B2	882
12	Cessna 340	TIO-540-J2B2	298
13	Cessna 402	TIO-540-J2B2	47
14	Cessna 414	TIO-540-J2B2	609
15	Cessna 421 Golden Eagle	TIO-540-J2B2	1,043
16	Cirrus SR20	IO-360-B	153
17	Cirrus SR22	TIO-540-J2B2	1,171
18	Gulfstream G550	BR700-710A1-10	64
19	Lancair 360	IO-360-B	292
20	Maule MT-7-235	250B17B	11
21	Mooney M20-K	TSIO-360C	2,047
22	Partenavia P.68 Victor	IO-360-B	3
23	Pilatus PC-12	PT6A-67B	715
24	Piper PA-23 Apache/Aztec	TIO-540-J2B2	147
25	Piper PA-24 Comanche	TIO-540-J2B2	86
26	Piper PA-28 Cherokee Series	IO-320-D1AD	648
27	Piper PA-28 Cherokee Series	O-320	289
28	Piper PA-30 Twin Comanche	IO-320-D1AD	47
29	Piper PA-31 Navajo	TIO-540-J2B2	331
30	Piper PA-31T Cheyenne	PT6A-28	14
31	Piper PA-32 Cherokee Six	TIO-540-J2B2	72
32	Piper PA-32 Cherokee Six	TIO-540-J2B2	579
33	Piper PA-34 Seneca	IO-360-B	528
34	Piper PA-34 Seneca	TSIO-360C	58
35	Piper PA-34 Seneca	TSIO-360C	6
36	Piper PA46-TP Meridian	PT6A-42	1,199
37	Raytheon Beech 18	TPE331-1UA	17
38	Raytheon Beech 60 Duke	TIO-540-J2B2	217
39	Raytheon Beech 99	PT6A-36	42
40	Raytheon Beech Baron 58	TIO-540-J2B2	234
41	Raytheon Beech Baron 58	TIO-540-J2B2	718
42	Raytheon Beech Bonanza 36	TIO-540-J2B2	1,282
43	Raytheon Beech Bonanza 36	TIO-540-J2B2	175
44	Raytheon Beech Bonanza 36	TIO-540-J2B2	1,026
45	Rockwell Commander 500	TIO-540-J2B2	22

ID	Aircraft Name	Engine Type	Number of Operation
46	Rockwell Commander 690	TPE331-10	248
47	Rockwell Commander 690	TPE331-10UK	6
48	Sikorsky CH-53 Sea Stallion	T64-GE-100	3
Total			25,123

Table A-5: Military Aircraft Activity at the San Antonio International Airport, 2006

ID	Aircraft Name	Engine Type	Number of Operation
1	Bell UH-1 Iroquois/ T 430	T400	127
2	Boeing 737-200 Series/ T-43	1PW006	706
3	Boeing C-17A/	4PW073	485
4	Boeing DC-9-10 Series	1PW005	485
5	Bombardier Learjet 35A/36A (C-21A)	1AS001	122
6	Lockheed C-130 Hercules	T56A15	67
7	Lockheed C-5 Galaxy	TF391	78
8	Lockheed Martin F-16 Fighting Falcon	F10010	189
9	Raytheon Beechjet 400/ T1	1PW037	989
10	Sikorsky UH-60 Black Hawk	T70070	485
11	T-38 Talon	J855HA	1,290
Total			5,024

Appendix B

Hourly Distribution of General Aviation Operations by Aircraft Type at SAIA

Table B-1: Hourly Distribution of General Aviation Operations by Aircraft Type at SAIA

Hour	Commercial		GA Jet		GA Piston		GA Turbo	
	Daily Operation	% of Total	Annual Operation	% of Total	Annual Operation	% of Total	Annual Operation	% of Total
24:00-1:00	4	1.1%	150	0.9%	90	1.0%	41	0.7%
1:00-2:00	0	0.0%	98	0.6%	52	0.6%	38	0.6%
2:00-3:00	0	0.0%	52	0.3%	32	0.4%	21	0.4%
3:00-4:00	0	0.0%	15	0.1%	14	0.2%	14	0.2%
4:00-5:00	0	0.0%	21	0.1%	11	0.1%	10	0.2%
5:00-6:00	2	0.6%	25	0.1%	26	0.3%	9	0.2%
6:00-7:00	12	3.4%	129	0.7%	26	0.3%	50	0.8%
7:00-8:00	18	5.1%	624	3.6%	147	1.6%	169	2.8%
8:00-9:00	18	5.1%	1,020	5.8%	393	4.4%	354	6.0%
9:00-10:00	10	2.9%	1,070	6.1%	581	6.4%	441	7.4%
10:00-11:00	20	5.7%	1,075	6.1%	734	8.1%	420	7.1%
11:00-12:00	29	8.3%	1,176	6.7%	765	8.5%	422	7.1%
12:00-13:00	18	5.1%	1,256	7.2%	745	8.3%	390	6.6%
13:00-14:00	21	6.0%	1,376	7.8%	645	7.2%	445	7.5%
14:00-15:00	23	6.6%	1,442	8.2%	714	7.9%	554	9.3%
15:00-16:00	31	8.9%	1,524	8.7%	691	7.7%	538	9.1%
16:00-17:00	14	4.0%	1,576	9.0%	762	8.5%	521	8.8%
17:00-18:00	27	7.7%	1,259	7.2%	682	7.6%	386	6.5%
18:00-19:00	19	5.4%	893	5.1%	590	6.5%	251	4.2%
19:00-20:00	14	4.0%	664	3.8%	411	4.6%	167	2.8%
20:00-21:00	25	7.1%	415	2.4%	330	3.7%	142	2.4%
21:00-22:00	20	5.7%	309	1.8%	229	2.5%	110	1.9%
22:00-23:00	15	4.3%	262	1.5%	209	2.3%	58	1.0%
23:00-24:00	10	2.9%	1,123	6.4%	141	1.6%	393	6.6%
Total	350	100.0%	17,554	100.0%	9,020	100.0%	5,944	100.0%

Appendix C

Emissions from Ground Support Equipment at SAIA

Table C-1: Emissions from GSE at the San Antonio International Airport

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour)			LTO per Eq.	Annual Hours	Daily Emissions (tons)		
								VOC	NO_X	CO			VOC	NO_X	CO
Air Cond.	Diesel	1	DV TECH	2000	107	60	0.75	0.59	7.45	2.22	1,131	1,131	0.000	0.001	0.000
		1	DV TECH	2001	107	60	0.75	0.55	7.10	1.98	1,131	1,131	0.000	0.001	0.000
		1	DV TECH	2007	107	60	0.75	0.38	5.17	1.03	1,131	1,131	0.000	0.000	0.000
		1	804-940, ACE804-940	1992	210	25	0.75	0.92	10.64	3.13	2,563	1,068	0.000	0.005	0.002
		1	ACE 802	1994	300	30	0.75	0.82	9.53	3.06	2,563	1,282	0.001	0.008	0.003
		1	Air-A-Plane 2030DE	1996	210	25	0.75	0.77	8.88	3.01	2,563	1,068	0.000	0.005	0.002
		1	Arpat	1998	210	30	0.75	0.70	8.27	2.73	2,563	1,282	0.000	0.005	0.002
		1	Arpat	1998	210	30	0.75	0.70	8.27	2.73	2,563	1,282	0.000	0.005	0.002
		1	Trilectron	1998	300	30	0.75	0.70	8.27	2.73	2,563	1,282	0.001	0.007	0.002
		1	ACE 802	1999	300	30	0.75	0.64	7.84	2.47	2,563	1,282	0.001	0.007	0.002
		1	Air-A-Plane 2030DE	1999	210	25	0.75	0.64	7.84	2.47	2,563	1,068	0.000	0.004	0.001
		1	Air-A-Plane 2030DE	2001	210	25	0.75	0.55	7.10	1.98	2,563	1,068	0.000	0.004	0.001
		1	804-940, ACE804-939	2002	210	25	0.75	0.51	6.78	1.75	2,563	1,068	0.000	0.003	0.001
		1	ACE 802	2002	300	30	0.75	0.51	6.78	1.75	2,563	1,282	0.000	0.006	0.002
Air Start Unit	Diesel	1	Stewart-Stevenson /TM-AC120	1985	425	7	0.90	1.29	13.58	5.50	2,746	320	0.000	0.005	0.002
		1	RJ326	1987	425	7	0.90	1.29	13.59	5.50	2,746	320	0.000	0.005	0.002
		1	RJ326	1987	425	7	0.90	1.29	13.59	5.50	2,746	320	0.000	0.005	0.002
		1	Stewart-Stevenson/TM-AC120	1992	425	7	0.90	1.03	12.08	4.89	2,746	320	0.000	0.004	0.002
		3	Stewart-Stevenson/TM-AC120	1992	425	7	0.90	1.03	12.08	4.89	2,746	320	0.001	0.013	0.005
		1	Stewart-Stevenson	1994	425	7	0.90	0.97	11.36	3.14	2,746	320	0.000	0.004	0.001
		2	Stewart-Stevenson/TM-AC170	1997	850	7	0.90	0.82	10.04	2.86	2,746	320	0.001	0.015	0.004
		1	Stewart-Stevenson	1998	425	7	0.90	0.75	9.57	2.20	2,746	320	0.000	0.004	0.001
		1	Tri Electron	2000	425	7	0.90	0.64	8.75	2.49	1,131	132	0.000	0.001	0.000
		1	S&S Tug	2004	850	7	0.90	0.46	7.25	2.03	2,746	320	0.000	0.005	0.002
		1	TLD	2007	850	7	0.90	0.36	6.13	1.68	2,746	320	0.000	0.005	0.001
	GAS	1	Ford-600	1992	425	7	0.90	4.79	10.11	122.63	2,746	320	0.002	0.004	0.045
Aircraft Pushback Tractor	Diesel	1	Td 225 SL	1978	88	8	0.80	1.29	13.58	5.50	1,748	233	0.000	0.001	0.000
		1	Clark Tug	1978	80	5	0.80	1.30	13.59	5.50	1,748	146	0.000	0.000	0.000
		1	FMC TUG T-750	1980	475	8	0.80	1.13	11.94	4.95	1,131	151	0.000	0.001	0.000
		1	S&S	1986	190	8	0.80	0.78	8.13	4.89	1,748	233	0.000	0.001	0.001
		1	Gt-50	1988	190	8	0.80	0.78	8.13	4.89	1,748	233	0.000	0.001	0.001
		1	Tug	1989	190	8	0.80	0.78	8.13	4.89	1,748	233	0.000	0.001	0.001
		1	Tug	1990	190	8	0.80	1.13	11.94	4.95	1,748	233	0.000	0.001	0.001
		1	GT 1628	1991	88	8	0.80	1.08	11.48	4.90	1,748	233	0.000	0.001	0.000
		1	FMC TUG T-750	1997	475	8	0.80	0.87	9.21	4.67	1,131	151	0.000	0.001	0.000
		5	Jetline	1998	86	8	0.80	0.81	8.66	4.34	1,748	233	0.000	0.002	0.001
		1	Stewart & Stevenson	1999	475	8	0.80	0.74	8.15	4.02	568	76	0.000	0.001	0.000
		1	GT-35	1999	88	8	0.80	0.74	8.15	4.02	1,748	233	0.000	0.000	0.000

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour) VOC	EF (Grams/hp-hour) NO_X	EF (Grams/hp-hour) CO	LTO per Eq.	Annual Hours	Daily Emissions (tons) VOC	Daily Emissions (tons) NO_X	Daily Emissions (tons) CO
		5	Stewart-Stevenson GT 35	1999	88	8	0.80	0.74	8.15	4.02	1,748	233	0.000	0.002	0.001
		1	FMC Technology- B600	1999	221	8	0.80	0.74	8.15	4.02	1,748	233	0.000	0.001	0.000
		1	GT-35	2001	88	8	0.80	0.64	7.38	3.79	1,748	233	0.000	0.000	0.000
		1	GT-35	2001	88	8	0.80	0.64	7.38	3.79	1,748	233	0.000	0.000	0.000
		1	Tug	2002	190	8	0.80	0.61	7.10	3.18	1,748	233	0.000	0.001	0.000
		1	S&S Tug	2002	475	8	0.80	0.61	7.10	3.18	1,748	233	0.000	0.002	0.001
		1	Tug	2003	190	8	0.80	0.57	6.85	2.93	1,748	233	0.000	0.001	0.000
		2	Tug Tech	2005	138	5	0.80	0.51	6.17	2.46	1,748	146	0.000	0.001	0.000
		1	FMC B400	2007	100	8	0.80	0.45	5.55	2.03	1,748	233	0.000	0.000	0.000
		1	FMC Technology- B400	2007	100	8	0.80	0.45	5.55	2.03	1,748	233	0.000	0.000	0.000
		1	TUG GT35- A	2007	100	8	0.80	0.45	5.55	2.03	1,748	233	0.000	0.000	0.000
		1	FMC B400	2007	100	8	0.80	0.45	5.55	2.03	1,748	233	0.000	0.000	0.000
	GAS	3	Tug; Northwestern JG	1976	88	8	0.80	5.89	8.68	210.00	1,748	233	0.001	0.001	0.031
		2	Int Hough	1986	88	8	0.80	5.89	8.68	209.00	1,748	233	0.001	0.001	0.021
		1	Eagle Model TT8/2	1995	88	5	0.80	5.52	10.11	177.97	1,748	146	0.000	0.000	0.006
		2	United Tractor PSI	1999	100	8	0.80	5.52	8.14	177.97	1,748	233	0.001	0.001	0.020
		1	Clark	1999	88	8	0.80	5.52	8.14	177.97	1,748	233	0.000	0.000	0.009
		1	Minneapolis Monline	1999	88	8	0.80	5.52	8.14	177.97	1,748	233	0.000	0.000	0.009
		1	United	1999	118	8	0.80	5.52	8.14	177.97	1,748	233	0.000	0.001	0.012
		1	United Tractor	1999	100	5	0.80	5.52	8.14	177.97	1,748	146	0.000	0.000	0.006
Baggage Tug	Diesel	12	United	1989	80	75	0.55	1.21	10.76	5.40	392	490	0.001	0.008	0.004
		2	Toyota	1992	107	75	0.55	1.17	9.22	5.60	392	490	0.000	0.002	0.001
		1	Toyota	1993	107	75	0.55	1.15	8.50	5.68	392	490	0.000	0.001	0.000
		1	Tiger Tug	1994	71	60	0.55	1.14	7.91	5.75	1,131	1,131	0.000	0.000	0.000
		1	Tiger Tug	1994	71	60	0.55	1.14	7.91	5.75	1,131	1,131	0.000	0.000	0.000
		1	TUG	1994	71	60	0.55	1.14	7.91	5.75	1,131	1,131	0.000	0.000	0.000
		1	Tug	1996	107	75	0.55	1.13	7.10	5.85	392	490	0.000	0.001	0.001
		2	Toyota	1997	107	75	0.55	1.12	6.90	5.87	392	490	0.000	0.001	0.001
		2	Toyota	1999	107	75	0.55	0.97	6.41	5.39	392	490	0.000	0.001	0.001
		1	Tug	2000	107	75	0.55	0.91	6.20	5.15	392	490	0.000	0.001	0.000
		2	Kabuta	2002	31	35	0.55	0.79	5.86	4.70	392	229	0.000	0.000	0.000
		2	Tug	2003	107	75	0.55	0.74	5.73	4.48	392	490	0.000	0.001	0.001
		1	Tug	2007	107	75	0.55	6.27	5.05	3.65	392	490	0.001	0.000	0.000
	GAS	1	TUG	2002	71	60	0.55	6.27	10.12	179.23	1,131	1,131	0.000	0.000	0.004
		1	TUG	2006	71	60	0.55	5.07	8.14	150.94	1,131	1,131	0.000	0.000	0.003
		1	TUG	2007	71	60	0.55	4.62	7.37	138.08	1,131	1,131	0.000	0.000	0.003
		1	Tug	1968	80	35	0.55	5.89	8.68	209.90	384	224	0.000	0.000	0.006
		2	MA-30-1, 30M218	1978	71	75	0.55	5.89	8.68	209.90	392	490	0.001	0.001	0.024
		2	MA-30-1, 30M218	1979	71	75	0.55	5.89	8.68	209.90	392	490	0.001	0.001	0.024

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour)			LTO per Eq.	Annual Hours	Daily Emissions (tons)		
								VOC	NO_X	CO			VOC	NO_X	CO
		2	MA-30-1, 30M218	1988	80	75	0.55	5.89	8.68	209.90	392	490	0.001	0.001	0.027
		13	Tug/Clark	1990	100	75	0.55	5.55	10.12	178.94	392	490	0.006	0.011	0.189
		3	TUG MA50	1996	107	75	0.55	5.55	10.12	178.94	392	490	0.001	0.003	0.047
		1	Tug	1996	107	75	0.55	5.55	10.12	178.94	392	490	0.000	0.001	0.016
		1	MA-30-1, 30M218	1996	80	75	0.55	5.55	10.12	178.94	392	490	0.000	0.001	0.012
		3	Clark Gt 50E	1997	107	35	0.55	5.55	10.12	178.94	392	229	0.001	0.001	0.022
		3	TUG MA50	1998	107	75	0.55	5.55	10.12	178.94	392	490	0.001	0.003	0.047
		5	United Tractor SML -340P-6	1999	118	35	0.55	5.55	10.12	178.94	392	229	0.001	0.002	0.040
		3	TUG MA50	1999	107	75	0.55	5.55	10.12	178.94	392	490	0.001	0.003	0.047
		1	Kawasaki Mule 1000	1999	25	35	0.80	5.55	10.12	178.94	392	229	0.000	0.000	0.002
		3	TUG MA50	2000	107	75	0.55	5.55	10.12	178.94	392	490	0.001	0.003	0.047
		1	Clarks	2002	107	35	0.55	5.55	10.12	179.23	392	229	0.000	0.000	0.007
		4	Tug	2002	107	75	0.55	5.55	10.12	179.23	392	490	0.002	0.004	0.062
		3	S&S Tug	2002	107	35	0.55	5.55	10.12	179.23	392	229	0.001	0.001	0.022
		10	Eagle TT-6GWEFI	2006	80	35	0.55	4.50	8.14	150.94	392	229	0.001	0.002	0.046
		2	Tug	2006	107	75	0.55	4.50	8.14	150.94	392	490	0.001	0.001	0.026
	LPG	4	Tug	1999	107	75	0.55	1.91	12.18	33.57	568	710	0.001	0.006	0.017
Belt Loader	**Diesel**	1	Nordco	1984	71	48	0.50	1.29	13.58	5.49	619	496	0.000	0.001	0.000
		2	Aceno	1991	71	48	0.50	1.13	10.88	3.57	619	496	0.000	0.001	0.000
		1	TUG	1993	107	25	0.50	1.12	9.50	3.67	1,131	471	0.000	0.000	0.000
		1	TUG	1993	107	25	0.50	1.12	9.50	3.67	1,131	471	0.000	0.000	0.000
		1	Wollard TC888	1994	118	48	0.50	1.11	8.88	3.71	619	496	0.000	0.001	0.000
		1	Wollard TC888	1997	118	48	0.50	1.08	7.50	3.81	619	496	0.000	0.001	0.000
		2	Tug	1997	71	48	0.50	1.08	7.50	3.81	619	496	0.000	0.001	0.000
		10	Tug	1998	71	48	0.50	1.01	7.20	3.68	619	496	0.001	0.004	0.002
		4	Tug	1999	107	48	0.50	0.95	6.93	3.54	568	454	0.000	0.002	0.001
		1	Hobart	1999	71	25	0.50	0.95	6.90	3.54	619	258	0.000	0.000	0.000
		2	663-244	2000	71	48	0.50	0.90	6.70	3.41	619	496	0.000	0.001	0.000
		2	Tug	2001	71	25	0.50	0.82	6.50	3.28	619	258	0.000	0.000	0.000
		2	Wollard TC886D	2005	118	48	0.50	0.63	5.75	2.80	619	496	0.000	0.001	0.000
		2	Wollard TC886D	2006	118	48	0.50	0.57	5.57	2.70	619	496	0.000	0.001	0.000
		2	Wollard	2007	118	25	0.50	0.54	5.42	2.62	619	258	0.000	0.000	0.000
	GAS	1	Cargo King	1955	71	25	0.50	5.89	8.68	209.90	619	258	0.000	0.000	0.006
		2	Tug/Cochran	1988	73	48	0.50	5.89	8.68	209.90	619	496	0.001	0.001	0.023
		2	Tug/Cochran	1989	73	48	0.50	5.89	8.68	209.90	619	496	0.001	0.001	0.023
		2	Tug/Cochran	1990	73	48	0.50	4.30	10.13	124.83	619	496	0.000	0.001	0.014
		5	Lantis	1991	71	48	0.50	4.30	10.13	124.83	619	496	0.001	0.003	0.033
		1	Tug	1993	107	48	0.50	4.30	10.13	124.83	619	496	0.000	0.001	0.010
		1	Tug	1994	107	48	0.50	4.30	10.13	124.83	619	496	0.000	0.001	0.010

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour)			LTO per Eq.	Annual Hours	Daily Emissions (tons)		
								VOC	NO_X	CO			VOC	NO_X	CO
		1	TUG 660-1	1997	107	48	0.50	4.30	10.13	124.83	619	496	0.000	0.001	0.010
		2	TUG 660-1	1998	107	48	0.50	4.30	10.13	124.83	619	496	0.001	0.002	0.020
		2	TUG 660-1	1999	107	48	0.50	4.30	10.13	124.83	619	496	0.001	0.002	0.020
		2	TUG 660-1	2000	107	48	0.50	4.30	10.13	124.87	619	496	0.001	0.002	0.020
		1	TUG	2005	107	25	0.50	3.55	8.24	106.70	1,131	471	0.000	0.000	0.002
		1	TUG	2006	107	25	0.50	3.59	7.34	97.49	1,131	471	0.000	0.000	0.002
		1	A01771D-3305	2004	71	25	0.50	3.92	9.16	116.00	619	258	0.000	0.000	0.003
		3	Tug	2008	107	48	0.50	2.43	5.50	75.72	619	496	0.001	0.001	0.018
	LPG	1	Wollard	1989	73	48	0.50	1.30	8.15	30.00	619	496	0.000	0.000	0.002
Cargo Loader	**Diesel**	1	FMC Commander 15	1980	80	80	0.50	2.43	13.67	8.30	1,131	1,508	0.000	0.000	0.000
		1	Lantis	1988	80	40	0.50	2.43	13.67	8.30	134	90	0.000	0.000	0.000
		1	FMC Commander 15	1989	80	80	0.50	2.43	13.67	8.30	1,131	1,508	0.000	0.000	0.000
		1	Lantis	1994	80	40	0.50	2.05	11.48	7.97	134	90	0.000	0.000	0.000
		1	Lantis	1996	80	40	0.50	1.90	10.59	7.80	134	90	0.000	0.000	0.000
		1	FMC Commander 15	1998	80	80	0.50	1.68	9.55	7.19	1,131	1,508	0.000	0.000	0.000
		2	1- FMC, 1-Lantis 828	1999	80	40	0.50	1.57	9.09	6.65	568	379	0.000	0.001	0.001
		1	Lantis	2000	80	40	0.50	1.46	8.70	6.10	134	90	0.000	0.000	0.000
		1	FMC Commander 30	2001	133	100	0.50	1.38	8.33	5.65	1,131	1,885	0.000	0.001	0.000
		7	Tiger	2001	133	40	0.50	0.98	7.35	5.16	940	627	0.001	0.006	0.005
		1	FMC Commander 30	2007	133	100	0.50	0.96	6.15	3.16	1,131	1,885	0.000	0.000	0.000
		1	FMC Commander 30	2008	133	100	0.50	0.88	5.70	2.86	1,131	1,885	0.000	0.000	0.000
		1	TLD	2008	133	40	0.50	0.68	5.60	4.47	134	90	0.000	0.000	0.000
Catering Truck	**Diesel**	1	Ford F700	1994	190	15	0.53	0.57	5.46	1.76	5,902	1,476	0.000	0.002	0.001
		1	Isuzu	1999	190	15	0.53	0.36	4.70	0.98	5,902	1,476	0.000	0.002	0.000
		1	Intl H700	2000	210	15	0.53	0.35	4.65	0.94	5,902	1,476	0.000	0.002	0.000
		1	Intl H700	2001	210	15	0.53	0.34	4.64	0.92	5,902	1,476	0.000	0.002	0.000
	GAS	1	Ford F700	1996	210	15	0.53	2.59	5.54	31.28	5,902	1,476	0.001	0.003	0.016
Deicing Unit	**GAS**	1	FMC Tempest	1980	263	7	0.95	4.25	10.11	122.61	43	5	-	-	-
		1	FMC Tempest	1980	263	7	0.95	4.25	10.11	122.61	43	5	-	-	-
		1	Trump	1986	270	7	0.95	4.25	10.11	122.61	283	33	-	-	-
		1	TM1800	1988	270	7	0.95	4.25	10.11	122.61	65	8	-	-	-
		1	Trump	1989	270	7	0.95	4.25	10.11	122.61	30	3	-	-	-
		1	Stinar	1994	270	7	0.95	4.25	10.11	122.61	30	3	-	-	-
		2	Ford/ Trump	1996	270	7	0.95	4.25	10.11	122.61	671	78	-	-	-
	Diesel	1	Global 2100LBSE	2001	416	7	0.95	0.58	5.38	3.85	375	44	-	-	-
Fuel Truck	**Diesel**	1	Chevy	1999	175	20	0.25	0.47	5.12	1.45	1,928	643	0.000	0.000	0.000
		2	International	1999	237	25	0.25	0.47	5.12	1.45	1,928	803	0.000	0.001	0.000
		1	2000 INTER 4700	2000	185	20	0.25	0.44	4.98	1.32	1,928	643	0.000	0.000	0.000
		1	Isuzu	2001	175	20	0.25	0.41	4.86	1.19	1,928	643	0.000	0.000	0.000

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour)			LTO per Eq.	Annual Hours	Daily Emissions (tons)		
								VOC	NO_X	CO			VOC	NO_X	CO
		2	International	2004	237	25	0.25	0.36	4.43	1.01	1,928	803	0.000	0.001	0.000
		1	International	2006	237	25	0.25	0.35	3.82	0.95	1,928	803	0.000	0.001	0.000
		23	Assorted Models	1999	237	25	0.25	0.34	5.36	1.21	1,928	803	0.001	0.018	0.004
	GAS	1	Ford F700	1990	210	20	0.25	3.93	6.42	53.37	1,928	643	0.000	0.001	0.005
Ground Power Unit	**Diesel**	1	GA047	1988	110	40	0.75	1.03	12.08	3.22	1,186	791	0.000	0.002	0.001
		1	GA047	1988	165	40	0.75	1.03	12.08	3.22	1,186	791	0.000	0.004	0.001
		1	90CT20P5	1991	165	40	0.75	0.98	11.44	3.18	1,186	791	0.000	0.003	0.001
		1	TUG	1995	115	120	0.75	0.81	9.35	3.04	1,131	2,262	0.000	0.002	0.001
		1	Hobart	2001	215	120	0.75	0.57	7.21	2.05	1,131	2,262	0.000	0.003	0.001
		1	Hobart	2002	215	120	0.75	0.52	6.90	1.84	1,131	2,262	0.000	0.003	0.001
		1	S&S TM4900	1996	110	40	0.75	0.78	8.97	3.02	1,186	791	0.000	0.002	0.001
		2	Ace	1999	194	40	0.75	0.65	7.90	2.51	1,186	791	0.000	0.005	0.002
		1	Arvico 4-90STD-D	1999	184	40	0.75	0.65	7.90	2.51	1,186	791	0.000	0.003	0.001
		1	Trilectron	1999	184	40	0.75	0.65	7.90	2.51	1,186	791	0.000	0.003	0.001
		1	Trilectron 90T400SLN	2001	184	40	0.75	0.57	7.21	2.05	1,186	791	0.000	0.002	0.001
		1	90T400SLN	2002	184	40	0.75	0.52	6.90	1.84	1,186	791	0.000	0.002	0.001
		1	Hobart TM 4900	2002	110	40	0.75	0.52	6.90	1.84	1,186	791	0.000	0.001	0.000
		7	Hobart, FCX, & Trilectron	2002	160	40	0.75	0.52	6.90	1.84	1,186	791	0.001	0.014	0.004
		1	Hobart Jet-Ex	2002	110	40	0.75	0.52	6.90	1.84	1,186	791	0.000	0.001	0.000
		1	Hobart	2003	110	40	0.75	0.48	6.63	1.63	1,186	791	0.000	0.001	0.000
		1	Hobart JET -EX5D	2003	110	40	0.75	0.48	6.63	1.63	1,186	791	0.000	0.001	0.000
		1	TLD	2004	194	40	0.75	0.45	6.22	1.44	1,186	791	0.000	0.002	0.001
		2	Hobart JET -EX	1998, 9	110	40	0.75	5.89	5.42	3.98	1,186	791	0.002	0.002	0.002
	GAS	1	Hobart JET -EX4	1997	70	40	0.75	4.25	10.11	122.73	1,186	791	0.001	0.001	0.015
		1	Hobart Jet-Ex	1999	88	40	0.75	4.25	10.11	122.73	1,186	791	0.001	0.002	0.019
Lavatory Truck	**GAS**	1	Ford	1991	235	20	0.25	2.99	5.90	41.56	2,466	822	0.000	0.001	0.006
		2	Ford-EFI	1998	235	15	0.25	1.75	4.81	9.81	2,466	617	0.000	0.001	0.002
		1	F350	1999	235	15	0.25	1.72	4.78	8.66	2,466	617	0.000	0.001	0.001
		1	Stenar	1999	235	20	0.25	1.72	4.78	8.66	2,466	822	0.000	0.001	0.001
		1	Ford F-350 Super duty	2000	235	15	0.25	1.69	4.76	7.96	2,466	617	0.000	0.001	0.001
	Diesel	1	Isuzu	2004	175	20	0.25	0.42	4.68	1.24	2,466	822	0.000	0.001	0.000
Service Truck	**Diesel**	1	TUG MH	1978	170	15	0.20	1.11	7.61	4.28	2,249	562	0.000	0.000	0.000
		1	Ford	1986	170	15	0.20	1.11	7.61	4.28	2,249	562	0.000	0.000	0.000
	GAS	1	Ford	1974	170	15	0.20	3.51	6.47	54.03	2,249	562	0.000	0.000	0.003
		1	F-252	1976	163	15	0.20	3.51	6.47	54.03	2,249	562	0.000	0.000	0.003
		1	LUV MIKADO	1977	163	15	0.20	3.51	6.47	54.03	2,249	562	0.000	0.000	0.003
		1	F-358	1978	163	15	0.20	3.51	6.47	54.03	2,249	562	0.000	0.000	0.003
		1	Ford F250 Pickup	1986	170	15	0.20	3.51	6.47	54.03	2,249	562	0.000	0.000	0.003
		1	Ford	1991	230	15	0.20	3.51	6.31	50.21	2,249	562	0.000	0.000	0.004

GSE Type	Fuel Type	# of Unit	Model Name	Model Year	HP	Minute/ Aircraft	LF	EF (Grams/hp-hour)			LTO per Eq.	Annual Hours	Daily Emissions (tons)		
								VOC	NO_X	CO			VOC	NO_X	CO
		1	Chevy S10	1995	140	15	0.20	2.79	5.74	35.83	2,249	562	0.000	0.000	0.002
		1	Ford F250 Pickup	1996	210	15	0.20	2.30	12.17	48.17	2,249	562	0.000	0.001	0.003
		1	Ford	1996	230	15	0.20	2.30	12.17	48.17	2,249	562	0.000	0.001	0.004
		1	F-350	1999	260	15	0.20	2.29	5.27	23.22	2,249	562	0.000	0.000	0.002
		1	Ford F150	1999	150	15	0.20	2.29	5.27	23.22	2,249	562	0.000	0.000	0.001
		1	Ford	1999	230	15	0.20	2.29	5.27	23.22	2,249	562	0.000	0.000	0.002
		1	Ford F250 Pickup	2000	360	15	0.20	2.19	5.18	20.63	2,249	562	0.000	0.001	0.003
		1	Ford	2002	360	15	0.20	1.99	5.01	15.80	2,249	562	0.000	0.001	0.002
Portable Air Stairs	**GAS**	1	Ford-250	1980	130	5	0.20	3.51	6.47	54.03	1,825	152	0.000	0.000	0.001
		1	Ford F350	1980	210	5	0.20	3.51	6.47	54.03	183	15	0.000	0.000	0.000
		1	SS055	1985	180	5	0.20	3.51	6.47	54.03	2,190	183	0.000	0.000	0.001
		1	Ford F350	1998	235	5	0.20	2.29	5.27	23.22	183	15	0.000	0.000	0.000
		1	Ford F350	2001	260	5	0.20	2.19	5.18	20.63	183	15	0.000	0.000	0.000
		1	Abby Generator	2005	12	5	0.30	0.50	7.13	1.92	1,131	94	0.000	0.000	0.000
		1	NMC TLPH310E	2001	235	5	0.20	2.19	5.18	20.63	183	15	0.000	0.000	0.000
	Diesel	1	Tug-Airstairs	2008	235	5	0.20	0.20	2.61	1.14	365	30	0.000	0.000	0.000
Lift Platform	**Diesel**	1	Wasp	1997	115	60	0.50	2.05	11.46	7.91	806	806	0.000	0.002	0.001
		1	Wasp	2006	115	60	0.50	1.23	7.51	4.64	806	806	0.000	0.001	0.001
Conveyor	**Diesel**	2	Lister Petter 1000	1999	80	40	0.50	0.95	6.93	3.54	568	379	0.000	0.001	0.000
Fork Lift	**LNG**	1	Yale	1998	60	60	0.30	2.48	12.19	48.82	1,131	1,131	0.000	0.000	0.001
		1	Toyota	2005	55	60	0.30	2.17	10.32	47.73	1,131	1,131	0.000	0.000	0.001
		1	Toyota	2007	55	60	0.30	1.81	8.33	42.91	1,131	1,131	0.000	0.000	0.001
Lift	**Diesel**	1	FL70 Freightliner	2008	250	60	0.50	1.10	6.78	4.08	1,131	1,131	0.000	0.001	0.001
	GAS	1	Ford 350	1994	185	60	0.50	5.57	10.12	179.91	1,131	1,131	0.001	0.002	0.028
		1	GMC	1994	235	60	0.50	5.57	10.12	179.91	806	806	0.002	0.003	0.051
		1	Ford	2000	235	60	0.50	5.57	10.13	179.99	806	806	0.002	0.003	0.051
Light Plant	**Diesel**	1	Allmand Brothers	1989	12.15	60	0.90	0.82	5.67	3.09	1,131	1,131	0.000	0.000	0.000
		1	Allmand Brothers	1994	12.15	60	0.90	0.82	5.67	3.09	1,131	1,131	0.000	0.000	0.000
Light Cart	**Diesel**	3	HS4000DH	1999	25	20	0.50	0.05	6.41	5.39	568	189	0.000	0.000	0.000
Total		**377**											**0.075**	**0.378**	**1.459**