Refining Commercial Lawn and Garden Equipment Population and Emission Estimates

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ABSTRACT

In the past, San Antonio region off-road emission inventories of commercial lawn and garden equipment contained inaccuracies in equipment counts and usage rates. A wide variety of businesses and agencies use lawn and garden equipment, causing the NONROAD model default values for emissions calculations to be inappropriate in some cases. The accuracy of lawn and garden equipment counts and usage rates increases with the use of local data acquired through surveys. Additionally, the accuracy of emissions calculations for this category also increased with the subdivision of the category into user types, such as commercial business, golf courses, or public schools. User types were then surveyed to determine local lawn and garden usage rates and equipment population in the San Antonio region for the year 2005.

Through analysis of the surveyed data, usage rates were found to differ significantly from usage rates provided through NONROAD model defaults. Survey results from some categories, such as Turf and Tiller equipment, reflected usage rates less than 10% of those of the NONROAD model defaults; whereas, categories such as Rear Mowers and Front Mowers, surveyed equipment usage was 200% more than that of the NONROAD model defaults. Thus, adjustments were made to the equipment populations in the NONROAD 2004 model based on the percent difference between the survey results and the NONROAD model defaults. Emissions were then geocoded by user type locations.

INTRODUCTION

In the past, off-road emission inventories of commercial lawn and garden equipment frequently contained inaccuracies in equipment counts and usage rates. In the San Antonio region, NONROAD model[1] default values for lawn and garden emission calculations were found to be inappropriate due to varying usage rates and the wide variety of businesses and agencies using lawn and garden equipment. However, the accuracy of lawn and garden equipment counts and usage rates can be increased with the use of local data acquired through surveys.

Facility types may use selected equipment at differing rates; for example, chainsaws are used more heavily in parks. When considering daily allocation of equipment usage, some sources, such as Public Schools, do not use lawn and garden equipment on weekends, while the opposite is true for other sources, such as Golf Courses. Consequently, when comparing usage rates determined by survey to usage rates determined by NONROAD model defaults, various equipment categories exhibited significant differences. Since commercial lawn and garden equipment emits over 6 tons of volatile organic compounds and almost 2 tons of nitrogen oxides a day in the San Antonio area, it is important to develop a methodology that produces accurate emissions estimations.

Commercial Lawn and Garden equipment for San Antonio was divided into the following 10 usage types as part of the process to increase equipment counts and usage estimates:

- Commercial Lawn and Garden Companies (both for residential properties and commercial properties),
- Golf Courses,
- Public Schools,
- Universities/Colleges,
- Non-Military Government Facilities, Parks, and Hospitals,
- Other Commercial Companies,
- Cemeteries,
- Private Airports,
- Commercial Airports, and
- Military Facilities (Army and Air Force Bases).

This paper will cover lawn and garden equipment emissions from commercial companies, golf courses, public schools, universities/colleges, non-military government facilities, other commercial companies, private airports, and commercial airports. Cemetery lawn and garden equipment was not calculated because emissions are insignificant, as cemeteries do not cover a large improved land area in the San Antonio region. Also, the low survey response rate from cemeteries would not provide a statistically significant difference. Emissions from military lawn and garden equipment are based on a different methodology and are also not included in this paper.

Lawn and garden equipment emissions estimates for volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO) for the San Antonio region were calculated for non-road equipment in the following categories:

- 2260004016 2-stroke commercial rotary tillers
- 2265004016 4-stroke commercial rotary tillers
- 2260004021 2-stroke commercial chain saw
- 2260004026 2-stroke commercial trimmer/Edger/Brush Cutter
- 2265004026 4-Stroke commercial trimmer/Edger/Brush Cutter
- 2260004030 2-stroke commercial leaf blower/vacuums
- 2265004030 4-stroke commercial leaf blower/vacuums
- 2260004071 2-stroke commercial turf equipment
- 2265004071 4-stroke commercial turf equipment
- 2270004071 Diesel commercial turf equipment
- 2265004011 4-stroke commercial lawnmower
- 2265004041 4-stroke commercial rear engine riding mower
- 2265004046 4-stroke commercial front mower
- 2265004051 4-Stroke commercial Shredder
- 2265004056 4-Stroke commercial Lawn and Garden Tractors
- 2270004056 Diesel commercial Lawn and Garden Tractors
- 2265004066 4-Stroke commercial Chipper/Stump Grinder
- 2267004066 LPG commercial Chipper/Stump Grinder
- 2270004066 Diesel commercial Chipper/Stump Grinder
- 2265004076 4-stroke commercial other lawn and garden equipment
- 2270004076 Diesel commercial other lawn and garden equipment
- 2270007010 Diesel shredders > 6 HP

METHODOLOGY

The methodology used in producing commercial Lawn and Garden equipment emission estimates for the San Antonio region is based on local data collected from surveys and aerial photographs, or on national data from the EPA NONROAD 2004 emission inventory model, in the absence of reliable local data. The methodology involves the following steps:

1) Conducting a survey to request equipment population, usage rates, and equipment characteristics
2) Determining equipment population and activity for sites without survey data
3) Conducting a second survey with pre-filled data obtained from the first survey for golf courses and private airports
4) Estimating VOC, NOx, and CO annual emissions for a typical ozone season weekday (tons/day) using survey responses and NONROAD model defaults
5) Spatially allocating emissions to 4km photochemical modeling grids with TransCAD 4.7 GIS software

Step 1: Conduct a Survey of Local Commercial Lawn and Garden Equipment Activity

The preferred method of calculating commercial lawn and garden equipment emissions involves conducting a survey of equipment use within the San Antonio region (Appendix A). The survey form requested the following information:

- Activity Rates (HRS) – Total annual hours of use by type of equipment
- Temporal Profiles – Equipment use on weekdays and equipment use on weekend days for all types of equipment
- Engine Characteristics:
  1) Engine Type – 2-stroke gasoline, 4-stroke gasoline, or diesel
  2) Engine Horsepower – rated power of the engine

Step 2: Determining Lawn and Garden Equipment Population for Commercial Equipment Without Survey Data

To determine total equipment for each county, the equipment counts reported in the survey responses were multiplied by the allocation factors listed in Table 1.

Table 1. Factors used to allocate survey responses by county.

Category	Equipment Allocation by County
Commercial Lawn and Garden Companies	Number of Companies
Golf Courses	Golf Course Acres
Public Schools	Number of Public School
Universities/Colleges	University/College Acres
Non-Military Government Facilities, Parks, and Hospitals	Allocated to the location reported in the survey response
Other Commercial Companies	Allocated to the location reported in the survey response
Cemeteries	No Emission Calculation
Private Airports	Airport Acres
Commercial Airports	Allocated to the location reported in the survey response
Military Bases	Allocated to the location reported in the survey response

Total equipment population was then adjusted by a factor based on the average hours of use per year from the survey data. Some equipment sources, for example front mowers, chainsaws and shredders, had higher activity rates than the NONROAD default hours, while other equipment types had lower. Equation 1 was used to calculate total equipment population for the San Antonio region.

Equation (1) $TPOP_A = SPOP_A$ X TOL X (SHR / NRHR) / SUR

where
$TPOP_A$ = Total population of equipment A (Table 2)
$SPOP_A$ = Survey population of equipment A
TOL = Total number of commercial companies, acres, or schools
SHR = Average annual hours for each equipment type from survey responses
NRHR = Default annual hours for each equipment type from the NONROAD model
SUR = Number of survey respondents

Example 1: Equipment Population of Commercial Companies' Chainsaws in the San Antonio region
= 221 chainsaws X 290 companies X (1408.5 survey hours / 303 default hours) / 54 survey responses
= 5,518 chainsaws

Example 2: Equipment Population of Golf Courses' Chainsaws in the San Antonio region
= 7 chainsaws X 8887 acres X (57.4 survey hours / 303 default hours) / 1316 acres of surveyed golf courses
= 9.0 chainsaws

Follow the methodology used by the ERG report "Development of Commercial Lawn and Garden Emission Estimations for the State of Texas and Selected Metropolitan Areas"[2], a 10% SWAG Factor was applied to the other equipment category for lawn and garden equipment used by commercial companies.

Step 3: Conduct a Second Survey of Golf Courses and Private Airports

After determining equipment populations for each golf course and private airport, a second survey was sent out with the estimations of their equipment population, HP, and activity hours to achieve a higher response rate. The second survey used the same format as the initial survey. Companies were asked to correct estimations and to send the surveys back to AACOG. The response rates for all surveys are listed below.

- Commercial Lawn and Garden Com: 19% Response Rate
- Golf Courses: 15% Response Rate
- Public Schools: 43% Response Rate
- Universities/Colleges: 62% Response Rate
- Gov. Fac., Parks, and Hospitals: Not Calculated
- Other Commercial Companies: Not Calculated
- Cemeteries: No Emission Calculation
- Private Airports: 21% Response Rate
- Commercial Airports: 100% Response Rate
- Military Bases: 100% Response Rate

Step 4: Estimating Annual Emissions of Ozone Precursors (tons/yr.)

Once county level equipment populations were determined, emissions of volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO) were calculated using NONROAD Model 2004 based on the following equation:

Equation (3) Emissions in g/yr. (VOC/CO/NOx) = EP x HP x HRS x LF x EF

where
EP = equipment population (Table 2)
HP = horse power (Table 3)
HRS = hours per piece of equipment (Table 4)
LF = load factor (NONROAD model default)
EF = emission factor for VOC/CO/NOx (NONROAD model default)

The values for the LF and EF were obtained from the EPA NONROAD Emission Inventory Model. Equipment population, horsepower, annual hours, weekday adjustment factor, and allocation by county were developed using the local data described above for each category. There were several adjustments made to account for local conditions in using the NONROAD Model: update to the population file and updates to the HP within the population file.

Population File

The equipment population for each type of equipment was summed based on the AACOG survey response (Table 2). This master spreadsheet was then converted into the population file for the NONROAD model for each category. Also, the population file was updated with the horsepower (HP) estimates from the survey. Table 3 lists the default NONROAD 2004 default HP and the calculated average HP from the survey responses. For the NONROAD run, equipment populations were allocated to horsepower bins based on survey responses.

In most cases, equipment horsepower were very similar or slightly lower between the default values and the survey responses. However, commercial companies used higher HP rotary tillers, rear riding mowers and shredders. Golf courses tended to use larger front-engine mowers, commercial turf equipment and lawn and garden tractors. Public schools tended to use larger rear-engine rider mowers and shredders, but smaller gasoline lawn and garden tractors and chainsaws. Universities/colleges tended to use smaller chainsaws and larger lawn and garden tractors.

Table 2. Total Equipment Population Estimations from the AACOG Survey Compared to EPA's NONROAD Default Equipment Population, 2005.*

Equipment Type	2005 EPA NONROAD Model Default Population	Commercial Lawn and Garden Companies	Universities/ Colleges	Public Schools	Golf Courses	Government Facilities/ Parks/ Hospitals	Other Companies	Commercial/ Private Airports	Percent of NONROAD Model Population
Lawn Mowers	11,020	3,131	20	475	44	175	34	12	35%
Tillers	4,054	113	3	5	4	7	0	2	3%
Chainsaws	5,258	5,518	26	50	9	551	9	3	117%
Trimmers	13,402	5,876	320	4,060	321	2,294	70	132	98%
Blowers	7,636	4,443	82	379	253	524	15	26	75%
Rear Mower	339	774	77	139	582	154	1	10	513%
Front Mower	2,764	4,548	61	232	1,795	225	3	16	249%
Shredder	2,127	2,403	31	202	0	16	8	7	125%
Tractor	2,719	111	8	416	113	83	3	10	27%
Chippers	682	470	0	7	4	49	0	0	78%
Turf	6,827	78	1	14	360	29	0	22	7%
Other	5,084	3,904	5	0	0	60	43	0	79%
Total	58,051	31,367	634	5,979	3,485	4,167	187	239	79%

*Does not include military Lawn and Garden Equipment.

Table 3. HP estimations for commercial companies, golf courses, public schools, universities/colleges, and private airports' commercial lawn and garden equipment in the San Antonio region, 2005.

Commercial Lawn & Garden Equipment	Engine Type	SCC	NONROAD Default HP	Commercial Lawn and Garden Comp.	Golf Courses	Public Schools	University/ College	Private Airports
Chain Saws	Gas. 2-cycle	2260004021	3.5	1.9	3.5	2.2	1.8	-
Trimmers/ Edgers/ Brush Cutters	Gas. 2-cycle	2260004026	1.5	1.5	1.5	1.4	1.3	0.9
Leaf Blowers/ Vacuums	Gas. 2-cycle	2260004031	2.0	1.8	2.0	2.1	2.3	1.0
Lawn Mowers	Gas. 4-cycle	2265004011	4.1	4.1	3.7	5.3	5.1	4.4
Rotary Tillers	Gas. 4-cycle	2265004016	4.7	8.0	4.7	4.6	6.0	-
Rear Engine Riding Mowers	Gas. 4-cycle	2265004041	10.7	21.2	10.7	19.6	16.8	-
Front Mowers	Gas. 4-cycle	2265004046	13.5	15.0	27.6	19.0	13.5	15.0
Shredders	Gas. 4-cycle	2265004051	4.2	4.2	-	38.0	-	-
Lawn and Garden Tractors	Gas. 4-cycle	2265004056	14.4	12.6	-	6.7	68.0	48.0
Other Lawn and Garden Eq.	Gas. 4-cycle	2265004076	5.4	5.4	-	-	8.0	-
Commercial Turf Eq./ Sod Cutters	Gas. 4-cycle	2265004071	12.6	3.1	18.1	25.0	-	-
Shredders	Gas. 4-cycle	2265007010	8.6	50.0	-	-	8.0	-
Chippers/Stump Grinders/Mulchers	Gas. 4-cycle	2265004066	28.0	28.0	-	-	-	-
Commercial Turf Eq./ Sod Cutters	Diesel	2270004076	48.8	48.8	-	23.4	28.0	-
Commercial Mowers	Diesel	2270004046	29.1	21.0	26.0	22.2	27.3	-
Lawn and Garden Tractors	Diesel	2270004056	21.0	13.0	47.9	21.6	29.6	-
Chippers/ Stump/ Grinders/Mulchers	Diesel	2270004066	93.4	93.4	142.4	40.0	-	-
Shredders	Diesel	2270007010	N/A	110.0	-	60.0	200.0	15.0

Season File

A final step in the calculation was to determine the percent of weekday versus weekend emissions. Equipment hours of operation on weekdays for all survey responses were added and divided by the total number of hours. A weekday versus weekend adjustment factor was calculated separately for each piece of equipment based on the survey responses (Table 4). On average, 92.6 percent of the equipment hours of operation are during weekdays and 7.4 percent of the equipment hours of operation occur during the weekend. The weekday survey results are much higher than the NONROAD default of 80% commercial lawn and garden usage on the weekdays. Many San Antonio companies that operate commercial lawn and garden equipment are not open on the weekends. The exceptions are golf courses (73% weekdays) and private airports (39% weekdays) that had lower usage of Lawn and garden equipment on weekdays compared to the default value.

Allocation File

An allocation file was created to properly allocate emissions to each county. To create this file, the values for all counties except those in the study area were replaced with zero in the default landscape allocation file for Texas (TX_LSCAP.AOL). The values for the San Antonio region were allocated based on the allocation listed in Table 5 for Commercial Companies, Golf Courses, Public Schools, Universities/Colleges, and Private Airports. For government facilities, commercial airports, and other commercial companies, the allocation was based on the location of the survey respondent. The values for each county were added up and the total was used as the value for the State of Texas. This allowed the NONROAD model to calculate emissions for the San Antonio region as a whole and distribute the emissions to each county appropriately.

Once the lawn and garden equipment was summed up for all categories, a comparison was done between the NONROAD 2004 defaults and the results from the survey. Table 2 shows the breakdown by category. Overall, the NONROAD model over predicted the number of lawn and garden equipment in the AACOG survey. AACOG survey indicates that local commercial lawn and garden equipment was only 79 percent of the NONROAD defaults. There were more rear-engine mowers and chippers in the AACOG survey than indicated by the NONROAD model. At the same time, the NONROAD model over predicted the number of tillers and turf equipment. These results do not include the lawn and garden equipment at military bases that would increase the total percentage of equipment.

Step 5: Spatially Allocating Emissions to 4km Photochemical Modeling Grids

Emissions were geocoded to locations of commercial companies, golf courses, public schools, universities/colleges, private airports, and population using TransCAD GIS software[3]. Emissions were aggregated to the 4km photochemical model grid system, as shown in Figure 2. The 4km grid system is based on the September 1999 modeling episode used in the San Antonio Early Action Compact (EAC) State Implementation Plan (SIP). Allocating emissions to actual facility locations increases the accuracy of ozone predictions in the photochemical model. Figures 1 and 2 show examples of this allocation for NOx emissions from diesel commercial land and garden equipment used by golf courses and public schools.

Table 4. Weekday/weekend allocation of commercial companies, golf courses, public schools, universities/colleges, and private airports' commercial lawn and garden equipment in the San Antonio region, 2005.

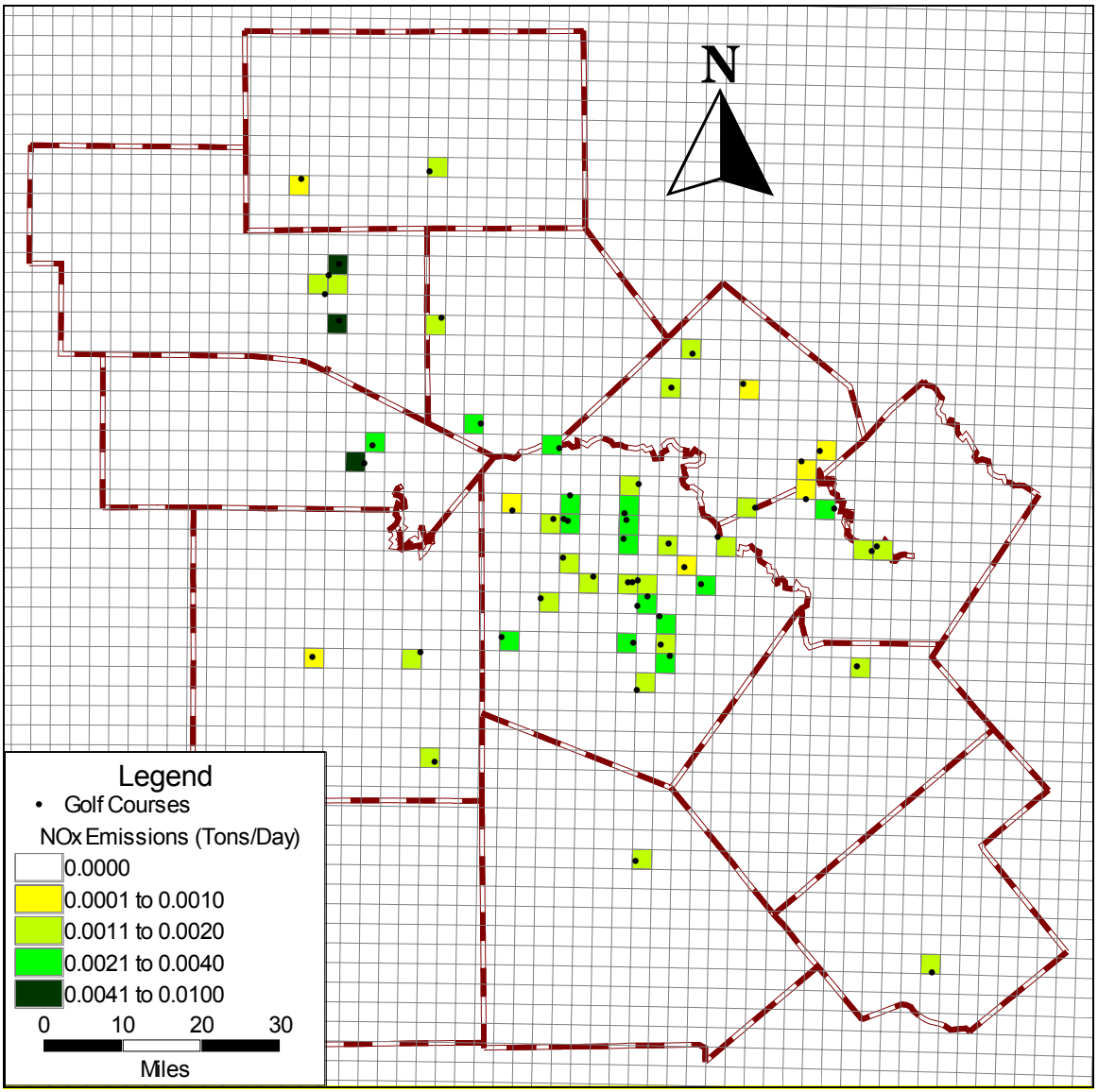
Commercial Lawn & Garden Equipment	Engine Type	Commercial Lawn and Garden Comp.		Golf Courses		Public Schools		University/College		Private Airports	
		Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Chain Saws	Gas. 2-cycle	5.5	0.0	0.2	0.1	0.9	0.0	1.7	0.0	-	-
Trimmers/ Edgers/ Brush Cutters	Gas. 2-cycle	6.1	0.1	1.7	0.3	4.0	0.0	3.8	0.0	0.3	1.4
Leaf Blowers/ Vacuums	Gas. 2-cycle	4.8	0.1	2.8	0.1	1.9	0.0	2.6	0.3	0.0	3.0
Lawn Mowers	Gas. 4-cycle	7.7	0.1	1.4	1.3	3.0	0.0	1.4	0.0	0.1	1.1
Rotary Tillers	Gas. 4-cycle	2.5	0.0	0.5	0.0	0.7	0.0	1.3	0.1	-	-
Rear Engine Riding Mowers	Gas. 4-cycle	4.8	0.2	4.0	3.5	5.6	0.0	3.5	0.3	-	-
Front Mowers	Gas. 4-cycle	5.6	0.0	4.0	1.7	5.4	0.1	2.7	0.0	0.3	0.0
Shredders	Gas. 4-cycle	5.5	0.0	-	-	4.5	0.0	-	-	-	-
Lawn and Garden Tractors	Gas. 4-cycle	1.9	0.0	-	-	4.2	0.0	2.7	0.0	2.1	0.2
Other Lawn and Garden Eq.	Gas. 4-cycle	6.0	0.0	-	-	-	-	1.6	0.0	-	-
Commercial Turf Eq./ Sod Cutters	Gas. 4-cycle	4.7	0.0	4.1	1.8	5.0	0.0	-	-	-	-
Shredders	Gas. 4-cycle	4.7	0.0	-	-	-	-	0.8	0.0	-	-
Chippers/Stump Grinders/Mulchers	Gas. 4-cycle	4.5	0.0	-	-	-	-	-	-	-	-
Commercial Turf Eq./ Sod Cutters	Diesel	4.7	0.0	-	-	4.5	0.0	2.0	0.0	-	-
Commercial Mowers	Diesel	3.0	0.0	-	-	4.8	0.0	5.0	0.0	-	-
Rear Engine Riding Mowers	Diesel	8.3	0.7	4.4	0.8	-	-	-	-	-	-
Lawn and Garden Tractors	Diesel	6.0	0.0	2.9	0.3	3.9	0.0	4.3	0.0	-	-
Chippers/ Stump/ Grinders/ Mulchers	Diesel	4.3	0.0	0.5	0.0	2.5	0.0	-	-	-	-
Shredders	Diesel	4.7	0.0	-	-	6.5	0.0	4.0	0.0	2.2	0.3
Average		5.0	0.1	2.4	0.9	3.8	0.0	2.7	0.1	0.8	1.0

Table 5. Allocation of commercial companies, golf courses, public schools, universities/colleges, and private airports' commercial lawn and garden equipment in the San Antonio region, 2005.

County	Commercial Lawn and Garden Companies		Golf Course		Public Schools		Universities/Colleges		Private Airports	
	Number of Employees	Percentage	Total Acres	Percentage	Number of Schools	Percentage	Total Acres	Percentage	Number of Private Airport	Percentage
Atascosa	7	0.2%	142	1.6%	28	4.5%	5	0.5%	1	5.5%
Bandera	8	0.2%	595	6.7%	7	1.1%	0	0.0%	0	0.0%
Bexar	3402	90.9%	4075	46.0%	412	66.0%	906	82.7%	5	27.8%
Comal	74	2.0%	511	5.8%	33	5.3%	0	0.0%	2	11.1%
Frio	0	0.0%	0	0.0%	10	1.6%	0	0.0%	2	11.1%
Gillespie	17	0.5%	210	2.4%	9	1.4%	0	0.0%	1	5.5%
Guadalupe	74	2.0%	687	7.8%	35	5.6%	184	16.8%	2	11.1%
Karnes	0	0.0%	160	1.8%	14	2.2%	0	0.0%	1	5.5%
Kendall	83	2.2%	300	3.4%	13	2.1%	0	0.0%	0	0.0%
Kerr	62	1.7%	1673	18.9%	18	2.9%	0	0.0%	1	5.5%
Medina	10	0.3%	335	3.8%	20	3.2%	0	0.0%	3	16.7%
Wilson	8	0.2%	165	1.9%	25	4.0%	0	0.0%	0	0.0%
Total	3744	100.0%	8852	100.0%	624	100.0%	1095	100.0%	18	100.0%

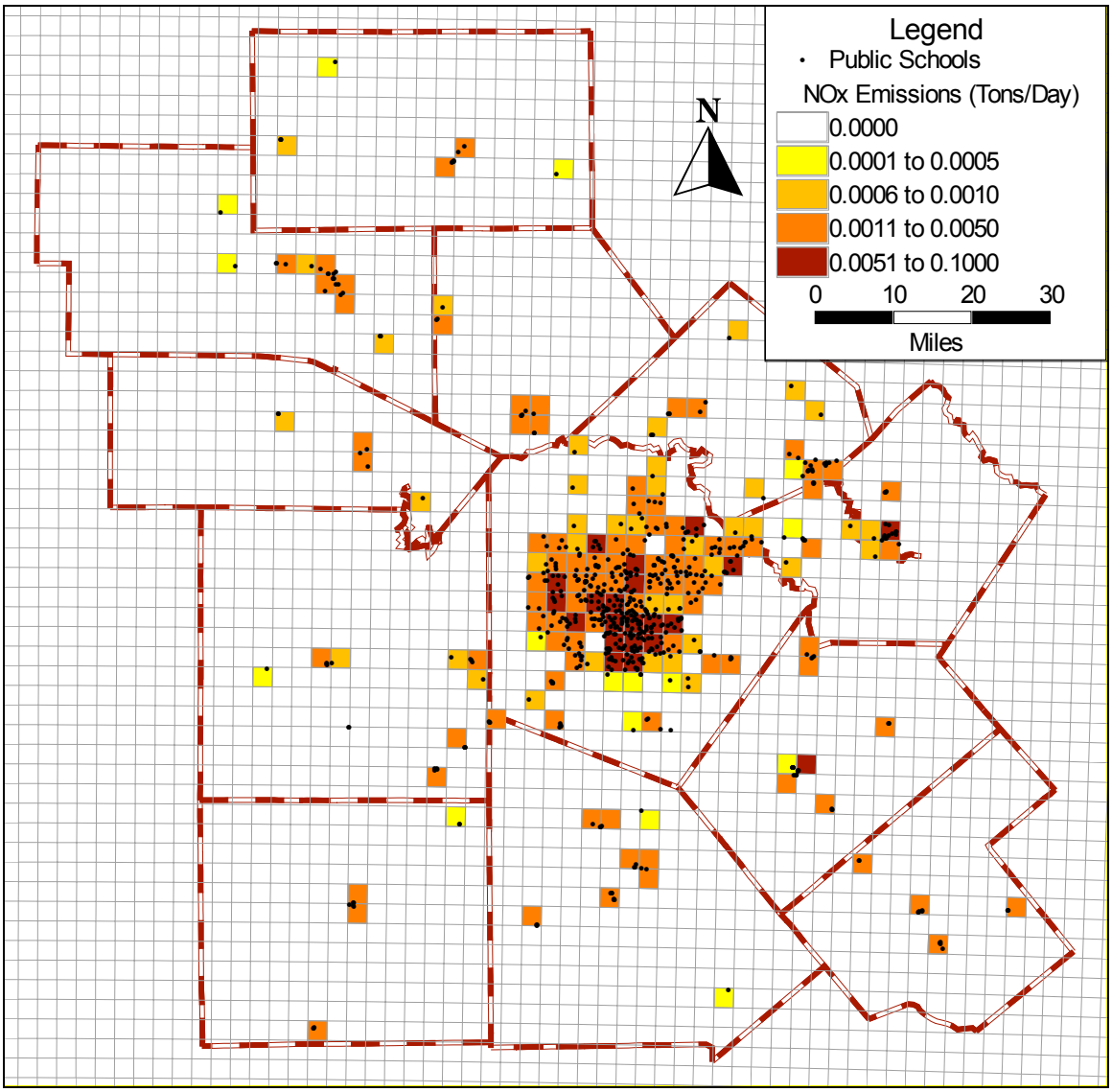
*Military Base Schools are not included (these schools are in the Miltary/Airport section)

Figure 1. NOx emissions from diesel lawn and garden equipment at golf course, 2005.



Plot Date: November 9, 2005
Map Compilation: October 12, 2005
Source: Aerial Photography, District Appraisal Data, and Telephone Survey

Figure 2. NOx emissions from diesel lawn and garden equipment at public schools, 2005.



Plot Date: November 9, 2005
Map Compilation: October 6, 2005
Source: School locations are from the National Center for Education Statistics, 2002. Available online: http://nces.ed.gov/ (20 July 2004)[4]

CONCLUSION

The NONROAD model default values proved inappropriate for commercial lawn and garden equipment and contained inaccuracies in equipment counts and usage rates, due to the wide variety of businesses and agencies using lawn and garden equipment. When comparing usage rates determined by survey to usage rates determined by NONROAD model defaults, various equipment categories and types of businesses exhibited significant differences.

Table 6 provides a detailed list of the emission inventory results compared to the NONROAD model default run. By using a detailed survey methodology, calculated emissions were 50% lower then the NONROAD model estimated. Since San Antonio has dry and hot weather and some commercial lawn and garden equipment population was greatly overestimated by the NONROAD model, may cause emissions from the equipment be less then NONROAD model prediction. Also, average equipment hp was lower than the NONROAD model prediction. Emissions from universities/colleges, other commercial companies, private airports, and commercial airports were insignificant; however, commercial companies, golf course, public schools, government facilities, and military bases are important sources of emissions in the San Antonio region.

Table 6. Emissions from lawn and garden equipment in the San Antonio region compared to the NONROAD model defaults, 2005.

Emission Source	VOC	NOx
Commercial	4.957	1.486
Golf Courses	0.212	0.166
Public Schools	0.505	0.027
University/Colleges	0.060	0.022
Government/Hospitals	0.564	0.073
Other Commercial Companies	0.016	0.018
Cemeteries	0.000	0.000
Private Airports	0.002	0.001
Commercial Airports	0.016	0.018
Military Bases	0.223	0.053
Total	6.556	1.864
NONROAD Default Emissions	14.262	2.654

Conducting a detailed survey of commercial lawn and garden equipment usage enabled significant improvements to the accuracy of emission inventory estimates. Using GIS software to allocate emissions to the photochemical model grid systems improves the accuracy of predicting ozone formation and the effectiveness of control strategies. Further research on this topic includes expanding the survey to increase the responses from cemeteries and updating emission results with NONROAD model 5.0 or MOVES.

Appendix A
Survey used to determine lawn and garden equipment population, horsepower, and hours

AACOG
Alamo Area Council Of Governments

October 3, 2004

[COMPANY NAME]
[STREET ADDRESS]
[CITY] [STATE] [ZIP]

ATTENTION: OPERATIONS MANAGER

Re: San Antonio Regional Emissions Inventory

The Alamo Area Council of Governments (AACOG) requests your assistance in the development of the air quality emission inventory for Bexar County and the surrounding counties. AACOG is conducting this inventory in order to assess and quantify local air quality within the metropolitan area of San Antonio and contiguous counties. This inventory is especially significant because the San Antonio region has been declared in non-attainment deferred of federal air quality standards, the National Ambient Air Quality Standards.

AACOG will calculate the equipment source component of this inventory from information submitted by local organizations involved in landscaping, lawn and garden and such activities in and around the San Antonio region using the enclosed survey. With this survey, we are requesting information on any lawn and garden, construction, or industrial equipment used during the 2004 calendar year within Atascosa, Bandera, Bexar, Comal, Frio, Gillespie, Guadalupe, Karnes, Kendall, Kerr, Medina, and Wilson counties. 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 achieve a true and correct emissions inventory. Please provide your responses on the attached survey and return it to us in the self-addressed envelope by the date indicated. The information you provide will be considered strictly confidential and unavailable to public information requests. Please submit your response by October 20, 2004.

Thank you for your time and participation. If you have any questions or comments please feel free to contact Steven Smeltzer at (210) 362-5266.

Regionally yours,

Al J. Notzon III
Executive Director

Enclosures (2)

	Internal Combustion Equipment Type	Engine Type Gasoline 2-cycle Gasoline 4-cycle Diesel Propane Natural Gas Electric	Approx. Horse-Power Rating	Number of Units Typically Operated	Avg. No. of Hours and Time of Day Each Unit Operated (MON-FRI)	Avg. No. of Hours and Time of Day Each Unit Operated (SAT & SUN)
COMMERCIAL LAWN AND GARDEN EQUIPMENT						
1	Lawn Mowers					
2	Rear Engine Riding Mowers					
3	Front Mowers					
4	Rotary Tillers					
5	Chain Saws					
6	Chippers/Stump Grinders/Mulchers					
7	Trimmers/Edgers/ Brush Cutters					
8	Commercial Turf Equipment/ Sod Cutters					
9	Leaf Blowers/ Vacuums					
10	Lawn and Garden Tractors					
11	Shredders					
12	Other Lawn and Garden Equipment: (Please Describe): _____					

REFERENCES

[1]U.S. Environmental Protection Agency, *National Nonroad Emissions Model 2004: Draft Version*, 2005, Ann Arbor, MI.

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KEY WORDS

Lawn and Garden Equipment
Emission Inventory
GIS
NONROAD model
Lawnmowers