**582-11-11219**

**Task 2.1 Project I**

**Commercial Lawn and Garden**

**Emission Inventory**

**Technical Report**

**December 31, 2013**

**Prepared by:**

**Alamo Area Council of Governments**

**Prepared in Cooperation with the**

**Texas Commission on Environmental Quality**

The preparation of this report was financed through grants from the State of Texas through the Texas Commission on Environmental Quality

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| --- | --- | --- | --- |
| **Title:** Commercial Lawn and Garden  Emission Inventory | | **Report Date:** December 31, 2013 | |
| **Authors:** AACOG Natural Resources/ Transportation Department | | **Type of Report:** Technical Report | |
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| **Abstract:** The compilation of the commercial lawn and garden equipment emissions inventory (EI) required extensive research and analysis, and provided a vast database of regional pollution sources and emission rates. An extensive survey was conducted of all entities identified as operating commercial lawn and garden equipment in the San Antonio-New Braunfels MSA. Businesses and agencies that were surveyed for this task included commercial lawn and garden companies, universities/colleges, public school districts, golf courses, cemeteries, government facilities, federal and state parks, other businesses and employers, commercial and private airports, and military facilities. The results of the survey indicate significantly higher populations of commercial trimmers, front mowers, shredders, and rear engine mowers in the AACOG region than the populations developed for the TexN Model. Leaf blowers, turf equipment, lawn and garden tractors, and chainsaws are also under-predicted in the TexN Model. AACOG’s 2012 survey results for total equipment were 280 percent higher than the existing equipment population in the TexN Model. Based on the results of AACOG’s survey, commercial lawn and garden equipment was estimated to emit 3.6 tons of VOCs and 1.1 tons of NOX per ozone season weekday. Trimmers were the largest source of VOC emissions, 0.65 tons per weekday, because of the large number and high activity rates of trimmers in the San Antonio New Braunfels MSA. The second largest source of VOC emissions was chippers/grinders (0.60 tons of VOCs per weekday), followed by chainsaws (0.46 tons), leaf blowers (0.45 tons), and rear engine mowers (0.44 tons). The largest source of NOX emissions was chippers and grinders at 0.52 tons per weekday. Other sources of NOX emissions included lawn and garden tractors, 0.19 tons per weekday and rear engine lawn mowers, 0.15 tons per weekday. A weekday versus weekend adjustment factor was calculated based on the hours of usage from the surveys for each facility type. The survey results show that commercial lawn and garden equipment usage was higher on weekdays compared to existing data in the TexN Model. | | | |
| **Related Reports:**  Alamo Area Council of Governments, June 1, 2012. “Proposed Planning Process for the Emission Inventory”. San Antonio, Texas. | **Distribution Statement:**  Alamo Area Council of  Governments, Natural Resources/Transportation Department | | **Permanent File:**  Alamo Area Council of  Governments, Natural Resources/Transportation Department |

# EXECUTIVE SUMMARY

The Clean Air Act (CAA) is the comprehensive federal law that regulates airborne emissions across the United States.[[1]](#footnote-1) 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, including ozone, which can injure health, harm the environment, and/or cause property damage. TCEQ operates three regulatory ozone monitors, CAMS23, CAMS58, and CAMS59, in the San Antonio area to determine compliance with the federal ozone standard. The annual fourth highest eight-hour average ozone concentrations, which are the values used in federal compliance calculations, have risen in recent years: from 75 ppb in 2009 to 83 ppb in 2013f.

Ozone is produced when volatile organic compounds (VOCs) and nitrogen oxides (NOX) react in the presence of sunlight, especially during the warm days of summer time.[[2]](#footnote-2) These ozone precursors can be generated by local processes and the majority of chemicals that form ground-level ozone originate from anthropogenic sources. To conduct analysis that determines emission reductions required to bring the area into compliance with the standards, local and state air quality planners need an accurate account of emissions and their sources in the region. The compilation of the commercial lawn and garden equipment emissions inventory (EI) required extensive research and analysis, and provided a vast database of regional pollution sources and emission rates.

Engines installed on commercial lawn and garden equipment that are regularly used by businesses and governmental agencies contribute to NOX and VOC emissions. Documenting the scale of commercial lawn and garden equipment activities are essential steps in the emission inventory effort. An extensive survey was conducted of all entities that operate commercial lawn and garden equipment in the San Antonio-New Braunfels MSA. Having local survey data on commercial lawn and garden equipment usage improves emission estimates of these sources. Businesses and agencies that were surveyed for this task included commercial lawn and garden companies, universities/colleges, public school districts, golf courses, cemeteries, government facilities, federal and state parks, other businesses and employers, commercial and private airports, and military facilities. For every business/agency category, there was at least a 21 percent response rate with an overall 34 percent response rate to the surveys. A very high response rate was obtained for several business categories: a 100 percent response rate for military bases, a 78 percent response rate for cemeteries, a 72 percent response rate for local government facilities, and a 71 percent response rate for airports.

Once the lawn and garden equipment was tallied for all categories, a comparison was made between TexN Model data and the results from the AACOG survey. There were significantly more commercial trimmers, front mowers, shredders, and rear engine mowers in the AACOG survey than the TexN Model. Leaf blowers, turf equipment, lawn and garden tractors, and chainsaws are also under-predicted in the TexN Model. Conversely, the TexN Model over predicted the number of tillers and commercial lawn mowers. AACOG’s 2012 survey results for total equipment were 280 percent higher than the existing equipment population in the TexN Model.

The methodology used to estimate emissions from the operation of lawn and garden equipment incorporated information on equipment type, equipment population, horsepower, and activity data extracted from returned survey questionnaires. When specific data such as load or emission factors were not provided in the survey returns, existing data in the TexN Model was used. Based on AACOG’s survey results, it was determined that commercial lawn and garden equipment emitted 3.6 tons of VOCs and 1.1 tons of NOX per ozone season weekday. Trimmers were the largest source of VOC emissions, 0.65 tons per weekday, because of the large number and high activity rates of trimmers in the San Antonio-New Braunfels MSA. The second largest source of VOC emissions was chippers/grinders (0.60 tons of VOC per weekday), followed by chainsaws (0.46 tons), leaf blowers (0.45 tons), and rear engine mowers (0.44 tons). The largest source of NOX emissions was chippers and grinders with 0.52 tons per weekday. Other sources of NOX emissions included lawn and garden tractors, 0.19 tons per weekday and rear engine lawn mowers, 0.15 tons per weekday.

A weekday versus weekend adjustment factor was calculated based on the hours of usage listed in the completed surveys for each facility type. Universities/colleges, public schools, federal and state parks, other companies, and Stinson airport reported no equipment usage on the weekends. The only categories with significant usage on the weekends were small airports, military facilities, and golf courses. The survey results show that commercial lawn and garden equipment usage was higher on weekdays compared to existing data in the TexN Model.

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# Introduction

## Background

The Clean Air Act (CAA) is the comprehensive federal law that regulates airborne emissions across the United States.[[3]](#footnote-3) 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, including ozone, which can injure health, harm the environment, and/or cause property damage. Air quality monitors measure concentrations of these pollutants throughout the country.

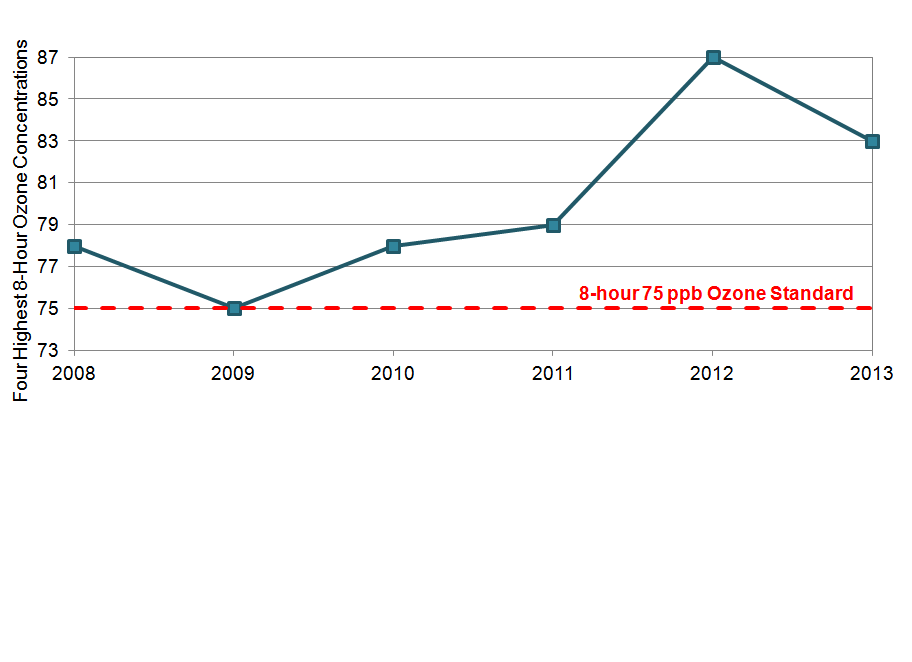
Ozone is produced when volatile organic compounds (VOC) and nitrogen oxides (NOX) react in the presence of sunlight, especially during the summer time.[[4]](#footnote-4) These ozone precursors can be generated by local processes and the majority of chemicals that form ground-level ozone originate from anthropogenic sources. 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.”[[5]](#footnote-5) Currently, the ozone primary standard, which is designed to protect human health, is set at 75 parts per billion (ppb). The secondary standard, which is designed to protect the environment, is in the same form and concentration as the primary standard.

To conduct analysis that determines emission reductions required to bring the area into compliance with the standards, local and state air quality planners need an accurate account of emissions and their sources in the region. Such sources include the small engines that power lawn and garden equipment. The compilation of the San Antonio-New Braunfels MSA commercial lawn and garden equipment emissions inventory (EI) required extensive research and analysis, and provided a vast database of regional pollution sources and emission rates. By understanding these varied sources that create ozone precursor pollutants, planners, political leaders, and citizens can work together to protect heath and the environment.

## Local Ozone and **Meteorological** Conditions

There are currently 11 air quality monitors, CAMS, in the San Antonio region that record ozone air pollution measurements. The data collected at these sites is processed for quality assurance by the Texas Commission on Environmental Quality (TCEQ) and is accessible via the Internet.[[6]](#footnote-6) The CAMS network in the San Antonio region includes both regulatory and non-regulatory monitors. Regulatory monitors meet EPA’s requirements for equipment type, site location criteria, and quality assurance. TCEQ operates three regulatory monitors in the San Antonio area: CAMS23, CAMS58, and CAMS59. The annual fourth highest eight-hour average ozone concentrations, which are the values used in federal compliance calculations, have risen significantly in recent years: from 75 ppb in 2009 to 83 ppb in 2013. Furthermore, the fourth highest eight-hour ozone average in the San Antonio region has exceeded 75 ppb for the last four years (Figure 1‑1).

Figure 1‑1: San Antonio-New Braunfels MSA’s 4th-highest 8-Hour Ozone Value, 2008 - 2013



## Inventory Pollutants

Ozone is a secondary pollutant because it forms as the result of chemical reactions between other pollutants, namely:

* Nitrogen oxides (NOX)
* Volatile organic compounds (VOC)

Emissions were calculated for an average ozone season weekday and weekend by county and by type of facility that uses commercial lawn and garden equipment.

## Geographic Area

The emission inventory includes all identified business/agency sources in the San Antonio-New Braunfels MSA, consisting of eight counties located in South Central Texas and part of the Hill Country. These counties are: Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson counties (figure 1-2).

## Modeling Domain Parameters

Development of input files and/or spatial surrogates for photochemical model emission processing was based on a grid system consistent with EPA’s Regional Planning Organizations (RPO) Lambert Conformal Conic map projection with the following parameters:

• First True Latitude (Alpha): 33°N

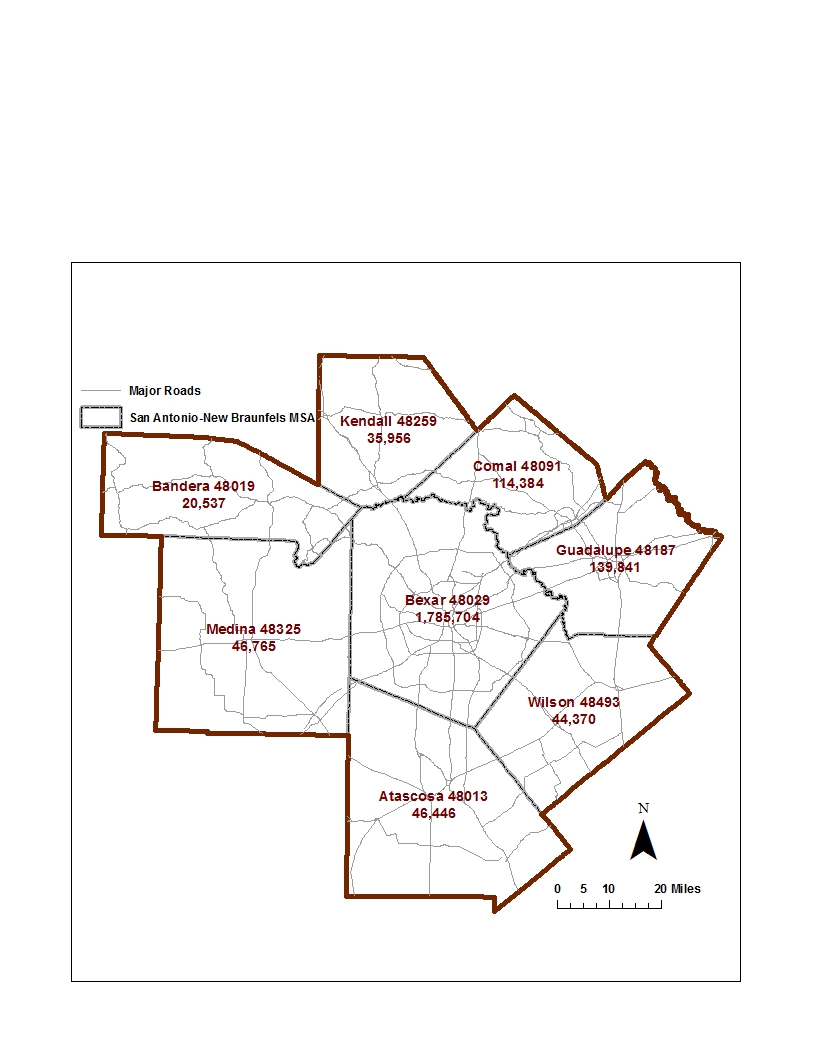
• Second True Latitude (Beta): 45°N

• Central Longitude (Gamma): 97°W

• Projection Origin: (97°W, 40°N)

• Spheroid: Perfect Sphere, Radius: 6,370 km

Figure 1‑2: San Antonio-New Braunfels MSA and 2012 Population Estimates**[[7]](#footnote-7)**

Plot Date: Dec. 16th, 2013

Map Compilation: Dec. 16th, 2013

Source: US Census Bureau

## Data Sources

Specific emission input data was calculated by AACOG based on protocols provided by EPA and TCEQ. Emission calculations are based on the local activity data collected through surveys and application of data developed for the TexN Model[[8]](#footnote-8). Other data sources include US Census County Business Patterns,[[9]](#footnote-9) Federal Aviation Administration,[[10]](#footnote-10) and U.S. Department of Education[[11]](#footnote-11). All current federal and state regulations, including TxLED diesel fuel, were taken into account when calculating emissions.

## Quality Check/Quality Assurance

“An overall QA program comprises two distinct components. The first component is that of quality control (QC), which is a system of routine technical activities implemented by inventory development personnel to measure and control the quality of the inventory as it is being developed. The QC system is designed to:

1. Provide routine and consistent checks and documentation points in the inventory development process to verify data integrity, correctness, and completeness;
2. Identify and reduce errors and omissions;
3. Maximize consistency within the inventory preparation and documentation process; and
4. Facilitate internal and external inventory review processes.

QC activities include technical reviews, accuracy checks, and the use of approved standardized procedures for emission calculations. These activities should be included in inventory development planning, data collection and analysis, emission calculations, and reporting.”[[12]](#footnote-12)

Routine QA procedures, such as verification of equations, data sources, and methodologies were conducted throughout the development of the emission inventory. As recommended by the Eastern Research Group, “More comprehensive procedures targeted:

* Critical points in the process;
* Critical components of the inventory; and
* Areas or activities where problems are anticipated”[[13]](#footnote-13)

Special emphases were put on critical components, such as equipment counts, activity rates, and reported horsepower, for quality checks. Commercial lawn and garden equipment data developed through the emission inventory process were compared to previous data sets from other emission inventories.

When errors were identified they were immediately corrected and documented. All emission inventory calculation methodologies were documented and described in detail so external parties can replicate the results. For every emission inventory category, documentation was consistent and contained details on data sources, methodology, formulas, and results. When the emission inventory was completed, documentation and spreadsheets were sent to TCEQ and other interested parties for review.

# Commercial Lawn and Garden Equipment Survey

Engines installed on commercial lawn and garden equipment contributes to tropospheric ozone formation because they emit NOX and VOCs. Therefore, determining and documenting the scale of lawn and garden equipment activity is essential for regional emission inventory efforts. Having local survey data on commercial lawn and garden equipment usage improves the emission estimates of these sources. Businesses and agencies in the San Antonio-New Braunfels MSA that were surveyed included the following 10 categories of commercial lawn and garden equipment owners:

* Golf Courses
* Universities/Colleges
* Public School Districts
* Commercial Lawn and Garden Companies and Land Clearing Companies (both for residential properties and commercial properties)
* Cemeteries
* Commercial and Private Airports
* Local Government Facilities
* Federal and State Parks
* Other Companies
* Military Facilities

## Survey of Commercial Lawn and Garden Equipment Activity

The preferred method for calculating emissions from the use of commercial lawn and garden equipment is a “bottom-up” survey approach that documents the characteristics of equipment operated by each category of users, e.g. golf courses, within the region. The survey collected the following data:

* 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
* Population of each equipment type
* Engine Characteristics:
* Fuel Type – gasoline 2-stroke, gasoline 4-stroke, diesel, LPG, electricity
* Engine Horsepower – rated power of the engine

A sample of both the survey cover letter and the survey form used in the process of developing the commercial lawn and garden equipment inventory are shown on the following pages.



Date

[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. This inventory is especially significant because the San Antonio region is close to violating federal air quality standards, the National Ambient Air Quality Standards.

AACOG will calculate equipment emissions from information submitted by local organizations involved in landscaping and lawn and garden activities in the San Antonio region using the enclosed survey. With this survey, we are requesting information on lawn and garden equipment used in Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson counties. The purpose of this survey is to provide better information and services to the region. 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. Please submit your response by October 20th, 2012.

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

Sincerely,

PBellaSignature.tif

Peter Bella,

Natural Resource Director

AACOG

**Survey for Equipment used in Commercial Lawn & Garden Service**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Equipment Type** | **Number of Equipment** | **Models**  **(if known)** | **Approximate Horse-power for Each Unit** | **Fuel Type**  **(Gasoline 2-stroke,**  **Gasoline 4 stroke,**  **LPG, Diesel, Electric)** | **Mon-Fri Average Daily Hours of Use for Each Unit** | **Sat –Sun Average Daily Hours of Use for Each Unit** |
| **Riding Rear Engine Mowers** |  |  |  |  |  |  |
| **Riding Front Engine Mowers** |  |  |  |  |  |  |
| **Push Lawn Mowers** |  |  |  |  |  |  |
| **Tow Behind Cutters & Turf Mowers** |  |  |  |  |  |  |
| **Tractors** |  |  |  |  |  |  |
| **Trimmer**  **Edger**  **Dethatcher** |  |  |  |  |  |  |
| **Tillers & Aerators** |  |  |  |  |  |  |
| **Blowers, Vacuums & Sweepers** |  |  |  |  |  |  |
| **Shredder** |  |  |  |  |  |  |
| **Chainsaw** |  |  |  |  |  |  |
| **Chipper & Splitter** |  |  |  |  |  |  |
| **Other Lawn & Garden Equipment (specify type)** |  |  |  |  |  |  |

## Second Survey of Commercial Lawn and Garden Equipment

After analyzing survey results, aerial photographs, district appraisal data, and other data sources, a second survey was sent to the local businesses that did not respond to the first survey. This second set of surveys differed from the first because it included estimations of the businesses’ equipment populations, horsepower, and activity rates. Otherwise, the second survey used the same format as the initial survey. Companies and facilities were asked to correct estimations and send the surveys back to AACOG.

In order to make a general conclusion about the targeted population, the number of returned surveys required for an accurate representation is an important concern. 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 +/- 6%. Since the population is finite, the following equation was used to select the sample size.[[14]](#footnote-14)

Equation 2‑1, Suitable sampling size for commercial lawn and garden equipment

RN = [CLV² x 0.25 x POP] / [CLV² x 0.25 + (POP – 1) CIN²]

Where,

RN = Number of survey responses needed to accurately represent the population

CLV = 95% confidence level (1.96)

POP = Population size (634 facilities)

CIN = ± 6% confidence interval (0.06)

The number of surveys needed for a 10% confidence interval:

RN = [(1.96) 2 x (0.25) x 634] / [(1.96) 2 x (0.25) + (634 – 1) x (0.06) 2]

= 186.4 facilities that use commercial lawn and garden equipment

Thus, local data was needed for 187 facilities that used lawn and garden equipment in order to meet the 95% level of confidence, and the ±6% confidence interval for equipment population. Survey response rates by sub-category of commercial lawn and garden equipment users are presented in Table 2‑1. Since 221 facilities responded to the survey, the sample size meets the required confidence level and confidence interval.

For each user category, there was at least a 21 percent response rate with an overall 35 percent response rate. A very high response rate was obtained for several business categories: a 100 percent response rate for military bases, a 78 percent response rate for cemeteries, a 76 percent repose rate for local government facilities, and a 71 percent response rate for airports. The lowest response rate was for commercial lawn and garden companies at 21 percent.

Table 2‑1: Commercial Lawn and Garden Survey Response Rates

|  |  |  |  |
| --- | --- | --- | --- |
| Facility Type | Survey Response | Total Number Surveyed | Percent of Total |
| Golf Courses | 16 | 46 | 35% |
| Universities/Colleges | 9 | 16 | 56% |
| Public Schools Districts | 22 School Districts (representing 426 Schools) | 45 School Districts (representing 624 Schools) | 47% |
| Commercial Lawn and Garden Companies | 77 | 374 | 21% |
| Local Government Facilities | 44 | 58 | 76% |
| Parks (State and Federal) | 4 | 7 | 57% |
| Cemeteries | 14 | 18 | 78% |
| Commercial and Private Airports (including SAIA) | 12 | 17 | 71% |
| Other Businesses and Employers | 16 | 44 | 36% |
| Military Facilities | 5 | 5 | 100% |
| Total | 221 | 634 | 35% |

## Determine Equipment Specification for Facilities that Lack Local Data

Missing equipment population and activity rates for facilities that did not respond to the surveys were determined by calculating equipment ratios from the survey responses of similar facilities. Either the total acreage or population size of the survey respondents was used to determine equipment ratios for those that did not respond to the survey. Data sources for the surrogate factors included aerial imagery, U.S. Department of Education[[15]](#footnote-15), and U.S. Census County Business Patterns[[16]](#footnote-16). Surrogate factors are listed in table 2-2 and the formulas used to calculate the surrogates are detailed in Equation 2‑2 and Equation 2‑3.

Table 2‑2: Lawn and Garden Equipment Surrogate Factors by Sub-category

|  |  |  |  |
| --- | --- | --- | --- |
| Facility Type | Allocation Method | Data Source | Year |
| Golf Courses | Acres per Golf Course | Aerial Imagery, Golf course Book of Lists | 2013 |
| Universities/Colleges | Acres per University | Aerial Imagery | 2013 |
| Public Schools | Number of Schools | U.S. Department of Education | 2013 |
| Commercial Lawn and Garden Companies | Number of Companies | US Census County Business Patterns | 2010 |
| Government Facilities\* | None | - | - |
| Parks\* | None | - | - |
| Cemeteries | Acres of Cemeteries | Aerial Imagery | 2013 |
| Small Airports | Number of Airports | Aerial Imagery | 2013 |
| Other Businesses and Employers\* | None | - | - |
| Military Facilities | None (100% response Rate) | - | - |

\*If a government facility, park and other business did not respond to the survey, no emissions were calculated

Equation 2-2 describes how collected survey data was used to determine the ratio of equipment per acre or facility.

Equation 2‑2, Survey-based equipment ratios

RATIOAB = EQAB / TOTALB

Where,

RATIOAB = Ratio of equipment type A used per acre or per facility at facility type B

EQAB = Total pieces of equipment type A used by facilities that responded to the survey for facility type B

TOTALB = Total acres or number of facilities used by facilities that responded to the survey for facility type B

Sample Equation: Equipment ratio for 4-stroke riding fairway deck & rough mowers (SCC Code 2265004041) used at Golf Courses in hp bin 25-40.

RATIOAB = 11 gasoline 4-stroke engine riding fairway deck & rough mowers at Golf Courses that responded to the survey / 2,503 Acres total area for respondents

= 0.00439 gasoline 4-stroke engine riding fairway deck & rough mower per acre at golf courses in hp bin 25-40

This ratio was used in Equation 2‑3 to determine the equipment population at facilities that did not respond to the survey.

Equation 2‑3, Estimated equipment population for facilities that did not respond to the survey

GPOPAB = ACRESB x RATIOAB

Where,

GPOPAB = Population of equipment type A for facility type B

ACRESB = Number of acres or facilities for facility B

RATIOAB = Ratio of equipment type A per acre for facility type B (from equation 2-2)

Sample Equation: 4-stroke gasoline riding fairway deck & rough mower (SCC Code 2265004041) used at Golf Courses B in hp bin 25-40

GPOPAB = 250 Acres for Golf Course B x 0.00439 4-stroke gasoline riding fairway deck & rough mower per acre at golf courses in hp bin 25-40 hp

= 1.2 4-stroke gasoline riding fairway deck & rough mower in hp bin 25-40 hp at golf courses B

## Golf Courses

Survey questionnaires were mailed to a list of golf courses’ addresses compiled from the Internet and other publically available sources. In all, 46 golf courses in the San Antonio-New Braunfels MSA were identified and contacted, of which 5 responded to the first survey and 9 responded to the second survey, although 2 of the 9 responded as closed businesses. The survey responses covered 39 percent of the golf courses in the San Antonio-New Braunfels MSA and 30 percent of the total acres (Table 2‑3). The second survey included a general estimation of equipment data for each local golf course based on their individual acreages and the data received in the first survey. The contacted golf courses were asked to make corrections if they found the data attributed to them incorrect and send back the survey questionnaires.

Table 2‑3: Golf Courses Survey Response Ratios, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of Golf Courses | | Acres | |
| Total | Percent of Total Golf Courses | Total | Percent of Total Acres |
| Responded to First 2012 Survey | 5 | 11% | 1,167 | 14% |
| Responded to Second 2012 Survey | 7 | 15% | 666 | 8% |
| Responded to 2005 Survey | 4 | 9% | 670 | 8% |
| Closed | 2 | 4% | - | 0% |
| Total for all Golf Courses | 46 | 100% | 8,384 | 100% |

Aerial photography and appraisal district data were used to determine the improved acres for each golf course that did not respond to the survey. Bexar County had the most acreage, 4,698 acres or 56 percent of the total, followed by Kendall County, 1,080 acres or 13 percent (Table 2‑4). The equipment to acre ratio was then calculated for golf courses by dividing the total pieces of equipment counted for each category in the first survey by the total number of acres for these golf courses. This ratio was used to calculate estimated equipment populations for the other golf courses.

Table 2‑4: Allocation of Golf Courses by County, 2012[[17]](#footnote-17)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| FIPS | County | Total Number of Golf Courses\* | Percentage | Total Acres of Golf Courses\* | Percentage |
| 48013 | Atascosa | 1 | 2% | 142 | 2% |
| 48019 | Bandera | 1 | 2% | 395 | 5% |
| 48029 | Bexar | 28 | 61% | 4,698 | 56% |
| 48091 | Comal | 5 | 11% | 767 | 9% |
| 48187 | Guadalupe | 4 | 9% | 669 | 8% |
| 48259 | Kendall | 3 | 7% | 1,080 | 13% |
| 48325 | Medina | 3 | 7% | 297 | 4% |
| 48493 | Wilson | 1 | 2% | 336 | 4% |
| Total (San Antonio – New Braunfels MSA) | | 46 | 100% | 8,384 | 100% |

\*Military Golf Courses are not included (lawn and garden equipment from these golf courses are included in the military facilities emission inventory)

The information provided in the survey returns, indicates a wide variety of commercial lawn and garden equipment is used at golf courses. Table 2‑5 shows golf course commercial lawn and garden equipment ratios per 100 acres. The most common types of equipment used at golf courses were diesel riding fairway deck and rough mowers (0.6 per 100 acres), 4-stroke golf carts used for lawn maintenance (0.5 per 100 acres), 2-stroke chainsaws (0.3 per 100 acres), and 4-stroke riding greens and tee mowers (0.3 per 100 acres).

A narrow confidence interval was determined for survey responses regarding horsepower ratings and hours of activity for the common commercial lawn and garden equipment used at golf courses. Diesel riding fairway deck and rough mowers had an average horsepower of 34.8 and were used 971 hours per year, while 2-stroke chainsaws had an average horsepower of 3.8 and were used 65 hours a year. The horsepower and activity rates for 4-stroke riding greens and tee mowers was 18.1 horsepower and 1,052 hours of operation per year (Table 2‑6). Commercial lawn and garden equipment used at military bases’ golf courses are included in the Military Facilities category.

Table 2‑5: Golf Courses Lawn and Garden Equipment Ratio per 100 Acres

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n (survey) | Standard Deviation\* | Low\* | Mean | High\* | Confidence Level\* |
| Blowers, Vacuums & Sweepers | 2260004031 | 19 | 1.9 | -0.6 | 0.2 | 1.1 | 0.9 |
| Blowers, Vacuums & Sweepers | 2265004031 | 6 | 1.2 | -0.9 | 0.1 | 1.0 | 0.9 |
| Chainsaw | 2260004021 | 22 | 1.2 | -0.2 | 0.3 | 0.7 | 0.5 |
| Chainsaw | 2265004021 | 2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Gator/Cart | 2270001060 | 3 | 0.5 | -0.5 | 0.0 | 0.6 | 0.5 |
| Gator/Cart | 2265001060 | 40 | 3.9 | -0.7 | 0.5 | 1.7 | 1.2 |
| Greens Rollers | 2265004056 | 11 | 0.8 | -0.3 | 0.1 | 0.6 | 0.5 |
| Push Lawn Mowers | 2260004011 | 7 | 2.0 | -1.4 | 0.1 | 1.6 | 1.5 |
| Push Lawn Mowers | 2265004011 | 16 | 2.2 | -0.9 | 0.2 | 1.3 | 1.1 |
| Riding Fairway Deck & Rough Mower | 2270004041 | 54 | 1.6 | 0.2 | 0.6 | 1.1 | 0.4 |
| Riding Fairway Deck & Rough Mower | 2265004041 | 18 | 1.2 | -0.3 | 0.2 | 0.8 | 0.6 |
| Riding Greens & Tee Mowers | 2270004041 | 12 | 0.4 | -0.1 | 0.1 | 0.4 | 0.2 |
| Riding Greens & Tee Mowers | 2265004041 | 25 | 2.0 | -0.5 | 0.3 | 1.1 | 0.8 |
| Sprayers | 2270004071 | 4 | 0.4 | -0.4 | 0.0 | 0.5 | 0.4 |
| Sprayers | 2265004071 | 7 | 0.2 | 0.0 | 0.1 | 0.2 | 0.1 |
| Tillers & Aerators | 2265004016 | 11 | 1.0 | -0.5 | 0.1 | 0.7 | 0.6 |
| Tractors | 2270004056 | 29 | 1.5 | -0.2 | 0.3 | 0.9 | 0.6 |
| Trimmer | 2260004026 | 18 | 2.1 | -0.7 | 0.2 | 1.2 | 1.0 |
| Turf top dresser & Spreaders | 2265004071 | 18 | 1.9 | -0.7 | 0.2 | 1.1 | 0.9 |
| Turf top dresser & Spreaders | 2270004071 | 1 | - | - | 0.0 | - | - |
| Tow Behind Cutters & Mowers | 2265004071 | 4 | - | - | 0.0 | - | - |
| Chippers/ Stump/ Grinders/ Mulchers | 2270004066 | 1 | - | - | 0.0 | - | - |
| TOTAL |  | 328 |  |  |  |  |  |

n\*: Denotes number of observations, or population.

#Statistics only calculated for equipment with more than 4 survey responses

Table 2‑6: Confidence Interval at 95% for Golf Courses Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n\* (survey) | Mean | Confidence Interval\* | Percent of Mean\* | N\* (Survey) | Mean | Confidence Interval\* | Percent of Mean\* |
| Blowers, Vacuums & Sweepers | 2260004031 | 19 | 2.2 | 0.2 | 8% | 19 | 433 | 218 | 50% |
| Blowers, Vacuums & Sweepers | 2265004031 | 6 | 17.8 | 7.2 | 40% | 6 | 517 | 302 | 58% |
| Chainsaw | 2260004021 | 22 | 3.8 | 2.7 | 71% | 22 | 65 | 28 | 42% |
| Chainsaw | 2265004021 | 2 | 2.0 | 12.4 | 622% | 2 | 78 | 523 | 667% |
| Gator/Cart | 2270001060 | 3 | 21.7 | 0.7 | 3% | 3 | 539 | 222 | 41% |
| Gator/Cart | 2265001060 | 40 | 13.2 | 0.8 | 6% | 40 | 1,108 | 138 | 12% |
| Greens Rollers | 2265004056 | 11 | 16.1 | 4.1 | 26% | 11 | 595 | 261 | 44% |
| Push Lawn Mowers | 2260004011 | 7 | 5.5 | 1.2 | 22% | 7 | 378 | 182 | 48% |
| Push Lawn Mowers | 2265004011 | 16 | 4.9 | 0.5 | 9% | 16 | 793 | 198 | 25% |
| Riding Fairway Deck & Rough Mower | 2270004041 | 54 | 34.8 | 2.9 | 8% | 54 | 971 | 100 | 10% |
| Riding Fairway Deck & Rough Mower | 2265004041 | 18 | 25.0 | 4.5 | 18% | 18 | 1,627 | 388 | 24% |
| Riding Greens & Tee Mowers | 2270004041 | 12 | 17.8 | 1.6 | 9% | 12 | 1,045 | 281 | 27% |
| Riding Greens & Tee Mowers | 2265004041 | 25 | 18.1 | 0.6 | 4% | 25 | 1,052 | 284 | 27% |
| Sprayers | 2270004071 | 4 | 30.4 | 6.4 | 21% | 4 | 613 | 556 | 91% |
| Sprayers | 2265004071 | 7 | 21.4 | 2.2 | 10% | 7 | 209 | 59 | 28% |
| Tillers & Aerators | 2265004016 | 11 | 14.8 | 3.9 | 26% | 11 | 63 | 43 | 69% |
| Tractors | 2270004056 | 29 | 39.2 | 3.3 | 8% | 29 | 684 | 218 | 32% |
| Trimmer | 2260004026 | 18 | 1.9 | 0.3 | 18% | 18 | 415 | 86 | 21% |
| Turf top dresser & Spreaders | 2265004071 | 18 | 18.3 | 2.0 | 11% | 18 | 2,538 | 754 | 30% |
| Turf top dresser & Spreaders | 2270004071 | 1 | 34.0 | - | - | 1 | 261 | - | - |
| Tow Behind Cutters & Mowers | 2265004071 | 4 | 6.0 | - | - | 4 | 1,095 | - | - |
| Chippers/ Stump/ Grinders/ Mulchers | 2270004066 | 1 | 141.0 | - | - | 1 | 131 | - | - |
| TOTAL |  | 328 |  |  |  | 328 |  |  |  |

n\*: Denotes number of observation, or population.

#Statistics only calculated for equipment with more than 4 survey responses

## Universities/Colleges

A list of universities and colleges was compiled from the Internet and other publically available sources and survey questionnaires were mailed to those within the San Antonio region. In all, 16 addresses were identified and contacted, of which 3 responded to the first survey and 2 responded to the second survey. The data provided by 4 facilities that responded to a 2005 survey was also included in the calculations. The facilities that responded to the surveys represented 51 percent of the total acreage of university and college campuses in the San Antonio-New Braunfels MSA (Table 2‑7).

Table 2‑7: Universities and Colleges Survey Response Ratios, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of Universities/Colleges | | Universities/Colleges Acres | |
| Total | Percent of Total Universities/ Colleges | Total | Percent of Total Acres |
| Responded to First 2012 Survey | 3 | 19% | 268 | 11% |
| Responded to Second 2012 Survey | 2 | 13% | 91 | 4% |
| Responded to 2005 Survey | 4 | 25% | 906 | 36% |
| Universities/Colleges Operating in 2012 | 16 | 100% | 2,541 | 100% |

The numbers of lawn and garden equipment owned by universities and colleges have a direct correlation with the size of their campuses. Therefore estimations for those institutions that did not respond to the survey were made based on the ratio of equipment populations to the total acres covered by the college campuses that responded to the survey. Most of the large universities and colleges, 91 percent of total acres, are in Bexar County (Table 2‑8) with small campuses in Guadalupe and Atascosa counties.

Table 2‑8: Number of Acres for University and Colleges by County, 2012

|  |  |  |  |
| --- | --- | --- | --- |
| FIPS | County | Total Acres | Percentage |
| 48013 | Atascosa | 9 | 0.4% |
| 48019 | Bandera | 0 | 0.0% |
| 48029 | Bexar | 2014 | 91.3% |
| 48091 | Comal | 0 | 0.0% |
| 48187 | Guadalupe | 184 | 8.3% |
| 48259 | Kendall | 0 | 0.0% |
| 48325 | Medina | 0 | 0.0% |
| 48493 | Wilson | 0 | 0.0% |
| Total (San Antonio – New Braunfels MSA) | | 2,207 | 100.0% |

As shown in Table 2‑9, the most common types of commercial lawn and garden equipment used at universities and colleges were 2-stroke trimmers/edgers/brush cutters (4.3 per 100 acres), 2-stroke leaf blowers (2.8 per 100 acres), and 4-stroke rear engine riding mowers (2.5 per 100 acres). The confidence interval for horsepower and annual hours was low for the most common lawn and garden equipment used at universities and colleges. Horsepower confidence intervals ranged from 5 to 8 percent, while the confidence interval for annual hours was between 16 and 24 percent for the common types of equipment (Table 2‑10).

Table 2‑9: Universities and Colleges Lawn and Garden Equipment Ratio per 100 Acres

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n | Mean | Standard Deviation | Confidence Level |
| Commercial Lawn Mowers | 2260004011 | 6 | 0.5 | 1.3 | 1.0 |
| Rotary Tillers | 2260004016 | 1 | 0.1 | # | # |
| Chain Saws | 2260004021 | 27 | 2.1 | 4.1 | 1.6 |
| Trimmers/Edgers/Brush Cutters | 2260004026 | 54 | 4.3 | 17.4 | 4.7 |
| Blowers, Vacuums & Sweepers | 2260004031 | 35 | 2.8 | 3.4 | 1.1 |
| Other L&G Equipment | 2260004076 | 2 | 0.2 | # | # |
| Commercial Lawn Mowers | 2265004011 | 15 | 1.2 | 4.5 | 2.3 |
| Rotary Tillers | 2265004016 | 5 | 0.4 | 1.0 | 0.8 |
| Trimmers/Edgers/Brush Cutters | 2265004026 | 1 | 0.1 | # | # |
| Rear Engine Riding Mowers | 2265004041 | 31 | 2.5 | 8.1 | 2.8 |
| Front Engine Riding Mowers | 2265004046 | 6 | 0.5 | 2.7 | 2.1 |
| Shredders | 2265004051 | 2 | 0.2 | # | # |
| Lawn and Garden Tractors | 2265004056 | 1 | 0.1 | # | # |
| Commercial Turf Equipment | 2265004071 | 4 | 0.3 | 1.6 | 1.6 |
| Other L&G Equipment | 2265004076 | 10 | 0.8 | 2.9 | 1.8 |
| Blowers, Vacuums & Sweepers | 2270004031 | 2 | 0.2 | # | # |
| Riding Rear Engine Mowers | 2270004041 | 7 | 0.6 | 0.5 | 0.4 |
| Shredders | 2270004051 | 1 | 0.1 | # | # |
| Lawn and Garden Tractors | 2270004056 | 8 | 0.6 | 4.6 | 3.2 |
| Other L&G Equipment | 2270004076 | 1 | 0.1 | # | # |

#Statistics only calculated for equipment with more than 4 survey responses

Table 2‑10: Confidence Interval at 95% for University and Colleges Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Push Lawn Mowers | 2260004011 | 6 | 6.2 | 0.9 | 14% | 6 | 322 | 237 | 74% |
| Tiller & Aerators | 2260004016 | 1 | 3.0 | - | - | 1 | 131 | - | - |
| Chainsaw | 2260004021 | 27 | 1.8 | 0.1 | 5% | 27 | 437 | 168 | 38% |
| Trimmer | 2260004026 | 53 | 1.6 | 0.1 | 6% | 53 | 823 | 128 | 16% |
| Blowers, Vacuums & Sweepers | 2260004031 | 35 | 2.7 | 0.1 | 5% | 35 | 391 | 93 | 24% |
| Push Lawn Mowers | 2265004011 | 15 | 5.4 | 0.8 | 14% | 15 | 513 | 178 | 35% |
| Tiller & Aerators | 2265004016 | 5 | 8.1 | 5.0 | 62% | 5 | 209 | 63 | 30% |
| Edger | 2265004026 | 1 | 3.5 | - | - | 1 | 522 | - | - |
| Riding Rear Engine Mowers | 2265004041 | 31 | 20.4 | 1.7 | 8% | 31 | 660 | 112 | 17% |
| Riding front Engine Mower | 2265004046 | 6 | 18.3 | 5.4 | 29% | 6 | 613 | 267 | 44% |
| Shredder | 2265004051 | 2 | 13.0 | - | - | 2 | 117 | - | - |
| Tractors | 2265004056 | 1 | 16.0 | - | - | 1 | 1305 | - | - |
| Tow Behind Cutters & Turf Mowers | 2265004071 | 4 | 15.6 | 5.6 | 36% | 4 | 331 | 338 | 102% |
| Blowers, Vacuums & Sweepers | 2270004031 | 2 | 3.0 | - | - | 2 | 313 | - | - |
| Riding Rear Engine Mowers | 2270004041 | 7 | 31.4 | 1.8 | 6% | 7 | 1342 | 283 | 21% |
| Shredder | 2270004051 | 1 | 200.0 | - | - | 1 | 131 | - | - |
| Tractors | 2270004056 | 8 | 3.9 | 0.3 | 7% | 8 | 1631 | 260 | 16% |
| Other Lawn and Garden Equipment | 2260004076 | 2 | 18.5 | - | - | 2 | 522 | - | - |
| Other Lawn and Garden Equipment | 2265004076 | 10 | 13.9 | 0.1 | 0% | 10 | 522 | 0 | 0% |
| Other Lawn and Garden Equipment | 2270004076 | 1 | 62.0 | - | - | 1 | 261 | - | - |

#Statistics only calculated for equipment with more than 4 survey responses

## Public School Districts

Of the 45 school districts in the San Antonio-New Braunfels MSA, 49 percent responded to the survey (Table 2‑11). These responding districts account for 71 percent of the public schools in the region. Emissions were calculated for school districts instead of individual schools because school districts often have one central maintenance department for the whole district. As provided in Table 2‑12, the majority of the schools in the MSA are located in Bexar County (75 percent), but Guadalupe County (6 percent), and Comal County (5 percent) also have a number of public schools.

Table 2‑11: Public Schools Survey Response Ratios, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of School Districts | | Number of Public Schools | |
| Total | Percent of Total School Districts | Total | Percent of Public Schools |
| Responded to First 2012 Survey | 9 | 20% | 260 | 42% |
| Responded to Second 2012 Survey | 7 | 16% | 43 | 7% |
| Responded to 2005 Survey | 6 | 13% | 141 | 23% |
| Total | 45 | 100% | 624 | 100% |

Table 2‑12: Allocation of Public Schools by County, 2012[[18]](#footnote-18)

|  |  |  |  |
| --- | --- | --- | --- |
| FIPS | County | Total Number of Schools\* | Percentage |
| 48013 | Atascosa | 25 | 4% |
| 48019 | Bandera | 6 | 1% |
| 48029 | Bexar | 493 | 75% |
| 48091 | Comal | 35 | 5% |
| 48187 | Guadalupe | 37 | 6% |
| 48259 | Kendall | 14 | 2% |
| 48325 | Medina | 20 | 3% |
| 48493 | Wilson | 28 | 4% |
| Total (San Antonio – New Braunfels MSA) | | 658 | 100 |

\*Military Base Schools are not included (lawn and garden equipment from these schools are included in the Airport/Military emission inventory)

The type of commercial lawn and garden equipment most commonly used at public schools was 2-stroke trimmers with 0.9 per school (Table 2‑13). Other common equipment types were 2-stroke leaf blowers (0.6 per school), 4-stroke riding rear engine mowers (0.4 per school), and 2-stroke push lawn mowers (0.3 per school). The 2-stroke trimmers had an average horsepower of 1.1 and annual usage of 341 hours, while 2-stroke leaf blowers had an average horsepower of 2.9 and annual usage of 34 hours (Table 2‑14).

Table 2‑13: Public Schools Lawn and Garden Equipment Ratio per Public School

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n (survey) | Mean | Standard Deviation# | Confidence Level# |
| Blowers, Vacuums & Sweepers | 2260004031 | 267 | 0.6 | 0.9 | 0.1 |
| Blowers, Vacuums & Sweepers | 2265004031 | 1 | 0.0 | - | - |
| Chainsaw | 2260004021 | 85 | 0.2 | 0.9 | 0.2 |
| Hedge Trimmer | 2265004026 | 3 | 0.0 | - | - |
| Other | 2270004076 | 4 | 0.0 | - | - |
| Other | 2265004076 | 191 | 0.4 | 0.4 | 0.1 |
| Push Lawn Mowers | 2260004011 | 149 | 0.3 | 0.4 | 0.1 |
| Push Lawn Mowers | 2265004011 | 29 | 0.1 | 0.5 | 0.2 |
| Riding front Engine Mower | 2270004046 | 14 | 0.0 | 0.5 | 0.3 |
| Riding front Engine Mower | 2265004046 | 65 | 0.1 | 0.3 | 0.1 |
| Riding Rear Engine Mowers | 2270004041 | 21 | 0.0 | 0.5 | 0.2 |
| Riding Rear Engine Mowers | 2265004041 | 160 | 0.4 | 0.6 | 0.1 |
| Shredders | 2270004066 | 6 | 0.0 | 0.0 | 0.0 |
| Shredders | 2265004066 | 3 | 0.0 | - | - |
| Tiller & Aerators | 2260004016 | 9 | 0.0 | 0.2 | 0.1 |
| Tiller & Aerators | 2265004016 | 11 | 0.0 | 0.5 | 0.3 |
| Tractors | 2270004056 | 34 | 0.1 | 0.2 | 0.1 |
| Tractors | 2265004056 | 8 | 0.0 | 0.4 | 0.3 |
| Trimmer | 2260004026 | 397 | 0.9 | 1.0 | 0.1 |

Table 2‑14: Confidence Interval at 95% for Public Schools Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval# | Percent of Mean# | n | Mean | Confidence Interval# | Percent of Mean# |
| Blowers, Vacuums & Sweepers | 2260004031 | 267 | 2.9 | 0.1 | 2% | 267 | 221 | 34 | 15% |
| Blowers, Vacuums & Sweepers | 2265004031 | 1 | 5.0 | - | - | 1 | 783 | - | - |
| Chainsaw | 2260004021 | 85 | 1.7 | 0.2 | 12% | 85 | 134 | 24 | 18% |
| Hedge Trimmer | 2265004026 | 3 | 6.5 | - | - | 3 | 522 | - | - |
| Other | 2270004076 | 4 | 45.5 | - | - | 4 | 653 | - | - |
| Other | 2265004076 | 191 | 15.1 | 0.4 | 3% | 191 | 313 | 18 | 6% |
| Push Lawn Mowers | 2260004011 | 149 | 5.9 | 0.1 | 2% | 149 | 140 | 55 | 39% |
| Push Lawn Mowers | 2265004011 | 29 | 5.9 | 0.3 | 6% | 29 | 436 | 124 | 28% |
| Riding front Engine Mower | 2270004046 | 14 | 22.0 | 1.8 | 8% | 14 | 483 | 286 | 59% |
| Riding front Engine Mower | 2265004046 | 65 | 19.1 | 0.2 | 1% | 65 | 67 | 34 | 51% |
| Riding Rear Engine Mowers | 2270004041 | 21 | 32.9 | 3.0 | 9% | 21 | 1,129 | 159 | 14% |
| Riding Rear Engine Mowers | 2265004041 | 160 | 23.5 | 0.4 | 2% | 160 | 517 | 96 | 18% |
| Shredders | 2270004066 | 6 | 59.7 | 19.2 | 32% | 6 | 848 | 590 | 70% |
| Shredders | 2265004066 | 3 | 42.0 | - | - | 3 | 1,175 | - | - |
| Tiller & Aerators | 2260004016 | 9 | 3.3 | 0.7 | 22% | 9 | 115 | 87 | 76% |
| Tiller & Aerators | 2265004016 | 11 | 6.9 | 2.9 | 42% | 11 | 56 | 57 | 100% |
| Tractors | 2270004056 | 34 | 48.6 | 6.1 | 12% | 34 | 540 | 176 | 33% |
| Tractors | 2265004056 | 8 | 31.0 | 15.4 | 50% | 8 | 1,201 | 345 | 29% |
| Trimmer | 2260004026 | 397 | 1.1 | 0.0 | 2% | 397 | 341 | 44 | 13% |

#Statistics only calculated for equipment with more than 4 survey responses

## Commercial Lawn and Garden and Maintenance Companies

A list of registered lawn and garden companies was compiled and survey questionnaires were mailed to their addresses. In all, 374 addresses for companies were identified and contacted, of which 41 responded to the survey after two mailing efforts. These results, along with the 2005 survey results from 36 other companies are summarized in Table 2‑15. The majority, 79 percent of the companies identified in this category are located in Bexar County, while 10 percent of the companies are in Comal County, and 6 percent of the companies are in Guadalupe County (Table 2‑16).

Table 2‑15: Lawn and Garden Maintenance Companies and Response Ratios, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of Companies | | Companies Employees | |
| Total | Percent of Total Companies | Total | Percent of Total Employees |
| Responded to First 2012 Survey | 21 | 6% | 76 | 3% |
| Responded to Second 2012 Survey | 20 | 5% | 171 | 7% |
| Responded to 2005 Survey | 36 | 10% | 225 | 9% |
| Commercial Companies Operating in 2012 | 374 | 100% | 2513 | 100% |

Table 2‑16: Commercial Lawn and Garden Companies in the San Antonio-New Braunfels MSA, 2010[[19]](#footnote-19)

|  |  |  |  |
| --- | --- | --- | --- |
| FIPS | County | Number of Commercial Companies | Percentage of Companies |
| 48013 | Atascosa | 0 | 0% |
| 48019 | Bandera | 0 | 0% |
| 48029 | Bexar | 296 | 79% |
| 48091 | Comal | 39 | 10% |
| 48187 | Guadalupe | 22 | 6% |
| 48259 | Kendall | 12 | 3% |
| 48325 | Medina | 0 | 0% |
| 48493 | Wilson | 5 | 1% |
| Total (San Antonio – New Braunfels MSA) | | 374 | 100% |

From the survey results, 2-stroke trimmers were the most common type of equipment used at commercial companies with an average of 3.1 per company (Table 2‑17). Other popular equipment types were 2-stroke leaf blowers (2.4 per company), 2-stroke chainsaws (2.2 per company) and 4-stroke lawn mowers (1.4 per company). Average horsepower and annual hours per equipment type are provided in Table 2‑18.

Table 2‑17: Lawn and Garden Maintenance Companies Lawn and Garden Equipment Ratio per Company

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n (survey) | Mean | Standard Deviation# | Confidence Level# |
| Chainsaws | 2260004021 | 170 | 2.2 | 3.0 | 0.4 |
| Trimmers/Edgers/Brush Cutters | 2260004026 | 236 | 3.1 | 3.0 | 0.4 |
| Blowers, Vacuums & Sweepers | 2260004031 | 185 | 2.4 | 2.8 | 0.4 |
| Other L&G Equipment | 2260004076 | 3 | 0.0 | # | # |
| Commercial Lawn Mowers | 2265004011 | 104 | 1.4 | 1.3 | 0.3 |
| Rotary Tillers | 2265004016 | 8 | 0.1 | 0.3 | 0.2 |
| Chain Saws | 2265004021 | 7 | 0.1 | 0.6 | 0.4 |
| Trimmers/Edgers/Brush Cutters | 2265004026 | 6 | 0.1 | 0.5 | 0.4 |
| Blowers, Vacuums & Sweepers | 2265004031 | 8 | 0.1 | 0.6 | 0.4 |
| Rear Engine Riding Mowers | 2265004041 | 64 | 0.8 | 1.8 | 0.4 |
| Front Engine Riding Mowers | 2265004046 | 51 | 0.7 | 1.8 | 0.5 |
| Shredders | 2265004051 | 13 | 0.2 | 1.2 | 0.6 |
| Lawn and Garden Tractors | 2265004056 | 3 | 0.0 | # | # |
| Chippers/Stump Grinders | 2265004066 | 37 | 0.5 | 2.0 | 0.6 |
| Commercial Turf Equipment | 2265004071 | 7 | 0.1 | 0.5 | 0.4 |
| Other L&G Equipment | 2265004076 | 8 | 0.1 | 0.5 | 0.3 |
| Rear Engine Riding Mowers | 2270004041 | 6 | 0.1 | 0.3 | 0.3 |
| Front Engine Riding Mowers | 2270004046 | 1 | 0.0 | # | # |
| Lawn and Garden Tractors | 2270004056 | 15 | 0.2 | 0.7 | 0.3 |
| Chippers/Stump Grinders | 2270004066 | 3 | 0.0 | # | # |
| Shredders | 2270004051 | 3 | 0.0 | # | # |

#Statistics only calculated for equipment with more than 4 survey responses

Table 2‑18: Confidence Interval at 95% for Lawn and Garden Maintenance Companies

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval# | Percent of Mean# | n | Mean | Confidence Interval# | Percent of Mean# |
| Commercial Lawn Mowers | 2260004011 | 17 | 5.0 | 0.8 | 17% | 17 | 1,711 | 500 | 29% |
| Rotary Tillers | 2260004016 | 6 | 2.2 | 1.6 | 72% | 6 | 444 | 153 | 35% |
| Chain Saws | 2260004021 | 170 | 2.0 | 0.1 | 3% | 170 | 1,103 | 117 | 11% |
| Trimmers/Edgers/Brush Cutters | 2260004026 | 236 | 1.4 | 0.1 | 6% | 236 | 1,359 | 107 | 8% |
| Blowers, Vacuums & Sweepers | 2260004031 | 185 | 1.9 | 0.1 | 4% | 185 | 1,046 | 122 | 12% |
| Other L&G Equipment | 2260004076 | 2 | 1.1 | - | - | 2 | 938 | - | - |
| Commercial Lawn Mowers | 2265004011 | 104 | 8.1 | 0.7 | 8% | 104 | 1,195 | 132 | 11% |
| Rotary Tillers | 2265004016 | 8 | 5.9 | 0.9 | 16% | 8 | 504 | 460 | 91% |
| Chain Saws | 2265004021 | 7 | 2.5 | 0.2 | 9% | 7 | 194 | 85 | 44% |
| Trimmers/Edgers/Brush Cutters | 2265004026 | 6 | 3.2 | 1.0 | 31% | 6 | 1,844 | 302 | 16% |
| Blowers, Vacuums & Sweepers | 2265004031 | 8 | 2.6 | 0.6 | 23% | 8 | 862 | 427 | 50% |
| Rear Engine Riding Mowers | 2265004041 | 64 | 20.9 | 1.0 | 5% | 64 | 1,196 | 217 | 18% |
| Front Engine Riding Mowers | 2265004046 | 51 | 17.0 | 2.1 | 13% | 51 | 1,312 | 301 | 23% |
| Shredders | 2265004051 | 13 | 3.2 | 0.5 | 14% | 13 | 1,365 | 210 | 15% |
| Lawn and Garden Tractors | 2265004056 | 3 | 14.8 | - | - | 3 | 226 | - | - |
| Chippers/Stump Grinders | 2265004066 | 37 | 155.3 | 24.9 | 16% | 37 | 1,105 | 119 | 11% |
| Commercial Turf Equipment | 2265004071 | 7 | 10.5 | 5.2 | 50% | 7 | 1,230 | 712 | 58% |
| Other L&G Equipment | 2265004076 | 8 | 9.1 | 3.2 | 35% | 8 | 946 | 421 | 44% |
| Rear Engine Riding Mowers | 2270004041 | 6 | 22.2 | 1.8 | 8% | 6 | 1,271 | 1133 | 89% |
| Front Engine Riding Mowers | 2270004046 | 1 | 25.0 | - | - | 1 | 783 | - | - |
| Lawn and Garden Tractors | 2270004056 | 15 | 36.4 | 15.3 | 42% | 15 | 1,686 | 388 | 23% |
| Chippers/Stump Grinders | 2270004066 | 3 | 86.0 | - | - | 3 | 783 | - | - |
| Shredders | 2270004051 | 3 | 102.7 | - | - | 15 | 1,218 | - | - |

#Statistics only calculated for equipment with more than 4 survey responses

## Cemeteries

A total of 14 cemeteries out of 18 in the San Antonio – New Braunfels MSA responded to the surveys (Table 2‑19). Since these cemeteries represent 94 percent of the total acres of all cemeteries, the survey had an excellent response rate. As shown in Table 2‑20, the majority of the cemeteries are in Bexar County with several small cemeteries in Comal, Medina, Guadalupe, and Wilson counties.

Table 2‑19: Cemeteries Survey Response Ratios, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of Cemeteries | | Cemeteries Acres | |
| Total | Percent of Total Cemeteries | Total | Percent of Total Acres |
| Responded to First Survey | 8 | 44% | 829 | 55% |
| Responded to Second Survey | 4 | 22% | 128 | 8% |
| Contract Work Lawn and Garden Maintenance Out | 2 | 11% | 478 | 32% |
| Cemeteries Operating in 2012 | 18 | 100% | 1,514 | 100% |

Table 2‑20: Number and Acres of Operating Cemeteries in the San Antonio-New Braunfels MSA, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| County | FIPS | Number of Cemeteries | Number of Acres | |
| Atascosa | 48013 | 0 | 0 | |
| Bandera | 48019 | 0 | 0 | |
| Bexar | 48029 | 12 | 1,389 | |
| Comal | 48091 | 2 | 51 | |
| Guadalupe | 48187 | 1 | 20 | |
| Kendall | 48259 | 0 | 0 | |
| Medina | 48325 | 1 | 38 | |
| Wilson | 48493 | 2 | 16 | |
| Total (San Antonio – New Braunfels MSA) | | 18 | | 1,514 |

The majority of the commercial lawn and garden equipment operating at cemeteries are 2-stroke trimmers, edgers, & dethatchers with 1.4 per 100 acres. Other common types of equipment used at cemeteries include diesel tractors (0.9 per 100 acres), 4-stroke riding rear engine mowers (0.8 per 100 acres), and leaf blowers (0.5 per 100 acres). All the commercial lawn and garden equipment used at cemeteries, summarized from survey responses, are listed in Table 2‑21, while the average horsepower and annual hours are located in Table 2‑22. For 2-stroke trimmers, edgers, & dethatchers, the average horsepower was 1.3 with an annual use of 1,249 hours per year.

Table 2‑21: Cemeteries Lawn and Garden Equipment Ratio per 100 Acres

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n (survey) | Mean | Standard Deviation | Confidence Level |
| Blowers, Vacuums & Sweepers | 2260004031 | 7 | 0.5 | 1.8 | 1.3 |
| Chainsaws | 2260004021 | 5 | 0.3 | 1.7 | 1.5 |
| Other | 2270004076 | 1 | 0.1 | # | # |
| Shredders | 2270004076 | 2 | 0.1 | # | # |
| Push Lawn Mowers | 2265004010 | 1 | 0.1 | # | # |
| Push Lawn Mowers | 2265004011 | 1 | 0.1 | # | # |
| Riding Front Engine Mowers | 2265004046 | 1 | 0.1 | # | # |
| Riding Rear Engine Mowers | 2270004046 | 4 | 0.3 | # | # |
| Riding Rear Engine Mowers | 2265004041 | 11 | 0.8 | 4.1 | 2.4 |
| Tractors | 2270004056 | 13 | 0.9 | 2.9 | 1.6 |
| Trimmers, Edgers, & Dethatchers | 2260004026 | 20 | 1.4 | 4.7 | 2.0 |

#Statistics only calculated for equipment with more than 4 survey responses

Table 2‑22: Confidence Interval at 95% for Cemeteries Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Blowers, Vacuums & Sweepers | 2260004031 | 7 | 1.3 | 0.5 | 34% | 7 | 639 | 353 | 55% |
| Chainsaws | 2260004021 | 5 | 2.1 | 0.5 | 23% | 5 | 63 | 51 | 81% |
| Other | 2270004076 | 1 | 55.0 | - | - | 1 | 1,827 | - | - |
| Shredders | 2270004076 | 2 | 45.0 | - | - | 2 | 68 | - | - |
| Push Lawn Mowers | 2265004010 | 1 | 3.0 | - | - | 1 | 65 | - | - |
| Push Lawn Mowers | 2265004011 | 1 | 4.5 | - | - | 1 | 26 | - | - |
| Riding Front Engine Mowers | 2265004046 | 1 | 16.0 | - | - | 1 | 783 | - | - |
| Riding Rear Engine Mowers | 2270004046 | 4 | 21.0 | - | - | 4 | 1,305 | - | - |
| Riding Rear Engine Mowers | 2265004041 | 11 | 18.8 | 2.5 | 13% | 11 | 1,388 | 452 | 33% |
| Tractors | 2270004056 | 13 | 30.9 | 1.9 | 6% | 13 | 1,546 | 288 | 19% |
| Trimmers, Edgers, Dethatchers | 2260004026 | 20 | 1.3 | 0.2 | 13% | 20 | 1,249 | 282 | 23% |

#Statistics only calculated for equipment with more than 4 survey responses

## Commercial and Private Airports

The City of San Antonio’s Aviation Department operates two municipal airports: San Antonio International Airport and Stinson Municipal Airport. San Antonio International Airport (SAIA) is located approximately seven miles north of the San Antonio central business district. Stinson Municipal Airport, the second oldest general aviation airport in continuous operation in the United States, is located south of the central business district. As the primary reliever for general aviation traffic in San Antonio, Stinson is extremely appealing to operators of light aircraft, individuals, and private aviation companies. There are also 14 other small municipal and private airports in the San Antonio-New Braunfels MSA that operate on a continuous basis.

A total of 11 airports responded to the commercial lawn and garden equipment survey which represents 70 percent of the airports in the MSA (Table 2‑23). Six of these airports are within Bexar County and 4 airports are located in Medina County while Comal, Guadalupe, and Atascosa counties also have airports (Table 2‑24).

Table 2‑23: Airports Survey Response Ratios, 2012

|  |  |  |
| --- | --- | --- |
| Survey Results | Number of Airports | Percent of Total Airports |
| Responded to First 2012 Survey | 3 | 19% |
| Responded to Second 2012 Survey | 6 | 38% |
| Responded to 2008 Survey | 2 | 13% |
| Small Airports Operating in 2012 | 16 | 100% |

Table 2‑24: Number of Airports in the San Antonio-New Braunfels MSA, 2012

|  |  |  |
| --- | --- | --- |
| County | FIPS | Number of Airports |
| Atascosa | 48013 | 1 |
| Bandera | 48019 | 0 |
| Bexar | 48029 | 6 |
| Comal | 48091 | 3 |
| Guadalupe | 48187 | 2 |
| Kendall | 48259 | 0 |
| Medina | 48325 | 4 |
| Wilson | 48493 | 0 |
| Total (San Antonio – New Braunfels MSA) | | 16 |

A ratio of commercial lawn and garden equipment per small airport was calculated to estimate equipment usage at small airports that did not respond to the survey. The survey responses from SAIA and Stinson were not included in this calculation. There were 1.0 4-stroke trimmers/edgers/brush cutters per small airport and 0.8 diesel tractors per small airport (Table 2‑25). Small airports also reported 2-stroke chainsaws (0.4 per small airport), 2-stroke leaf blowers (0.4 per small airport), and 4-stroke push lawn mowers (0.4 per small airport). As listed in Table 2‑26, diesel tractors on average had 74 horsepower and are used 1,019 hours per year, while 2-stroke trimmers averaged 1.8 horsepower and are used 247 hours per year.

Table 2‑25: Small Airports Lawn and Garden Equipment Ratio per Airport

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | n | Mean | Standard Deviation | Confidence Level |
| Chainsaws | 2260004021 | 4 | 0.4 | 0.7 | 0.4 |
| Trimmers/ Edgers/ Brush Cutters | 2260004026 | 10 | 1.0 | 2.0 | 1.2 |
| Blowers, Vacuums & Sweepers | 2260004031 | 4 | 0.4 | 0.5 | 0.3 |
| Push Lawn Mowers | 2265004011 | 4 | 0.4 | 0.5 | 0.3 |
| Riding Rear Engine Mowers | 2265004041 | 3 | 0.4 | 0.5 | 0.3 |
| Riding Front Engine Mowers | 2265004046 | 3 | 0.2 | # | # |
| Lawn and Garden Tractors | 2265004056 | 2 | 0.1 | # | # |
| Riding Rear Engine Mowers | 2270004046 | 2 | 0.2 | # | # |
| Tractors | 2270004056 | 9 | 0.8 | 1.5 | 0.9 |
| Shredders | 2270007010 | 1 | 0.1 | # | # |

#Statistics only calculated for equipment with more than 3 survey responses

Table 2‑26: Confidence Interval at 95% for Small Airports Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Chainsaws | 2260004021 | 4 | 2.0 | 0.0 | 0% | 4 | 138 | 52 | 37% |
| Trimmers/Edgers/Brush Cutters | 2260004026 | 11 | 1.8 | 0.3 | 19% | 11 | 854 | 247 | 29% |
| Blowers, Vacuums & Sweepers | 2260004031 | 4 | 2.0 | 0.0 | 0% | 4 | 125 | 71 | 57% |
| Push Lawn Mowers | 2265004011 | 4 | 5.9 | 1.6 | 27% | 4 | 264 | 138 | 52% |
| Riding Rear Engine Mowers | 2265004041 | 4 | 18.0 | 8.3 | 46% | 4 | 306 | 382 | 125% |
| Riding Front Engine Mowers | 2265004046 | 2 | 30.0 | - | - | 2 | 2,088 | - | - |
| Lawn and Garden Tractors | 2265004056 | 1 | 16.0 | - | - | 1 | 1,305 | - | - |
| Riding Rear Engine Mowers | 2270004046 | 2 | 30.0 | - | - | 2 | 1,774 | - | - |
| Tractors | 2270004056 | 9 | 73.7 | 14.7 | 20% | 9 | 1,019 | 449 | 44% |
| Shredders | 2270007010 | 1 | 42.0 | - | - | 1 | 653 | - | - |

## Local Government Facilities

Commercial lawn and garden equipment surveys were also distributed to local government municipalities and agencies. The survey results represent 76 percent of the government agencies and 96 percent of the population in the San Antonio-New Braunfels MSA (Table 2‑27). The only municipalities that did not respond to the survey were several small cities and towns in the region. If a government entity did not respond to the survey, commercial lawn and garden equipment emissions were not calculated for this entity.

Table 2‑27: Local Government Facilities Response Rate, 2012

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Survey Results | Number of Government Agencies | Percent of Total Government Agencies | Total Population in the Government Region[[20]](#footnote-20) | Percent of Total Population |
| Responded to First 2012 Survey | 29 | 51% | 1,680,465 | 75% |
| Responded to Second 2012 Survey | 9 | 16% | 414,541 | 19% |
| Responded to Third 2012 Survey | 3 | 5% | 12,958 | 1% |
| Responded to 2005 Survey | 3 | 5% | 29,406 | 1% |
| Government Agencies in the San Antonio - New Braunfels MSA | 58 | 100% | 2,234,003 | 100% |

As shown on Table 2‑28, there was a wide variety of commercial lawn and garden equipment used at government facilities. The most common commercial lawn and garden equipment operated at government facilities was 2-stroke trimmers with an average horsepower of 1.8 and 718annual hours of use. Other common equipment was 2-stroke chainsaws, 2.8 horsepower and 626 hours of use per year, and 2-stroke leaf blowers, 2.3 horsepower and 471 hours of use per year.

Table 2‑28: Confidence Interval at 95% for Local Government Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Push Lawn Mowers | 2260004011 | 9 | 3.5 | 1.4 | 41% | 9 | 569 | 299 | 53% |
| Tillers & Aerators | 2260004016 | 15 | 3.7 | 0.8 | 22% | 15 | 170 | 142 | 83% |
| Chain Saws | 2260004021 | 283 | 2.8 | 0.1 | 4% | 283 | 626 | 68 | 11% |
| Trimmer | 2260004026 | 322 | 1.8 | 0.1 | 5% | 322 | 718 | 75 | 10% |
| Blowers, Vacuums & Sweepers | 2260004031 | 199 | 2.3 | 0.1 | 4% | 199 | 471 | 79 | 17% |
| Other | 2260004076 | 2 | 1.8 | - | - | 2 | 68 | - | - |
| Lawn Mowers | 2265004011 | 59 | 5.6 | 0.5 | 9% | 59 | 614 | 156 | 25% |
| Tillers & Aerators | 2265004016 | 7 | 5.3 | 1.1 | 21% | 7 | 101 | 87 | 86% |
| Chainsaw | 2265004021 | 5 | 2.0 | 0.0 | 0% | 5 | 1044 | 0 | 0% |
| Trimmer | 2265004026 | 18 | 2.0 | 0.7 | 33% | 18 | 1508 | 371 | 25% |
| Rear Engine Riding Mowers | 2265004041 | 64 | 22.7 | 1.4 | 6% | 64 | 875 | 148 | 17% |
| Riding Front Engine Mowers | 2265004046 | 12 | 16.8 | 0.6 | 4% | 12 | 784 | 96 | 12% |
| Lawn and Garden Tractors | 2265004056 | 24 | 38.3 | 12.4 | 32% | 24 | 486 | 172 | 35% |
| Chippers/ Stump/ Grinders/ Mulchers | 2265004066 | 5 | 50.1 | 44.1 | 88% | 5 | 382 | 279 | 73% |
| Tow Behind Cutters & Turf Mowers | 2265004071 | 4 | 33.0 | - | - | 4 | 388 | - | - |
| Other | 2265004076 | 28 | 6.4 | 2.3 | 36% | 28 | 338 | 200 | 59% |
| Tillers & Aerators | 2270004016 | 1 | 36.2 | - | - | 1 | 2387 | - | - |
| Blowers, Vacuums & Sweepers | 2270004031 | 3 | 55.3 | - | - | 3 | 1305 | - | - |
| Riding Rear Engine Mowers | 2270004041 | 48 | 23.6 | 1.4 | 6% | 48 | 1022 | 212 | 21% |
| Front Mowers | 2270004046 | 5 | 16.6 | 5.7 | 34% | 5 | 626 | 376 | 60% |
| Lawn and Garden Tractors | 2270004056 | 110 | 67.2 | 5.0 | 7% | 110 | 1399 | 130 | 9% |
| Chippers/ Stump/ Grinders/ Mulchers | 2270004066 | 4 | 77.8 | - | - | 4 | 783 | - | - |
| Tow Behind Cutters & Turf Mowers | 2270004071 | 4 | 25.0 | - | - | 4 | 2088 | - | - |
| Other | 2270004076 | 6 | 31.0 | 7.9 | 25% | 6 | 1331 | 367 | 28% |
| Shredders | 2270004051 | 24 | 63.0 | 11.1 | 18% | 24 | 830 | 287 | 35% |

#Statistics only calculated for equipment with more than 4 survey responses

## Federal and State Parks

State Parks in the AACOG region include Hill Country - Louise Merrick Unit State Natural Area in Medina County, Government Canyon State Natural Area in Bexar County, and Guadalupe River State Park/Honey Creek State Natural Area in Kendall County. The National Historical Parks in the region are Mission Concepción, Mission San José, Mission San Juan, and Mission Espada. Of the 7 Federal and State Parks in the San Antonio-New Braunfels MSA, 4 responded to the survey (Table 2‑29). If a federal or state park did not respond, the commercial lawn and garden equipment population was not calculated for the park.

Table 2‑29: Federal and State Parks Survey Response Ratios, 2012

|  |  |  |
| --- | --- | --- |
| Survey Results | Number of Parks | Percent of Total Parks |
| Responded to First 2012 Survey | 4 | 57% |
| Responded to Second 2012 Survey | 0 | 0% |
| Small Airports Operating in 2012 | 7 | 100% |

## Other Companies Lawn and Garden Equipment

Large businesses or facilities not included in other categories were sent surveys to determine if they operate commercial lawn and garden equipment. To be included in the survey, the company had to have a large area of maintained land. Forty-four businesses met the qualifications and 16 responded to the survey (Table 2‑30). If a business or facility did not respond, lawn and garden equipment populations were not calculated for this entity.

Table 2‑30: Other Companies Response Rate, 2012

|  |  |  |
| --- | --- | --- |
| Survey Results | Number of Other Companies | Percent of Other Companies |
| Responded to First 2012 Survey | 14 | 32% |
| Responded to Second 2012 Survey | 2 | 5% |
| Total Number of Other Companies Surveyed | 44 | 100% |

These businesses reported a limited amount of equipment operated at their facilities (Table 2‑31). The most commonly reported types of equipment were 2-stroke trimmers with an average horsepower of 0.9 and 436 annual hours of use. Leaf blowers with an average horsepower of 1.2 and 4-stroke lawn mowers with an average horsepower of 5.1 were also reported in the survey results.

Table 2‑31: Confidence Interval at 95% for Other Companies Commercial Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Blowers, Vacuums & Sweepers | 2260004031 | 10 | 1.2 | 0.4 | 35% | 10 | 233 | 191 | 82% |
| Chainsaw | 2260004021 | 4 | 1.8 | 0.5 | 28% | 4 | 86 | 142 | 166% |
| Edger | 2260004016 | 1 | 1.0 | - | - | 1 | 783 | - | - |
| Other Lawn and Garden | 2265004076 | 1 | 11.0 | - | - | 1 | 3 | - | - |
| Push Lawn Mowers | 2260004011 | 2 | 3.0 | - | - | 2 | 31 | - | - |
| Push Lawn Mowers | 2265004011 | 10 | 5.1 | 1.0 | 20% | 10 | 93 | 58 | 63% |
| Riding Front Engine Mowers | 2265004046 | 8 | 11.3 | 2.2 | 20% | 8 | 68 | 24 | 36% |
| Riding Rear Engine Mowers | 2270004046 | 1 | 38.0 | - | - | 1 | 1044 | - | - |
| Riding Rear Engine Mowers | 2265004041 | 2 | 35.0 | - | - | 2 | 1044 | - | - |
| Tractors | 2270004056 | 3 | 63.3 | - | - | 3 | 522 | - | - |
| Trimmer | 2260004026 | 16 | 0.9 | 0.1 | 14% | 16 | 436 | 230 | 53% |
| Trimmer | 2265004026 | 2 | 6.8 | - | - | 2 | 44 | - | - |

## Military Facilities

There were five military facilities surveyed in the San Antonio-New Braunfels MSA: Lackland, Randolph, Fort Sam Houston, Camp Bullis, and Canyon Lake Recreation Center. Randolph Air Force Base (RAFB) is located in Bexar County, Texas, northeast of the City of San Antonio. The base is home to the 12th Flying Training Wing and is one of the few bases that conduct instructor pilot training. Lackland Air Force Base is located in Bexar County, Texas, in the west southwestern part of the City of San Antonio. The base is home to the 37th Training Wing whose primary mission is to provide training to new recruits entering the Air Force. Lackland gained a flying mission when adjacent Kelly Air Force Base closed in 2001. The 2-mile-long runway is now a joint-use facility between Lackland AFB and the city of San Antonio. In addition, “with the closure of Kelly AFB Lackland gained the section of base known as Security Hill. Security Hill is home to numerous Air Combat Command units such as the 67th Network Warfare Wing and the Air Intelligence Agency.”[[21]](#footnote-21)

The US Army’s Fort Sam Houston (Ft. Sam) is a 3,265-acre military reservation located in Bexar County, Texas 3 miles northeast of downtown San Antonio. “The primary mission at Ft. Sam Houston is medical training and a support post housing Headquarters U.S. 5th Army, U.S. 5th Army Recruiting Brigade, Brooke Army Medical Center (BAMC), Institute of Surgical Research (ISR), U.S. Army Medical Department Center and School, U.S. Army Center Brigade, and U.S. Army Medical Command.”[[22]](#footnote-22) Ft. Sam employs military, civilian and contractor personnel to perform functions in support of installation facilities and active, reserve and retired military personnel and their dependents. "Camp Bullis is located 18 miles northwest of downtown San Antonio and consists of 27,880 acres of training facilities, temporary barracks, firing ranges, and maneuvering areas. Camp Bullis provides field training, weapon firing, and assault landing strips for active US Army and US Air Force units, joint Army and Air Force exercises, Army, Navy and Marine Corps Reserve units, and the Texas National Guard units."[[23]](#footnote-23) Canyon Lake Recreational Center (CLRC) is located in Comal County, Texas, southeast of Canyon Lake near the spillway. The center is approximately 30 miles northeast of downtown San Antonio and 10 miles northwest of New Braunfels. The center does not house any troops, but provides recreational facilities to local organizations and military personnel and their families.

There was a 100 percent response rate from the military facilities with Camp Bullis contracting out lawn and garden maintenance activities. Respondents reported operating 130 2-stroke trimmers with an average horsepower of 2.9 and 537 annual hours of use at the military bases. The 44 2-stroke leaf blowers had an average horsepower of 2.7 and 744 annual hours of use, while 18 2-stroke chainsaws had an average horsepower of 2.9 and 687 annual hours of use (Table 2‑32).

Table 2‑32: Confidence Interval at 95% for Military Facilities Commercial Lawn and Garden Equipment

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Horsepower | | | | Hours/Year | | | |
| n | Mean | Confidence Interval | Percent of Mean | n | Mean | Confidence Interval | Percent of Mean |
| Blowers, Vacuums & Sweepers | 2260004031 | 44 | 2.7 | 0.2 | 8% | 44 | 744 | 165 | 22% |
| Blowers, Vacuums & Sweepers | 2265004031 | 1 | 1.0 | - | - | 1 | 1668 | - | - |
| Chainsaw | 2260004021 | 18 | 2.9 | 0.4 | 15% | 18 | 687 | 309 | 45% |
| Edger | 2260004026 | 3 | 3.5 | - | - | 3 | 1305 | - | - |
| Power Pruner | 2260004026 | 3 | 3.8 | - | - | 3 | 313 | - | - |
| Power Pruner | 2265004026 | 2 | 3.5 | - | - | 2 | 365 | - | - |
| Push Lawn Mowers | 2265004011 | 10 | 2.5 | 0.7 | 26% | 10 | 511 | 414 | 81% |
| Riding Rear Engine Mowers | 2270004041 | 5 | 1.9 | 0.9 | 45% | 5 | 1356 | 1252 | 92% |
| Riding Rear Engine Mowers | 2265004041 | 13 | 5.5 | 2.6 | 46% | 13 | 2255 | 474 | 21% |
| Shredders | 2270004066 | 2 | 3.1 | - | - | 2 | 1122 | - | - |
| Shredders | 2265004066 | 1 | 3.0 | - | - | 1 | 261 | - | - |
| Tillers & Aerators | 2260004016 | 2 | 3.5 | - | - | 2 | 2088 | - | - |
| Tractors | 2270004056 | 24 | 2.5 | 0.7 | 26% | 24 | 683 | 340 | 50% |
| Trimmer | 2260004026 | 130 | 2.9 | 0.1 | 4% | 130 | 537 | 108 | 20% |
| Trimmer | 2265004026 | 8 | 1.0 | 0.0 | 0% | 8 | 1878 | 0 | 0% |
| Other Lawn and Garden Eq. | 2265004076 | 20 | 3.6 | 0.7 | 19% | 20 | 334 | 84 | 25% |
| Other Lawn and Garden Eq. | 2270004076 | 37 | 2.2 | 0.5 | 23% | 37 | 524 | 100 | 19% |

## Lawn and Garden Equipment Totals

Once the lawn and garden equipment was tallied for all categories, a comparison was done between TexN Model data and the results from the survey. Since most of the commercial lawn and garden equipment in the San Antonio-New Braunfels MSA is used more often than the existing usage rates in the TexN model, Equation 2‑4 was used to compare total equipment populations between the survey responses and the TexN model.

Equation 2‑4, Equipment Population by Commercial Lawn and Garden Category

POPA.B = POPA.B.Actual x HRSA.B.Survey / HRSA.B.TexN

POPA.B = Daily ozone season emissions for equipment type A for Commercial Lawn and Garden category B

POPA.B.Actual = Calculated population of equipment type A for Commercial Lawn and Garden category B

HRSA.B.Survey = Survey results for annual hours for equipment type A for Commercial Lawn and Garden category B

HRSA.B.TexN  = TexN Model annual hours for equipment type A for Commercial Lawn and Garden category B

Sample Equation: Equipment population for 4-stroke rear engine riding mowers (SCC code 2265004041) used at cemeteries

POPA.B = 12 mowers x 1,388 average hours from survey responses / 569 hours from TexN Model

= 28 4-stroke rear engine riding mowers used at cemeteries

There were significantly more trimmers, front mowers, shedders and rear engine mowers in the AACOG survey than listed in the TexN Model (Figure 2‑1). Leaf blowers, turf equipment, lawn and garden tractors, and chainsaws are also under-predicted in the TexN Model. Conversely, the TexN Model over-predicted the number of tillers and lawn mowers. Most of the equipment in the “other” category are golf carts used for lawn and garden maintenance activities. As show in table 2-34, most of these golf carts are used at golf courses and public schools. This equipment can also be classified as specialty vehicles/carts with SCC codes of 2260001060, 2265001060, and 2270001060.

The greatest difference in commercial lawn and garden equipment populations by county was Bexar County with 35,719 pieces of equipment compared to 12,089 in the TexN Model (Table 2‑33). Likewise, the survey results for Guadalupe County indicate a significantly higher lawn and garden equipment population (3,059) than the TexN Model (911). Comal County’s surveyed equipment population increased from 1,716 to 3,959, while Kendall County’s increased from 563 to 1,830 pieces of equipment, when compared to the TexN model counts.

Table 2‑34 shows the breakdown by category for AACOG’s 2005 survey results, 2012 survey results and ERG’s 2002 survey.[[24]](#footnote-24) AACOG’s results match closely with ERG’s findings for most categories. Overall, the TexN Model under-predicts the number of lawn and garden equipment in the San Antonio-New Braunfels MSA compared to the results from previous studies. AACOG’s 2012 survey results were 280 percent higher than existing data in the TexN Model, while ERG’s 2002 survey of equipment is 310 percent higher (ERG results indicate that the number was 223 percent, but they did not survey all categories). AACOG found more chainsaws, turf equipment, front mowers, and trimmers compared to ERG’s results. There were fewer tillers, lawn mowers, and leaf blowers in the survey returns compared to ERG findings.

Figure 2‑1: Comparison of Surveys Equipment Population Estimations and TexN Model Existing Estimates by Category, San Antonio-New Braunfels MSA

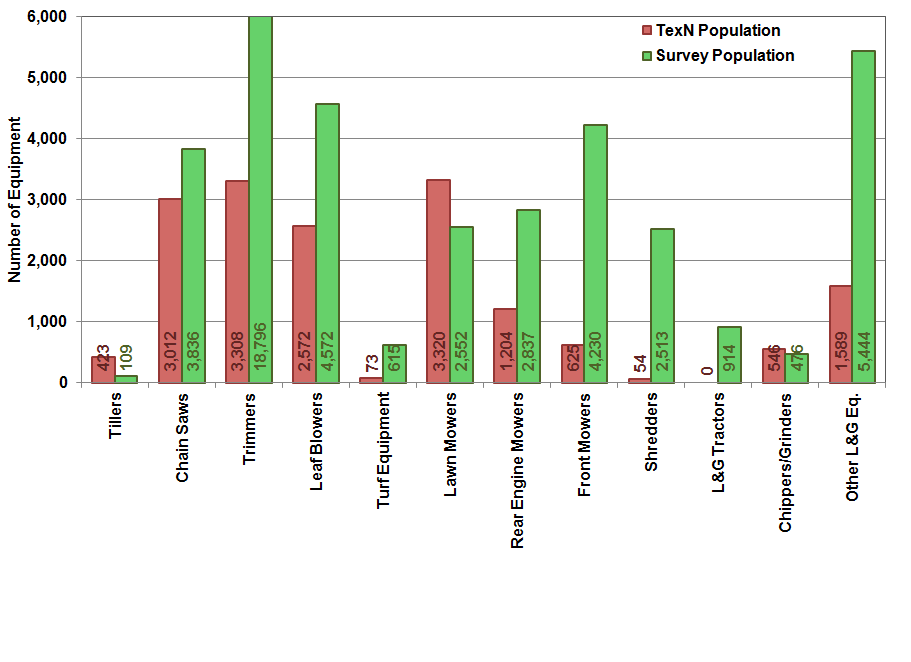


Table 2‑33: Comparison of Surveys Equipment Population Estimations and TexN Model Existing Estimates by County, San Antonio-New Braunfels MSA, 2012

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC Code | Atascosa | | Bandera | | Bexar | | Comal | | Guadalupe | | Kendall | | Medina | | Wilson | | Total | |
| TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. |
| Tillers | 2260004016 | 8 | 0 | 6 | 0 | 204 | 42 | 29 | 3 | 15 | 2 | 9 | 1 | 8 | 0 | 3 | 1 | 282 | 49 |
| 2265004016 | 4 | 0 | 3 | 0 | 102 | 43 | 14 | 5 | 8 | 3 | 5 | 2 | 4 | 0 | 2 | 1 | 141 | 55 |
| 2270004016 | - | - | - | - | - | 5 | - | - | - | - | - | - | - | - | - | - | - | 5 |
| Chain Saws | 2260004021 | 82 | 38 | 63 | 1 | 2,177 | 2,953 | 309 | 347 | 164 | 250 | 101 | 110 | 82 | 40 | 34 | 56 | 3,012 | 3,795 |
| 2265004021 | - | 0 | - | 0 | - | 35 | - | 2 | - | 1 | - | 1 | - | 0 | - | 0 | - | 41 |
| Trimmers | 2260004026 | 90 | 184 | 69 | 26 | 2,377 | 14,378 | 337 | 1,396 | 179 | 1,065 | 111 | 493 | 90 | 165 | 37 | 299 | 3,289 | 18,007 |
| 2265004026 | 1 | 23 | 0 | 0 | 14 | 630 | 2 | 46 | 1 | 69 | 1 | 13 | 1 | 1 | 0 | 6 | 19 | 789 |
| Leaf Blowers | 2260004031 | 67 | 20 | 51 | 9 | 1,781 | 3,440 | 253 | 401 | 134 | 264 | 83 | 146 | 67 | 18 | 28 | 72 | 2,464 | 4,370 |
| 2265004031 | 2 | 1 | 2 | 1 | 60 | 120 | 8 | 15 | 5 | 10 | 3 | 8 | 2 | 1 | 1 | 3 | 83 | 159 |
| 2270004031 | 1 | 0 | 1 | - | 18 | 31 | 3 | - | 1 | 12 | 1 | - | 1 | - | 0 | - | 25 | 43 |
| Turf Equipment | 2260004071 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2265004071 | 1 | 9 | 1 | 24 | 36 | 341 | 5 | 53 | 3 | 45 | 2 | 68 | 1 | 18 | 1 | 21 | 50 | 580 |
| 2270004071 | 1 | 0 | 0 | 1 | 17 | 30 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | 24 | 36 |
| Lawn Mowers | 2260004011 | - | 5 | - | 2 | - | 358 | - | 48 | - | 27 | - | 16 | - | 5 | - | 10 | - | 470 |
| 2265004011 | 90 | 18 | 69 | 16 | 2,400 | 1,560 | 341 | 196 | 181 | 133 | 112 | 97 | 90 | 23 | 37 | 39 | 3,320 | 2,081 |
| Rear Engine Riding Mowers | 2265004041 | 33 | 29 | 25 | 32 | 870 | 1,253 | 123 | 153 | 66 | 138 | 41 | 116 | 33 | 36 | 14 | 59 | 1,204 | 1,816 |
| 2267004041 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2270004041 | - | 15 | - | 36 | - | 618 | - | 96 | - | 83 | - | 109 | - | 28 | - | 37 | - | 1,021 |
| Front Mowers | 2265004046 | 4 | 28 | 3 | 1 | 107 | 3,222 | 15 | 438 | 8 | 254 | 5 | 123 | 4 | 36 | 2 | 63 | 147 | 4,165 |
| 2270004046 | 13 | 1 | 10 | 0 | 345 | 45 | 49 | 4 | 26 | 7 | 16 | 3 | 13 | 3 | 5 | 1 | 477 | 65 |
| Shredders | 2265004051 | 1 | 0 | 1 | - | 39 | 1,373 | 6 | 180 | 3 | 102 | 2 | 55 | 1 | - | 1 | 23 | 54 | 1,734 |
| 2270004051 | - | 34 | - | - | - | 477 | - | 40 | - | 141 | - | 11 | - | 54 | - | 21 | - | 779 |
| Lawn and Garden Tractors | 2265004056 | 8 | 0 | 6 | 0 | 204 | 42 | 29 | 3 | 15 | 2 | 9 | 1 | 8 | 0 | 3 | 1 | 282 | 49 |
| 2270004056 | 4 | 0 | 3 | 0 | 102 | 43 | 14 | 5 | 8 | 3 | 5 | 2 | 4 | 0 | 2 | 1 | 141 | 55 |
| Equipment Type | SCC Code | Atascosa | | Bandera | | Bexar | | Comal | | Guadalupe | | Kendall | | Medina | | Wilson | | Total | |
| TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. | TexN Pop. | Survey Pop. |
| Lawn and Garden Tractors | 2265004056 | - | 1 | - | 1 | - | 37 | - | 4 | - | 10 | - | 4 | - | 5 | - | 3 | - | 65 |
| 2270004056 | - | 24 | - | 6 | - | 630 | - | 59 | - | 59 | - | 32 | - | 25 | - | 13 | - | 849 |
| Chippers/ Stump Grinders | 2260004066 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2265004066 | 7 | 0 | 5 | 0 | 190 | 332 | 27 | 43 | 14 | 25 | 9 | 14 | 7 | 2 | 3 | 6 | 262 | 422 |
| 2270004066 | 8 | 1 | 6 | 0 | 205 | 39 | 29 | 4 | 15 | 2 | 10 | 1 | 8 | 6 | 3 | 1 | 284 | 54 |
| Other Lawn and Garden Equipment | 2260004076 | - | 0 | - | - | - | 212 | - | 23 | - | 16 | - | 7 | - | - | - | 3 | - | 262 |
| 2265004076 | 43 | 98 | 33 | 130 | 1,145 | 3,331 | 162 | 393 | 86 | 339 | 53 | 393 | 43 | 132 | 18 | 169 | 1,584 | 4,985 |
| 2270004076 | 0 | 1 | 0 | 1 | 3 | 183 | 0 | 5 | 0 | 2 | 0 | 5 | 0 | 1 | - | 1 | 4 | 197 |
|  |  | 456 | 530 | 348 | 289 | 12,089 | 35,719 | 1,716 | 3,959 | 911 | 3,059 | 563 | 1,830 | 456 | 600 | 187 | 909 | 16,726 | 46,895 |

Table 2‑34: Comparison of Surveys Equipment Population Estimations and TexN Model Existing Estimates by SCC Code, San Antonio-New Braunfels MSA

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC Code | TexN Model Existing Population (2012) | AACOG 2012 Survey\* | | | | | | | | | | | Percent of TexN Model Population | AACOG 2005 Results | ERG Results for San Antonio (2002) |
| Commercial Lawn and Garden Companies | Universities / Colleges | Public Schools | Golf Courses | Cemeteries | Government Facilities | Federal and State Parks | Other Companies | Commercial/ Private Airports | Military Facilities | Total from AACOG's Survey |
| Tillers | 2260004016 | 282 | 27 | 1 | 3 | - | - | 5 | 1 | 2 | 1 | 9 | 49 | 17% | 35% | 292% |
| 2265004016 | 141 | 41 | 4 | 2 | 5 | - | 1 | - | - | 1 | - | 55 | 39% |
| 2270004016 | - | - | - | - | - | - | 5 | - | - | - | - | 5 | - |
| Chain Saws | 2260004021 | 3,012 | 3,010 | 78 | 57 | 16 | 1 | 585 | 1 | 1 | 5 | 41 | 3,795 | 126% | 230% | 107% |
| 2265004021 | - | 22 | - | - | 2 | - | 17 | - | - | - | - | 41 | - |
| Trimmers | 2260004026 | 3,289 | 11,348 | 652 | 1,494 | 269 | 192 | 1,687 | 10 | 51 | 164 | 2,139 | 18,007 | 547% | 444% | 232% |
| 2265004026 | 19 | 392 | 8 | 26 | - | - | 198 | - | 1 | 1 | 164 | 789 | 4,155% |
| Leaf Blowers | 2260004031 | 2,464 | 3,330 | 98 | 316 | 135 | 17 | 332 | 1 | 8 | 19 | 116 | 4,370 | 177% | 248% | 347% |
| 2265004031 | 83 | 119 | - | 4 | 30 | - | - | - | - | - | 6 | 159 | 191% |
| 2270004031 | 25 | - | 10 | - | - | - | 33 | - | - | - | - | 43 | 172% |
| Turf Equipment | 2260004071 | - | - | - | - | - | - | - | - | - | - | - | 0 | - | 737% | 359% |
| 2265004071 | 50 | 61 | 4 | - | 512 | - | 2 | - | - | - | - | 580 | 1,159% |
| 2270004071 | 24 | - | - | - | 14 | - | 8 | - | - | 14 | - | 36 | 149% |
| Lawn Mowers | 2260004011 | - | 348 | 10 | 78 | 22 | - | 13 | - | - | - | - | 470 | - | 131% | 231% |
| 2265004011 | 3,320 | 1,550 | 38 | 47 | 332 | - | 89 | - | 2 | 10 | 13 | 2,081 | 63% |
| Rear Engine Riding Mowers | 2265004041 | 1,204 | 708 | 72 | 220 | 631 | 28 | 98 | - | 4 | 3 | 52 | 1,816 | 151% | 163% | 205% |
| 2267004041 | - | - | - | - | - | - | - | - | - | - | - | 0 | - |
| 2270004041 | - | 82 | 33 | 63 | 742 | - | 86 | - | - | 3 | 12 | 1,021 | - |
| Front Mowers | 2265004046 | 147 | 3,778 | 86 | 76 | - | 10 | 109 | - | 6 | 99 | - | 4,165 | 2,833% | 1,388% | 186% |
| 2270004046 | 477 | 8 | - | 21 | - | 11 | 7 | - | 2 | 16 | - | 65 | 14% |
| Shredders | 2265004051 | 54 | 1,724 | 9 | - | - | - | - | - | - | - | - | 1,734 | 3,210% | 5,514% | 0% |
| 2270004051 | - | 355 | 5 | - | - | 3 | 399 | 1 | - | 18 | - | 779 | - |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC Code | TexN Model Existing Population (2012) | AACOG 2012 Survey\* | | | | | | | | | | | Percent of TexN Model Population | AACOG 2005 Results | ERG Results for San Antonio (2002) |
| Commercial Lawn and Garden Companies | Universities / Colleges | Public Schools | Golf Courses | Cemeteries | Government Facilities | Federal and State Parks | Other Companies | Commercial/ Private Airports | Military Facilities | Total from AACOG's Survey |
| Lawn and Garden Tractors | 2265004056 | - | 5 | 4 | 7 | 29 | - | 16 | - | - | 5 | - | 65 | - | - | 0% |
| 2270004056 | - | 226 | 48 | 69 | 119 | 39 | 283 | - | 3 | 32 | 30 | 849 | - |
| Chippers/ Stump Grinders | 2265004066 | - | 407 | - | 11 | - | - | 4 | - | - | - | 1 | 422 | - | 122% | 201% |
| 2267004066 | 262 | - | - | - | - | - | - | - | - | - | - | 0 | 0% |
| 2270004066 | 284 | 25 | - | 17 | 1 | - | 7 | - | - | - | 5 | 54 | 19% |
| Other Lawn and Garden Equipment | 2260004076 | - | 224 | 34 | - | - | - | 2 | 1 | - | - | - | 262 | - | 283% | 227% |
| 2265004076 | 1,584 | 610 | 172 | 1,440 | 2,490 | - | 161 | - | - | 5 | 108 | 4,985 | 315% |
| 2270004076 | 4 | - | 1 | 9 | 13 | 4 | 18 | - | - | 3 | 149 | 197 | 4,930% |
| Total |  | 16,726 | 28,400 | 1,367 | 3,959 | 5,360 | 306 | 4,166 | 15 | 80 | 398 | 2,843 | 46,895 | 280% | 310% | 223% |

\*Survey results are weighted by the average hours from the TexN Model

#Based on the 2010 8-county MSA: Atascosa, Bandera, Bexar, Comal, Guadalupe, Kendall, Medina, and Wilson Counties

# Commercial Lawn and Garden Equipment Emissions

## Estimate Ozone Precursors Emissions

The methodology used to estimate commercial lawn and garden equipment emissions incorporated information on equipment type, equipment population, horsepower, and activity data extracted from returned survey questionnaires. When specific data such as load or emission factors were not provided in the survey returns, existing data in the TexN Model was used (Appendix A). The TexN Model run specifications were:

* Analysis Year = 2012
* Max Tech. Year = 2012
* Met Year = Typical Year
* Period = Ozone Season Day
* Summation Type = Typical Day (Weekday)
* Post Processing Adjustments = All
* Rules Enabled = All
* Regions = Bexar County
* Sources = Commercial Lawn and Garden Equipment

Ozone season daily VOC and NOX emissions were calculated by horsepower bin using the formula provided below. Bexar County 2012 VOC and NOX emission factors by horsepower bin are provided in Appendix A. If the emission factor was not available from the TexN Model for a specific hp bin, the emission factor from the closest horsepower bin was used.

Equation 3‑1, Ozone season daily emissions for commercial lawn and garden equipment

DEA.B = POPA.B x HRSA.B x HPA.B x LFA x EFA.B / 907,184.74 grams/ton / 365 days per year

Where,

DEA.B = Daily ozone season emissions for equipment type A for hp bin B (tons/day)

POPA.B = Population of equipment type A for hp bin B (from survey)

HRSA.B = Annual activity rate for equipment type A for hp bin B, hrs (from survey)

HPA.B = Average rated horsepower for equipment type A for hp bin B, hp (from survey)

LFA = Load factor for equipment type A (from TexN Model)

EFA.B = Average emissions factor for equipment type A for hp bin B, g/hp-hr (from TexN Model)

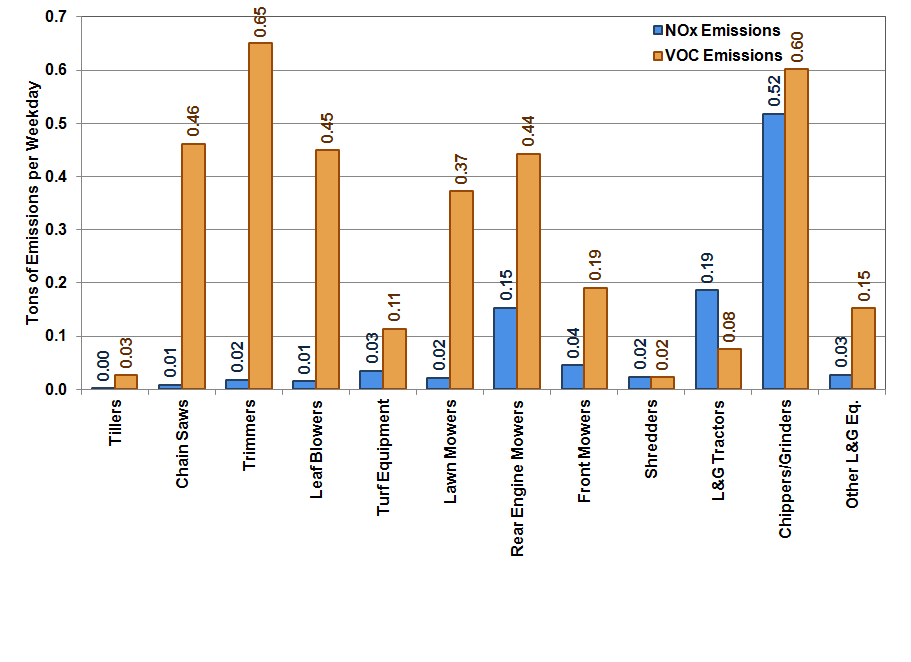
Sample Equation: Ozone season daily NOX emissions from diesel tractors (SCC 2270004056) in hp bin 75-100 for Small Airports in the San Antonio-New Braunfels MSA

DEA.B = 8.18 tractors x 1,310 hours x 86.3 hp x 0.43 x 4.03 g of NOX/hp-hr / 907,184.74 grams/ton / 365 days per year

= 0.0048 tons of NOX per ozone season day

Based on data collected from the survey, commercial lawn and garden equipment was estimated to emit 3.6 tons of VOCs and 1.1 tons of NOX per ozone season weekday. Trimmers were the largest source of VOC emissions, 0.65 tons per weekday, because of the large number and high activity rates of trimmers in the San Antonio New Braunfels MSA (Figure 3‑1). The second largest source of VOC emissions was chippers/grinders (0.60 tons of VOC per weekday), followed by chainsaws (0.46 tons), leaf blowers (0.45 tons), and rear engine mowers (0.44 tons). The largest source of NOX emissions was chippers and grinders with 0.52 tons per weekday. Other sources of NOX emissions included lawn and garden tractors, 0.19 tons per weekday and rear engine lawn mowers, 0.15 tons per weekday.

Figure 3‑1: Commercial Lawn and Garden Equipment Emissions by Equipment Type, Tons per Ozone Season Weekday, 2012



Most lawn and garden equipment operated in the San Antonio-New Braunfels MSA is located in Bexar County; therefore, emissions estimates are highest for Bexar with, 2.73 tons of VOCs and 0.80 tons of NOX per weekday (Figure 3‑2). Comal County was second with 0.33 tons of VOCs and 0.09 tons of NOX and Guadalupe County was third with 0.23 tons of NOX and 0.07 tons of VOCs per weekday. As shown in Figure 3‑3, NOX emissions based on survey results were significantly higher than those based on the TexN model. The largest difference between survey-based and model-based NOX emissions for individual equipment categories was chippers/grinders, lawn and garden tractors, and rear engine mowers. NOX emissions were slightly lower for front mowers and tillers when using the results from the survey. Detailed emissions results for weekday and weekend NOX and VOC emissions are provided in Table 3‑1 to Table 3‑4, while Table 3‑5 provides a comparison between the results of the survey and existing data in the TexN model.

Figure 3‑2: Commercial Lawn and Garden Equipment Emissions by County, Tons per Ozone Season Weekday, 2012

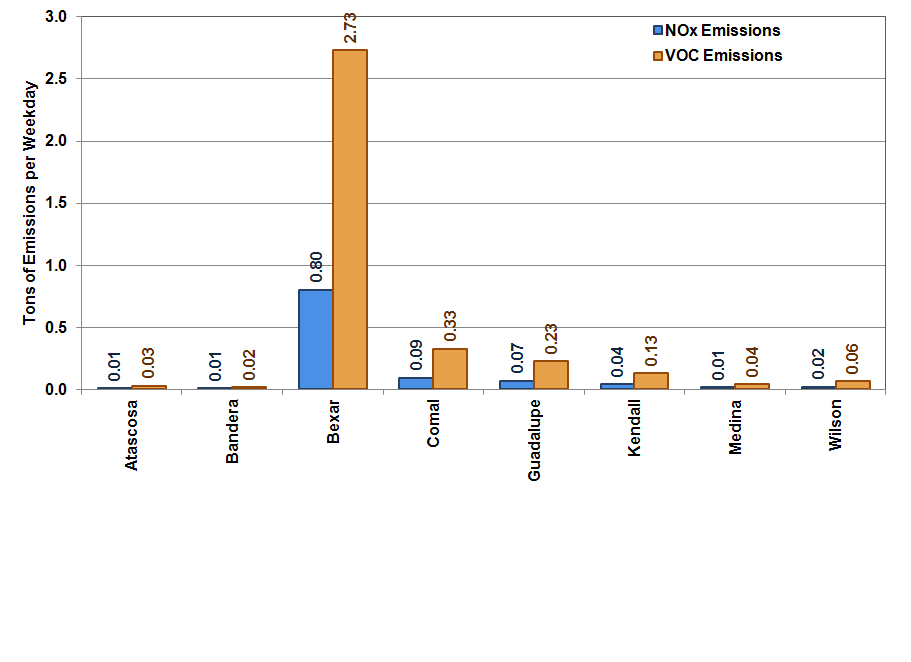


Figure 3‑3: Ozone Season Daily Commercial Lawn and Garden Equipment NOX Emissions by Equipment Type, San Antonio New Braunfels MSA, 2012

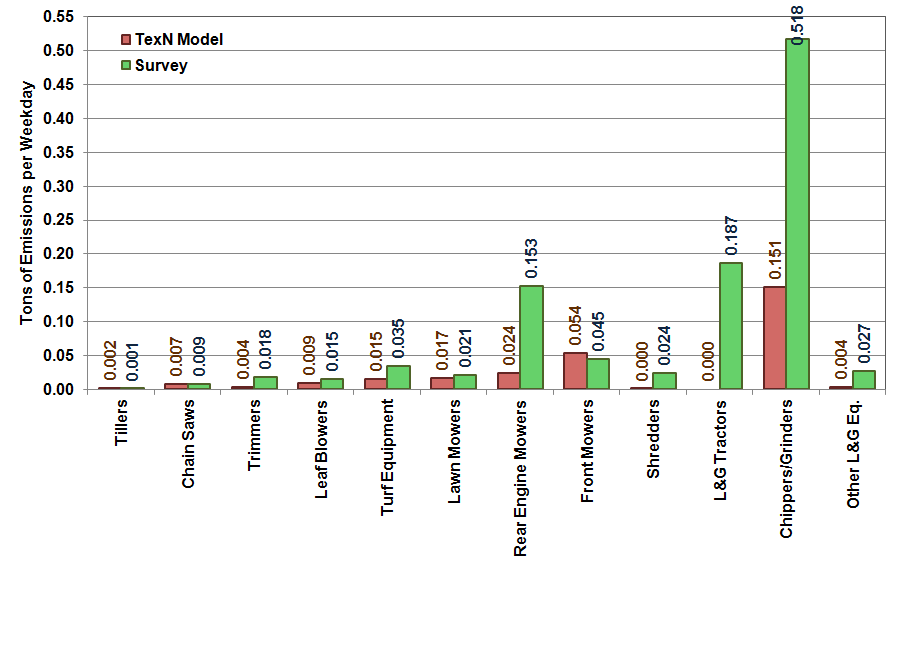


Table 3‑1: Ozone Season Weekday Commercial Lawn and Garden Equipment NOX Emissions by County, 2012

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Atascosa  (48013) | Bandera  (48019) | Bexar  (48029) | Comal  (48091) | Guadalupe  (48187) | Kendall  (48259) | Kerr  (48265) | Medina  (48325) | Total |
| Tillers | 2260004016 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| 2265004016 | 0.0000 | 0.0000 | 0.0006 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0007 |
| 2270004016 | - | - | 0.0000 | - | - | - | - | - | 0.0000 |
| Chain Saws | 2260004021 | 0.0000 | 0.0000 | 0.0067 | 0.0007 | 0.0004 | 0.0002 | 0.0001 | 0.0001 | 0.0084 |
| 2265004021 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| Trimmers | 2260004026 | 0.0002 | 0.0000 | 0.0124 | 0.0013 | 0.0010 | 0.0004 | 0.0002 | 0.0002 | 0.0158 |
| 2265004026 | 0.0001 | 0.0000 | 0.0014 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0018 |
| Leaf Blowers | 2260004031 | 0.0001 | 0.0000 | 0.0086 | 0.0011 | 0.0007 | 0.0004 | 0.0001 | 0.0002 | 0.0111 |
| 2265004031 | 0.0000 | 0.0001 | 0.0013 | 0.0002 | 0.0001 | 0.0002 | 0.0000 | 0.0001 | 0.0020 |
| 2270004031 | 0.0000 | - | 0.0011 | - | 0.0009 | - | - | - | 0.0019 |
| Turf Equipment | 2265004071 | 0.0003 | 0.0008 | 0.0130 | 0.0018 | 0.0015 | 0.0023 | 0.0006 | 0.0007 | 0.0210 |
| 2270004071 | 0.0000 | 0.0001 | 0.0127 | 0.0002 | 0.0002 | 0.0003 | 0.0001 | 0.0001 | 0.0136 |
| Lawn Mowers | 2260004011 | 0.0000 | 0.0000 | 0.0017 | 0.0002 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0022 |
| 2265004011 | 0.0001 | 0.0000 | 0.0151 | 0.0019 | 0.0011 | 0.0006 | 0.0001 | 0.0003 | 0.0192 |
| Rear Engine Riding Mowers | 2265004041 | 0.0012 | 0.0008 | 0.0520 | 0.0057 | 0.0049 | 0.0033 | 0.0010 | 0.0023 | 0.0712 |
| 2270004041 | 0.0012 | 0.0024 | 0.0499 | 0.0095 | 0.0063 | 0.0074 | 0.0020 | 0.0029 | 0.0816 |
| Front Mowers | 2265004046 | 0.0001 | 0.0000 | 0.0301 | 0.0041 | 0.0023 | 0.0012 | 0.0004 | 0.0005 | 0.0387 |
| 2270004046 | 0.0001 | 0.0000 | 0.0045 | 0.0004 | 0.0005 | 0.0003 | 0.0003 | 0.0001 | 0.0063 |
| Shredders | 2265004051 | 0.0000 | - | 0.0013 | 0.0002 | 0.0001 | 0.0001 | - | 0.0000 | 0.0016 |
| 2270004051 | 0.0001 | - | 0.0151 | 0.0013 | 0.0024 | 0.0004 | 0.0018 | 0.0009 | 0.0220 |
| Lawn and Garden Tractors | 2265004056 | 0.0001 | 0.0001 | 0.0016 | 0.0003 | 0.0021 | 0.0002 | 0.0003 | 0.0001 | 0.0047 |
| 2270004056 | 0.0032 | 0.0010 | 0.1460 | 0.0089 | 0.0117 | 0.0041 | 0.0039 | 0.0030 | 0.1818 |
| Chippers/ Stump Grinders | 2265004066 | 0.0001 | 0.0000 | 0.3983 | 0.0523 | 0.0296 | 0.0163 | 0.0013 | 0.0068 | 0.5047 |
| 2267004066 | - | - | 0.0003 | - | - | - | - | - | 0.0003 |
| 2270004066 | 0.0001 | 0.0000 | 0.0090 | 0.0009 | 0.0006 | 0.0003 | 0.0019 | 0.0002 | 0.0130 |
| Other Lawn and Garden Equipment | 2260004076 | 0.0000 | - | 0.0003 | 0.0000 | 0.0000 | 0.0000 | - | 0.0000 | 0.0003 |
| 2265004076 | 0.0004 | 0.0005 | 0.0128 | 0.0018 | 0.0013 | 0.0016 | 0.0005 | 0.0007 | 0.0196 |
| 2270004076 | 0.0001 | 0.0000 | 0.0062 | 0.0002 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0069 |
| Total | | 0.0077 | 0.0059 | 0.8021 | 0.0931 | 0.0682 | 0.0397 | 0.0146 | 0.0194 | 1.0507 |

Table 3‑2: Ozone Season Weekend Commercial Lawn and Garden Equipment NOX Emissions by County, 2012

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Atascosa  (48013) | Bandera  (48019) | Bexar  (48029) | Comal  (48091) | Guadalupe  (48187) | Kendall  (48259) | Kerr  (48265) | Medina  (48325) | Total |
| Tillers | 2260004016 | - | - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2265004016 | 0.0000 | 0.0001 | 0.0010 | 0.0002 | 0.0001 | 0.0002 | 0.0001 | 0.0001 | 0.0017 |
| 2270004016 | - | - | 0.0000 | - | - | - | - | - | 0.0000 |
| Chain Saws | 2260004021 | 0.0000 | 0.0001 | 0.0020 | 0.0003 | 0.0002 | 0.0003 | 0.0001 | 0.0001 | 0.0032 |
| 2265004021 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| Trimmers | 2260004026 | 0.0002 | 0.0005 | 0.0075 | 0.0012 | 0.0010 | 0.0015 | 0.0005 | 0.0005 | 0.0128 |
| 2265004026 | 0.0000 | - | 0.0002 | 0.0000 | 0.0000 | 0.0000 | - | 0.0000 | 0.0002 |
| Leaf Blowers | 2260004031 | 0.0002 | 0.0006 | 0.0080 | 0.0013 | 0.0011 | 0.0017 | 0.0005 | 0.0005 | 0.0139 |
| 2265004031 | 0.0001 | 0.0001 | 0.0018 | 0.0003 | 0.0003 | 0.0004 | 0.0001 | 0.0001 | 0.0032 |
| 2270004031 | - | - | 0.0000 | - | 0.0000 | - | - | - | 0.0000 |
| Turf Equipment | 2265004071 | 0.0016 | 0.0045 | 0.0533 | 0.0087 | 0.0076 | 0.0122 | 0.0034 | 0.0038 | 0.0950 |
| 2270004071 | 0.0000 | 0.0000 | 0.0019 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0021 |
| Lawn Mowers | 2260004011 | 0.0001 | 0.0002 | 0.0022 | 0.0004 | 0.0003 | 0.0005 | 0.0001 | 0.0002 | 0.0039 |
| 2265004011 | 0.0001 | 0.0004 | 0.0056 | 0.0009 | 0.0007 | 0.0010 | 0.0003 | 0.0003 | 0.0093 |
| Rear Engine Riding Mowers | 2265004041 | 0.0014 | 0.0039 | 0.0504 | 0.0080 | 0.0068 | 0.0108 | 0.0030 | 0.0034 | 0.0878 |
| 2270004041 | 0.0001 | 0.0004 | 0.0063 | 0.0010 | 0.0008 | 0.0012 | 0.0003 | 0.0004 | 0.0104 |
| Front Mowers | 2265004046 | 0.0000 | - | 0.0029 | 0.0004 | 0.0003 | 0.0001 | 0.0001 | 0.0000 | 0.0039 |
| 2270004046 | 0.0000 | - | 0.0004 | 0.0001 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0008 |
| Shredders | 2265004051 | - | - | 0.0001 | 0.0000 | 0.0000 | 0.0000 | - | 0.0000 | 0.0002 |
| 2270004051 | 0.0000 | - | 0.0011 | 0.0002 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0015 |
| Lawn and Garden Tractors | 2265004056 | 0.0002 | 0.0004 | 0.0047 | 0.0008 | 0.0007 | 0.0010 | 0.0004 | 0.0003 | 0.0085 |
| 2270004056 | 0.0003 | 0.0002 | 0.0120 | 0.0015 | 0.0011 | 0.0006 | 0.0011 | 0.0002 | 0.0169 |
| Chippers/ Stump Grinders | 2265004066 | - | - | 0.0383 | 0.0050 | 0.0028 | 0.0016 | 0.0000 | 0.0006 | 0.0484 |
| 2267004066 | - | - | - | - | - | - | - | - | - |
| 2270004066 | 0.0000 | 0.0000 | 0.0010 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0012 |
| Other Lawn and Garden Equipment | 2260004076 | - | - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | - | 0.0000 | 0.0000 |
| 2265004076 | 0.0008 | 0.0023 | 0.0282 | 0.0046 | 0.0040 | 0.0064 | 0.0018 | 0.0020 | 0.0501 |
| 2270004076 | 0.0000 | 0.0000 | 0.0013 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0014 |
| Total | | 0.0053 | 0.0137 | 0.2302 | 0.0349 | 0.0281 | 0.0397 | 0.0118 | 0.0126 | 0.3765 |

Table 3‑3: Ozone Season Weekday Commercial Lawn and Garden Equipment VOC Emissions by County, 2012

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Atascosa  (48013) | Bandera  (48019) | Bexar  (48029) | Comal  (48091) | Guadalupe  (48187) | Kendall  (48259) | Kerr  (48265) | Medina  (48325) | Total |
| Tillers | 2260004016 | 0.0001 | 0.0000 | 0.0094 | 0.0007 | 0.0004 | 0.0002 | 0.0004 | 0.0001 | 0.0114 |
| 2265004016 | 0.0000 | 0.0001 | 0.0117 | 0.0013 | 0.0009 | 0.0006 | 0.0001 | 0.0004 | 0.0150 |
| 2270004016 | - | - | 0.0000 | - | - | - | - | - | 0.0000 |
| Chain Saws | 2260004021 | 0.0026 | 0.0002 | 0.3693 | 0.0406 | 0.0232 | 0.0118 | 0.0066 | 0.0057 | 0.4600 |
| 2265004021 | 0.0000 | 0.0000 | 0.0014 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0017 |
| Trimmers | 2260004026 | 0.0061 | 0.0009 | 0.4899 | 0.0495 | 0.0394 | 0.0175 | 0.0099 | 0.0087 | 0.6217 |
| 2265004026 | 0.0012 | 0.0000 | 0.0230 | 0.0019 | 0.0013 | 0.0005 | 0.0000 | 0.0003 | 0.0283 |
| Leaf Blowers | 2260004031 | 0.0022 | 0.0011 | 0.3400 | 0.0434 | 0.0264 | 0.0138 | 0.0024 | 0.0076 | 0.4369 |
| 2265004031 | 0.0001 | 0.0002 | 0.0089 | 0.0011 | 0.0007 | 0.0007 | 0.0001 | 0.0003 | 0.0121 |
| 2270004031 | 0.0000 | - | 0.0001 | - | 0.0001 | - | - | - | 0.0003 |
| Turf Equipment | 2265004071 | 0.0016 | 0.0045 | 0.0675 | 0.0099 | 0.0085 | 0.0126 | 0.0034 | 0.0040 | 0.1119 |
| 2270004071 | 0.0000 | 0.0000 | 0.0017 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0019 |
| Lawn Mowers | 2260004011 | 0.0004 | 0.0003 | 0.0669 | 0.0093 | 0.0051 | 0.0029 | 0.0005 | 0.0027 | 0.0881 |
| 2265004011 | 0.0016 | 0.0004 | 0.2236 | 0.0275 | 0.0165 | 0.0093 | 0.0010 | 0.0040 | 0.2840 |
| Rear Engine Riding Mowers | 2265004041 | 0.0076 | 0.0046 | 0.3118 | 0.0343 | 0.0294 | 0.0198 | 0.0063 | 0.0137 | 0.4276 |
| 2270004041 | 0.0002 | 0.0004 | 0.0094 | 0.0018 | 0.0012 | 0.0014 | 0.0004 | 0.0005 | 0.0153 |
| Front Mowers | 2265004046 | 0.0006 | 0.0000 | 0.1444 | 0.0198 | 0.0110 | 0.0056 | 0.0022 | 0.0026 | 0.1863 |
| 2270004046 | 0.0000 | 0.0000 | 0.0041 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0000 | 0.0046 |
| Shredders | 2265004051 | 0.0000 | - | 0.0154 | 0.0020 | 0.0011 | 0.0006 | - | 0.0003 | 0.0194 |
| 2270004051 | 0.0000 | - | 0.0026 | 0.0002 | 0.0004 | 0.0000 | 0.0002 | 0.0002 | 0.0036 |
| Lawn and Garden Tractors | 2265004056 | 0.0004 | 0.0004 | 0.0104 | 0.0016 | 0.0129 | 0.0011 | 0.0016 | 0.0009 | 0.0293 |
| 2270004056 | 0.0006 | 0.0002 | 0.0363 | 0.0044 | 0.0020 | 0.0007 | 0.0012 | 0.0006 | 0.0460 |
| Chippers/ Stump Grinders | 2265004066 | 0.0002 | 0.0000 | 0.4730 | 0.0621 | 0.0351 | 0.0194 | 0.0014 | 0.0081 | 0.5993 |
| 2267004066 | - | - | 0.0001 | - | - | - | - | - | 0.0001 |
| 2270004066 | 0.0000 | 0.0000 | 0.0013 | 0.0001 | 0.0001 | 0.0000 | 0.0003 | 0.0000 | 0.0018 |
| Other Lawn and Garden Equipment | 2260004076 | 0.0000 | - | 0.0375 | 0.0041 | 0.0028 | 0.0013 | - | 0.0005 | 0.0463 |
| 2265004076 | 0.0021 | 0.0026 | 0.0674 | 0.0097 | 0.0070 | 0.0084 | 0.0028 | 0.0036 | 0.1037 |
| 2270004076 | 0.0000 | 0.0000 | 0.0020 | 0.0001 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0022 |
| Total | | 0.0277 | 0.0159 | 2.7291 | 0.3257 | 0.2259 | 0.1285 | 0.0409 | 0.0646 | 3.5584 |

Table 3‑4: Ozone Season Weekend Commercial Lawn and Garden Equipment VOC Emissions by County, 2012

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Atascosa  (48013) | Bandera  (48019) | Bexar  (48029) | Comal  (48091) | Guadalupe  (48187) | Kendall  (48259) | Kerr  (48265) | Medina  (48325) | Total |
| Tillers | 2260004016 | - | - | 0.0010 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0012 |
| 2265004016 | 0.0000 | 0.0000 | 0.0012 | 0.0002 | 0.0001 | 0.0001 | 0.0000 | 0.0000 | 0.0017 |
| 2270004016 | - | - | 0.0000 | - | - | - | - | - | 0.0000 |
| Chain Saws | 2260004021 | 0.0001 | 0.0000 | 0.0302 | 0.0037 | 0.0020 | 0.0012 | 0.0002 | 0.0005 | 0.0378 |
| 2265004021 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0001 |
| Trimmers | 2260004026 | 0.0008 | 0.0002 | 0.0489 | 0.0066 | 0.0040 | 0.0018 | 0.0027 | 0.0007 | 0.0656 |
| 2265004026 | 0.0000 | - | 0.0045 | 0.0002 | 0.0001 | 0.0001 | - | 0.0000 | 0.0049 |
| Leaf Blowers | 2260004031 | 0.0001 | 0.0002 | 0.0314 | 0.0038 | 0.0022 | 0.0015 | 0.0002 | 0.0006 | 0.0399 |
| 2265004031 | 0.0000 | 0.0000 | 0.0015 | 0.0002 | 0.0001 | 0.0002 | 0.0000 | 0.0001 | 0.0021 |
| 2270004031 | - | - | 0.0000 | - | 0.0000 | - | - | - | 0.0000 |
| Turf Equipment | 2265004071 | 0.0005 | 0.0015 | 0.0187 | 0.0030 | 0.0026 | 0.0041 | 0.0011 | 0.0013 | 0.0329 |
| 2270004071 | 0.0000 | 0.0000 | 0.0003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0003 |
| Lawn Mowers | 2260004011 | 0.0000 | 0.0001 | 0.0061 | 0.0008 | 0.0005 | 0.0004 | 0.0000 | 0.0002 | 0.0081 |
| 2265004011 | 0.0001 | 0.0001 | 0.0218 | 0.0028 | 0.0017 | 0.0011 | 0.0001 | 0.0004 | 0.0282 |
| Rear Engine Riding Mowers | 2265004041 | 0.0005 | 0.0013 | 0.0382 | 0.0047 | 0.0034 | 0.0042 | 0.0010 | 0.0014 | 0.0549 |
| 2270004041 | 0.0000 | 0.0001 | 0.0019 | 0.0003 | 0.0002 | 0.0004 | 0.0001 | 0.0001 | 0.0033 |
| Front Mowers | 2265004046 | 0.0001 | - | 0.0140 | 0.0022 | 0.0013 | 0.0005 | 0.0006 | 0.0002 | 0.0190 |
| 2270004046 | 0.0000 | - | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 |
| Shredders | 2265004051 | - | - | 0.0015 | 0.0002 | 0.0001 | 0.0001 | - | 0.0000 | 0.0018 |
| 2270004051 | 0.0000 | - | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 |
| Lawn and Garden Tractors | 2265004056 | 0.0002 | 0.0001 | 0.0024 | 0.0006 | 0.0007 | 0.0004 | 0.0006 | 0.0001 | 0.0051 |
| 2270004056 | 0.0001 | 0.0001 | 0.0022 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0032 |
| Chippers/ Stump Grinders | 2265004066 | - | - | 0.0456 | 0.0060 | 0.0034 | 0.0018 | 0.0000 | 0.0008 | 0.0576 |
| 2267004066 | - | - | - | - | - | - | - | - | - |
| 2270004066 | 0.0000 | 0.0000 | 0.0001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0002 |
| Other Lawn and Garden Equipment | 2260004076 | - | - | 0.0030 | 0.0004 | 0.0002 | 0.0001 | - | 0.0001 | 0.0038 |
| 2265004076 | 0.0003 | 0.0008 | 0.0112 | 0.0017 | 0.0014 | 0.0022 | 0.0006 | 0.0007 | 0.0188 |
| 2270004076 | 0.0000 | 0.0000 | 0.0005 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0005 |
| Total | | 0.0028 | 0.0046 | 0.2865 | 0.0378 | 0.0244 | 0.0204 | 0.0076 | 0.0073 | 0.3914 |

Table 3‑5: Ozone Season Daily Commercial Lawn and Garden Equipment Emissions by SCC Code, San Antonio New Braunfels MSA, 2012

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC Code | NOX | | | | VOC | | | |
| Weekday | | Weekend | | Weekday | | Weekend | |
| TexN Model | Updated Emission Inventory | TexN Model | Updated Emission Inventory | TexN Model | Updated Emission Inventory | TexN Model | Updated Emission Inventory |
| Tillers | 2260004016 | 0.0008 | 0.0001 | 0.0005 | 0.0000 | 0.0300 | 0.0114 | 0.0180 | 0.0012 |
| 2265004016 | 0.0013 | 0.0007 | 0.0008 | 0.0017 | 0.0155 | 0.0150 | 0.0093 | 0.0017 |
| 2270004016 | - | 0.0000 | - | 0.0000 | - | 0.0000 | - | 0.0000 |
| Chain Saws | 2260004021 | 0.0074 | 0.0084 | 0.0044 | 0.0032 | 0.5681 | 0.4600 | 0.3409 | 0.0378 |
| 2265004021 | - | 0.0001 | - | 0.0001 | - | 0.0017 | - | 0.0001 |
| Trimmers | 2260004026 | 0.0038 | 0.0158 | 0.0023 | 0.0128 | 0.1724 | 0.6217 | 0.1034 | 0.0656 |
| 2265004026 | 0.0001 | 0.0018 | 0.0001 | 0.0002 | 0.0010 | 0.0283 | 0.0006 | 0.0049 |
| Leaf Blowers | 2260004031 | 0.0069 | 0.0111 | 0.0041 | 0.0139 | 0.3284 | 0.4369 | 0.1971 | 0.0399 |
| 2265004031 | 0.0023 | 0.0020 | 0.0014 | 0.0032 | 0.0097 | 0.0121 | 0.0058 | 0.0021 |
| 2270004031 | 0.0002 | 0.0019 | 0.0001 | 0.0000 | 0.0000 | 0.0003 | 0.0000 | 0.0000 |
| Turf Equipment | 2265004071 | 0.0020 | 0.0210 | 0.0012 | 0.0950 | 0.0098 | 0.1119 | 0.0059 | 0.0329 |
| 2270004071 | 0.0131 | 0.0136 | 0.0078 | 0.0021 | 0.0013 | 0.0019 | 0.0008 | 0.0003 |
| Lawn Mowers | 2260004011 | - | 0.0022 | - | 0.0039 | - | 0.0881 | - | 0.0081 |
| 2265004011 | 0.0165 | 0.0192 | 0.0099 | 0.0093 | 0.1875 | 0.2840 | 0.1125 | 0.0282 |
| Rear Engine Riding Mowers | 2265004041 | 0.0238 | 0.0712 | 0.0143 | 0.0878 | 0.1088 | 0.4276 | 0.0653 | 0.0549 |
| 2270004041 | - | 0.0816 | - | 0.0104 | - | 0.0153 | - | 0.0033 |
| Front Mowers | 2265004046 | 0.0013 | 0.0387 | 0.0008 | 0.0039 | 0.0059 | 0.1863 | 0.0035 | 0.0190 |
| 2270004046 | 0.0527 | 0.0063 | 0.0316 | 0.0008 | 0.0071 | 0.0046 | 0.0043 | 0.0002 |
| Shredders | 2265004051 | 0.0001 | 0.0016 | 0.0001 | 0.0002 | 0.0012 | 0.0194 | 0.0007 | 0.0018 |
| 2270004051 | - | 0.0220 | - | 0.0015 | - | 0.0036 | - | 0.0002 |
| Lawn and Garden Tractors | 2265004056 | - | 0.0047 | - | 0.0085 | - | 0.0293 | - | 0.0051 |
| 2270004056 | - | 0.1818 | - | 0.0169 | - | 0.0460 | - | 0.0032 |
| Chippers/ Stump Grinders | 2265004066 | 0.0208 | 0.5047 | 0.0125 | 0.0484 | 0.0570 | 0.5993 | 0.0342 | 0.0576 |
| 2267004066 | - | 0.0003 | - | - | - | 0.0001 | - | - |
| 2270004066 | 0.1303 | 0.0130 | 0.0782 | 0.0012 | 0.0133 | 0.0018 | 0.0080 | 0.0002 |
| Other Lawn and Garden Equipment | 2260004076 | - | 0.0003 | - | 0.0000 | - | 0.0463 | - | 0.0038 |
| 2265004076 | 0.0034 | 0.0196 | 0.0020 | 0.0501 | 0.0325 | 0.1037 | 0.0195 | 0.0188 |
| 2270004076 | 0.0007 | 0.0069 | 0.0004 | 0.0014 | 0.0001 | 0.0022 | 0.0001 | 0.0005 |
| Total |  | 0.2873 | 1.0507 | 0.1724 | 0.3765 | 1.5498 | 3.5584 | 0.9299 | 0.3914 |

## Temporal Allocation

A weekday versus weekend adjustment factor was calculated based on the total hours of commercial lawn and garden equipment usage for each time period as determined from the surveys for each facility type.

Equation 3‑2, Weekday Allocation of Emissions

DEB.Weekday = (HRSB.Weekday x 5) / [ (HRSB.Weekday x 5) + (HRSB.Weekend x 2) ]

Where,

DEB.Weekday = Percent of Emissions on Weekdays for Commercial Lawn and Garden category B

HRSB.Weekday = Total Survey Weekday Hours for Commercial Lawn and Garden category B

HRSB.Weekend = Total Survey Weekday Hours for Commercial Lawn and Garden category B

Sample Equation: Percentage of commercial lawn and garden equipment operated on weekdays at cemeteries

DEB.Weekday = (275.2 hours x 5) / [ (275.2 hours x 5) + (1.2 hours x 2) ]

= 99.8% of emissions from commerical lawn and garden emissions from cemeteries occur on weekdays.

The percentage of ozone season day emissions that occurs on weekdays and weekend days is provided in Table 3‑6. Universities/colleges, public schools, federal and state parks, other companies, and Stinson airport reported no equipment usage on the weekends. The only categories with significant equipment usage on the weekends were small airports, military facilities, and golf courses. The survey results show that commercial lawn and garden equipment usage was higher on weekdays compared to data in the TexN Model. Table 3‑7 documents EPS3 temporal allocation file factors by commercial lawn and garden category.

Table 3‑6: Weekday and Weekend Allocation of Emissions by Category

|  |  |  |
| --- | --- | --- |
| Category | Weekday Allocation | Weekend Allocation |
| Commercial Lawn and Garden Companies | 96.3% | 3.7% |
| Universities / Colleges | 100.0% | 0.0% |
| Public Schools | 100.0% | 0.0% |
| Golf Courses | 88.2% | 11.8% |
| Government Facilities | 99.3% | 0.7% |
| Federal and State Parks | 100.0% | 0.0% |
| Other Companies | 100.0% | 0.0% |
| Cemeteries | 99.8% | 0.2% |
| Commercial/ Private Airports | 80.9% | 19.1% |
| Stinson Airport | 100.0% | 0.0% |
| San Antonio International Airport | 93.8% | 6.2% |
| Military Facilities | 84.3% | 15.7% |
| Weighted Average\* | 95.7% | 4.3% |
| Existing Data in TexN Model# | 81.0% | 19.0% |

\*Weighted by total NOX Emissions

#Based on Weekend Emissions per day being 60% compared to a Weekend day

Table 3‑7: EPS3 Temporal Allocation File Factors by Commercial Lawn and Garden Category

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Category | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday | Total |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Commercial Lawn and Garden Companies | 21 | 21 | 21 | 21 | 21 | 2 | 2 | 147 |
| Universities / Colleges | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| Public Schools | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| Golf Courses | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 21 |
| Government Facilities | 54 | 54 | 54 | 54 | 54 | 1 | 1 | 378 |
| Federal and State Parks | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| Other Companies | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| Cemeteries | 142 | 142 | 142 | 142 | 142 | 1 | 1 | 994 |
| Commercial/ Private Airports | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 35 |
| Stinson Airport | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| San Antonio International Airport | 6 | 6 | 6 | 6 | 6 | 1 | 1 | 42 |
| Military Facilities | 13 | 13 | 13 | 13 | 13 | 6 | 6 | 91 |
| Weighted Average\* | 9 | 9 | 9 | 9 | 9 | 1 | 1 | 63 |
| Existing Data in TexN Model | 16 | 16 | 16 | 16 | 16 | 10 | 10 | 112 |
| Existing Data in TCEQ Modeling Files | 16 | 16 | 16 | 16 | 16 | 10 | 10 | 112 |

\*Weighted by total NOX Emissions

# Appendix A: TexN Load and Emission Factors for Commercial Lawn and Garden Equipment: Bexar County, 2012

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Minimum HP | Maximum HP | LF | NOX | VOC |
| Tillers | 2260004016 | 0 | 1 | 0.4 | 1.12 | 175.55 |
| 2260004016 | 1 | 3 | 0.4 | 1.15 | 182.63 |
| Chain Saws | 2260004021 | 1 | 3 | 0.7 | 1.23 | 64.41 |
| 2260004021 | 3 | 6 | 0.7 | 0.85 | 66.42 |
| Trimmers | 2260004026 | 0 | 1 | 0.91 | 1.68 | 63.57 |
| 2260004026 | 3 | 6 | 0.91 | 1.18 | 47.75 |
| LeafBlowers | 2260004031 | 0 | 1 | 0.94 | 1.59 | 62.25 |
| 2260004031 | 3 | 6 | 0.94 | 1.11 | 43.68 |
| Turf Equipment | 2260004071 | 1 | 3 | 0.6 | 0.99 | 124.83 |
| Shedders | 2260007005 | 6 | 11 | 0.7 | 0.85 | 62.19 |
| Lawn Mowers | 2265004011 | 1 | 3 | 0.33 | 2.74 | 40.67 |
| 2265004011 | 3 | 6 | 0.33 | 2.27 | 32.32 |
| 2265004011 | 6 | 11 | 0.33 | 2.36 | 35.35 |
| Tillers | 2265004016 | 3 | 6 | 0.4 | 2.45 | 54.78 |
| Trimmers | 2265004026 | 3 | 6 | 0.91 | 1.74 | 23.76 |
| 2265004026 | 6 | 11 | 0.91 | 1.82 | 10.73 |
| 2265004026 | 11 | 16 | 0.91 | 1.79 | 8.70 |
| 2265004026 | 16 | 25 | 0.91 | 1.79 | 8.67 |
| LeafBlowers | 2265004031 | 3 | 6 | 0.94 | 1.95 | 23.72 |
| 2265004031 | 6 | 11 | 0.94 | 1.99 | 9.85 |
| 2265004031 | 11 | 16 | 0.94 | 2.04 | 9.94 |
| 2265004031 | 16 | 25 | 0.94 | 2.06 | 9.93 |
| 2265004031 | 25 | 40 | 0.94 | 3.80 | 5.54 |
| 2265004031 | 50 | 75 | 0.94 | 4.79 | 6.36 |
| 2265004031 | 100 | 175 | 0.94 | 4.81 | 6.36 |
| Rear Engine Riding Mowers | 2265004041 | 3 | 6 | 0.38 | 2.04 | 24.16 |
| 2265004041 | 6 | 11 | 0.38 | 2.46 | 13.83 |
| 2265004041 | 11 | 16 | 0.38 | 2.58 | 14.66 |
| 2265004041 | 16 | 25 | 0.38 | 2.43 | 14.51 |
| Front Mowers | 2265004046 | 6 | 11 | 0.65 | 2.05 | 9.66 |
| 2265004046 | 11 | 16 | 0.65 | 1.97 | 8.96 |
| 2265004046 | 16 | 25 | 0.65 | 2.36 | 10.95 |
| 2265004046 | 25 | 40 | 0.65 | 4.49 | 5.04 |
| Shredders | 2265004051 | 1 | 3 | 0.8 | 1.87 | 22.04 |
| 2265004051 | 3 | 6 | 0.8 | 1.92 | 22.06 |
| Lawn and Garden Tractors | 2265004056 | 3 | 6 | 0.44 | 2.01 | 22.86 |
| 2265004056 | 6 | 11 | 0.44 | 2.50 | 15.01 |
| 2265004056 | 11 | 16 | 0.44 | 2.50 | 15.34 |
| 2265004056 | 16 | 25 | 0.44 | 2.38 | 14.51 |

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| --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Minimum HP | Maximum HP | LF | NOX | VOC |
| Chippers/Stump Grinders | 2265004066 | 3 | 6 | 0.78 | 2.13 | 20.29 |
| 2265004066 | 6 | 11 | 0.78 | 2.02 | 9.46 |
| 2265004066 | 11 | 16 | 0.78 | 1.93 | 8.54 |
| 2265004066 | 16 | 25 | 0.78 | 2.26 | 10.73 |
| 2265004066 | 25 | 40 | 0.78 | 4.28 | 5.24 |
| 2265004066 | 50 | 75 | 0.78 | 4.81 | 5.56 |
| 2265004066 | 75 | 100 | 0.78 | 4.79 | 5.27 |
| 2265004066 | 100 | 175 | 0.78 | 4.79 | 5.50 |
| Turf Equipment | 2265004071 | 3 | 6 | 0.6 | 2.31 | 32.25 |
| 2265004071 | 6 | 11 | 0.6 | 2.56 | 13.52 |
| 2265004071 | 11 | 16 | 0.6 | 2.49 | 12.56 |
| 2265004071 | 16 | 25 | 0.6 | 2.45 | 12.97 |
| 2265004071 | 25 | 40 | 0.6 | 4.78 | 5.75 |
| 2265004071 | 50 | 75 | 0.6 | 4.81 | 4.92 |
| Other Lawn and Garden Equipment | 2265004076 | 0 | 1 | 0.58 | 2.11 | 37.64 |
| 2265004076 | 1 | 3 | 0.58 | 1.65 | 21.47 |
| 2265004076 | 3 | 6 | 0.58 | 1.98 | 20.08 |
| 2265004076 | 6 | 11 | 0.58 | 2.03 | 11.15 |
| 2265004076 | 11 | 16 | 0.58 | 2.15 | 10.01 |
| 2265004076 | 16 | 25 | 0.58 | 2.42 | 12.84 |
| 2265004076 | 25 | 40 | 0.58 | 3.69 | 4.43 |
| 2265004076 | 50 | 75 | 0.58 | 3.70 | 4.09 |
| 2265004076 | 75 | 100 | 0.58 | 3.70 | 3.99 |
| 2265004076 | 100 | 175 | 0.58 | 3.70 | 3.91 |
| Shredders | 2265007010 | 6 | 11 | 0.8 | 1.92 | 9.52 |
| 2265007010 | 11 | 16 | 0.8 | 2.01 | 8.22 |
| 2265007010 | 16 | 25 | 0.8 | 2.28 | 9.14 |
| Chippers/Stump Grinders | 2267004066 | 25 | 40 | 0.78 | 6.45 | 1.78 |
| 2267004066 | 50 | 75 | 0.78 | 7.26 | 1.90 |
| 2267004066 | 75 | 100 | 0.78 | 7.23 | 1.90 |
| 2267004066 | 100 | 175 | 0.78 | 7.23 | 1.90 |
| Leaf Blowers | 2270004031 | 3 | 6 | 0.43 | 5.67 | 1.03 |
| 2270004031 | 25 | 40 | 0.43 | 4.35 | 0.85 |
| 2270004031 | 40 | 50 | 0.43 | 4.35 | 0.85 |
| 2270004031 | 50 | 75 | 0.43 | 4.09 | 0.56 |
| 2270004031 | 75 | 100 | 0.43 | 4.03 | 0.56 |
| 2270004031 | 100 | 175 | 0.43 | 3.97 | 0.40 |
| Front Mowers | 2270004046 | 3 | 6 | 0.43 | 5.36 | 0.97 |
| 2270004046 | 6 | 11 | 0.43 | 5.10 | 0.92 |
| 2270004046 | 11 | 16 | 0.43 | 4.76 | 0.95 |
| 2270004046 | 16 | 25 | 0.43 | 4.83 | 0.96 |
| 2270004046 | 25 | 40 | 0.43 | 4.31 | 0.84 |
| 2270004046 | 40 | 50 | 0.43 | 4.38 | 0.85 |
| 2270004046 | 50 | 75 | 0.43 | 4.09 | 0.56 |
| 2270004046 | 75 | 100 | 0.43 | 4.05 | 0.56 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Minimum HP | Maximum HP | LF | NOX | VOC |
| Lawn and Garden Tractors | 2270004056 | 6 | 11 | 0.43 | 5.10 | 0.92 |
| 2270004056 | 11 | 16 | 0.43 | 4.93 | 0.98 |
| 2270004056 | 16 | 25 | 0.43 | 4.79 | 0.95 |
| 2270004056 | 25 | 40 | 0.43 | 4.29 | 0.84 |
| 2270004056 | 40 | 50 | 0.43 | 4.30 | 0.84 |
| 2270004056 | 75 | 100 | 0.43 | 4.03 | 0.56 |
| Chippers/Stump Grinders | 2270004066 | 16 | 25 | 0.43 | 4.80 | 0.95 |
| 2270004066 | 25 | 40 | 0.43 | 4.32 | 0.84 |
| 2270004066 | 40 | 50 | 0.43 | 4.33 | 0.85 |
| 2270004066 | 50 | 75 | 0.43 | 4.09 | 0.56 |
| 2270004066 | 75 | 100 | 0.43 | 4.01 | 0.55 |
| 2270004066 | 100 | 175 | 0.43 | 3.97 | 0.41 |
| 2270004066 | 175 | 300 | 0.43 | 3.79 | 0.37 |
| 2270004066 | 300 | 600 | 0.43 | 3.78 | 0.32 |
| 2270004066 | 600 | 750 | 0.43 | 3.78 | 0.31 |
| 2270004066 | 750 | 1000 | 0.43 | 4.75 | 0.43 |
| 2270004066 | 1000 | 1200 | 0.43 | 4.75 | 0.43 |
| Turf Equipment | 2270004071 | 6 | 11 | 0.43 | 5.53 | 1.00 |
| 2270004071 | 11 | 16 | 0.43 | 4.96 | 0.98 |
| 2270004071 | 16 | 25 | 0.43 | 4.77 | 0.95 |
| 2270004071 | 25 | 40 | 0.43 | 4.40 | 0.86 |
| 2270004071 | 40 | 50 | 0.43 | 4.30 | 0.84 |
| 2270004071 | 50 | 75 | 0.43 | 4.10 | 0.56 |
| 2270004071 | 75 | 100 | 0.43 | 4.04 | 0.56 |
| 2270004071 | 100 | 175 | 0.43 | 3.98 | 0.41 |
| Other Lawn and Garden Equipment | 2270004076 | 11 | 16 | 0.43 | 4.80 | 0.95 |
| 2270004076 | 16 | 25 | 0.43 | 4.82 | 0.96 |
| 2270004076 | 25 | 40 | 0.43 | 4.35 | 0.85 |
| 2270004076 | 40 | 50 | 0.43 | 4.35 | 0.85 |
| 2270004076 | 50 | 75 | 0.43 | 4.09 | 0.56 |
| 2270004076 | 75 | 100 | 0.43 | 4.03 | 0.56 |
| 2270004076 | 100 | 175 | 0.43 | 3.98 | 0.41 |
| Specialty Vehicles/Carts | 2260001060 | 6 | 11 | 0.58 | 1.94 | 12.67 |
| 2260001060 | 25 | 40 | 0.58 | 0.70 | 142.78 |
| 2260001060 | 50 | 75 | 0.58 | 0.70 | 142.63 |
| Specialty Vehicles/Carts | 2265001060 | 1 | 3 | 0.58 | 1.93 | 30.40 |
| 2265001060 | 3 | 6 | 0.58 | 1.93 | 26.72 |
| 2265001060 | 11 | 16 | 0.58 | 2.10 | 10.88 |
| 2265001060 | 16 | 25 | 0.58 | 2.45 | 12.99 |
| 2265001060 | 25 | 40 | 0.58 | 4.05 | 4.98 |
| 2265001060 | 40 | 50 | 0.58 | 4.05 | 4.62 |
| 2265001060 | 50 | 75 | 0.58 | 4.05 | 4.44 |
| 2265001060 | 75 | 100 | 0.58 | 4.05 | 4.28 |
| 2265001060 | 100 | 175 | 0.58 | 4.05 | 4.18 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Equipment Type | SCC | Minimum HP | Maximum HP | LF | NOX | VOC |
| Specialty Vehicles/Carts | 2267001060 | 25 | 40 | 0.58 | 6.09 | 1.70 |
| 2267001060 | 40 | 50 | 0.58 | 6.09 | 1.70 |
| 2267001060 | 50 | 75 | 0.58 | 6.09 | 1.70 |
| 2267001060 | 75 | 100 | 0.58 | 6.09 | 1.70 |
| 2267001060 | 100 | 175 | 0.58 | 6.09 | 1.70 |
| Specialty Vehicles/Carts | 2270001060 | 11 | 16 | 0.21 | 5.35 | 2.16 |
| 2270001060 | 16 | 25 | 0.21 | 5.35 | 2.16 |
| 2270001060 | 25 | 40 | 0.21 | 4.77 | 2.00 |
| 2270001060 | 40 | 50 | 0.21 | 4.77 | 2.00 |
| 2270001060 | 50 | 75 | 0.21 | 4.60 | 1.31 |
| 2270001060 | 75 | 100 | 0.21 | 4.63 | 1.35 |
| 2270001060 | 100 | 175 | 0.21 | 4.63 | 1.00 |
| 2270001060 | 175 | 300 | 0.21 | 4.41 | 0.92 |
| 2270001060 | 300 | 600 | 0.21 | 4.41 | 0.80 |
| 2270001060 | 1000 | 1200 | 0.21 | 5.37 | 1.03 |

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