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## **Economic value and structure of the Tennessee turfgrass industry in 1991**

Joseph Eric Carson

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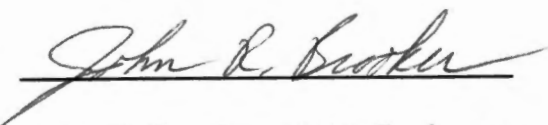
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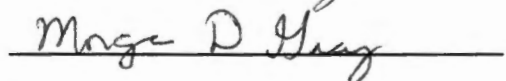
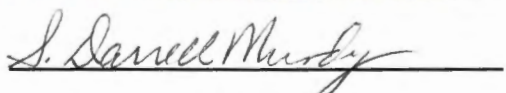

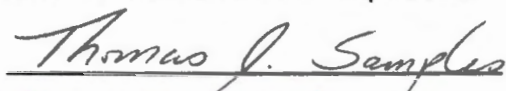
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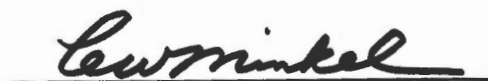


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**ECONOMIC VALUE AND STRUCTURE OF THE TENNESSEE  
TURFGRASS INDUSTRY IN 1991**

**A Thesis**

**Presented for the**

**Master of Science**

**Degree**

**The University of Tennessee, Knoxville**

**Joseph Eric Carson**

**May 1993**

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To my family, the most important contributors, who not only gave me the guidance, patience, and encouragement that I needed, but also their love.

## ABSTRACT

The purpose of this study was to define the structure and estimate the value of the Tennessee turfgrass industry in 1991. The turfgrass industry in Tennessee encompassed the development, production, and management of specialized grasses for utility, beautification, and recreation. By using this definition, the structure of the industry was determined. There were fifteen components identified as relevant to this study and each of these were sampled by either list frame sampling procedures or random list frame sampling procedures. The fifteen components that made up the Tennessee turfgrass industry were: (1) airports, (2) cemeteries, (3) churches, (4) commercial establishments (industrial and motels/hotels), (5) counties, (6) golf courses, (7) home owners, (8) institutions (health agencies, hospitals, mental health agencies, and nursing homes), (9) lawn care companies, (10) multiple dwellings, (11) municipalities, (12) parks, (13) roadsides, (14) schools, (15) sod producers.

Mail questionnaires were used to gather the information needed for this study. Most of the questionnaires were designed to collect information on the total area of turf maintained and the annual expenditures to maintain this turf. There were also questions dealing with new equipment expenditures in 1991 and current and replacement cost of the existing equipment. Information was also collected about turf care problems, source of answers to turf management problems, and number of persons employed with turfgrass responsibilities.

After the data were collected, a sample mean was determined for each

question on the questionnaire. This mean was then multiplied by the estimated proportion of the population that maintained a lawn. This product provided an estimate of the total amount of acres maintained or the dollar values expended in 1991. The total estimated turf acres maintained in Tennessee in 1991 was 889,382 acres. To maintain this turf, an estimated \$360 million was expended by the fifteen components of the industry. Detailed information regarding sample means and confidence intervals are presented by expense categories for all fifteen components of the turf industry.

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## CHAPTER I

### INTRODUCTION

#### Turfgrass Industry Growth and Importance

In the past 30 years Americans have moved from an agriculturally based economy to an industrialized economy. The movement from one type of economy to another, along with the increased growth in the population, has caused a change in the landscape from one characterized by farmlands and cities to a suburban landscape. The establishment and maintenance of turfgrass has dominated land development in the new suburbs [Price, Rossi, Dhillon, and Hailey]. The movement in types of economies has also caused an important growth in the turfgrass industry because of the additional amount of technology associated with the industrialized economy. This technology, which has made many jobs easier and faster, has generated adjustments in overall lifestyles.

Some of this free time is utilized not only by recreational and other types of activities, but also by home maintenance/improvement activity. The attractiveness of a lawn has not only influenced the homeowner but also the overall public [Emmons]. These manicured lawns not only serve the aesthetic appeal of people, but also provide a shield that helps prevent soil erosion and trap much of the estimated 12 million tons of dust released into the earth's atmosphere each year. The turfgrass cover also provides glare reduction, heat dissipation, and safety conditions for recreational purposes [Daniel and Freeborg]. Without adequate

information, the general public will be unaware of the economic value of the maintenance of turfgrass to the state's economy.

### Differences in Turf Described by Definitions

Three key definitions presented by Vengris and Torello describe the differences between turf, lawns, and turfgrass ecosystem. First, **turf** is defined as a dense vegetative ground cover composed of close-mown stems and leaves of plants. This type of turf comprises plant life, such as grasses or other small plants, which exists on the upper stratum of the earth's surface. The second definition is for **lawn**, which is defined to include any grass or small plant life that is maintained solely for outdoor recreation. A lawn is usually kept closely mown for the purpose of looking pleasing to the eye. Lawns are commonly found around homes, parks, schools, etc. The third definition is **turfgrass ecosystem**. A turfgrass ecosystem refers to a tightly knit group of turf-type plants existing in intimate association with its immediate environment. Edaphic factors (characteristics of the soil), climatic factors (temperature, light, wind, moisture), and biotic factors (plants, animals, and cultural practices such as chemical applications) affect the way the ecosystem survives.

### Turfgrass Industry Definition and Components

In this study, turfgrass was defined to encompass all three definitions developed by Vengris and Torello. These turf stands are located around areas

such as homes, parks, institutions, golf courses, airports, schools, and other related areas. Management of these lawn areas contributes to the overall turfgrass industry. The turfgrass industry encompasses the development, production, and management of specialized grasses for utility, beautification, and recreation. Grasses used for pasture and other forage purposes were excluded from this definition of the turfgrass industry.

The turfgrass industry in the United States is a multibillion dollar business, and is one of the fastest growing segments of the horticulture industry in general [Emmons]. Contained within this turfgrass industry are many economic specializations such as development, production, and management that make up the turfgrass industry [Daniel and Freeborg]. These activities produce jobs not only in the areas of maintenance and installations of turf, but also in sales of pesticides, horticultural supplies, sod farming, seed production, garden centers, manufacturing of turf equipment, and sales and service of this equipment. All of these together make the turfgrass industry an important component in the economy of any state.

#### Turfgrass Industry Information for Tennessee

The value of turfgrass industry in Tennessee has not been estimated via a statistically sound procedure. Because of this data void, a need for this type of information has evolved. The Tennessee Turfgrass Association, from which this study has been partially funded, desires this information to enhance service to

members of its association and the general public. Industry participants in both turfgrass production and maintenance need quantitative and qualitative data to be better able to prioritize research issues and to help develop long-run strategies. The maintenance professionals in the state, such as golf course superintendents, can also use the information in turf-care planning and budgeting decisions.

### Objectives

The overall goal of this project was to estimate the annual economic value of the turfgrass industry, i.e., the total amount of money spent on turfgrass maintenance in Tennessee during 1991. Several objectives, which are actually procedural steps that need to be accomplished in order to achieve the overall goal, are listed below.

1. Identification of the various components to be included as part of the Tennessee turfgrass industry and determination of the population within each of these components.
2. Determination of the appropriate sampling procedure and the resulting sample size for each component of the turfgrass industry.
3. Collection of the required turf-maintenance expense information from each component of the turfgrass industry.
4. Estimation of the total amount spent for turfgrass maintenance, total value of turf maintenance equipment, and total acreage of turf maintained in Tennessee.



## CHAPTER II

### REVIEW OF LITERATURE

#### Other State Turfgrass Surveys

Researchers have conducted surveys of the turfgrass industry in many states during the past 30 years. The primary goals of these surveys were to: (1) list the important strata that make up the turfgrass industry in that particular state, (2) estimate the annual turfgrass maintenance costs for each strata identified, and (3) generate a comprehensive, industry-wide turfgrass maintenance value. There have been studies limited to a major city, such as Atlanta, Georgia and Los Angeles, California. On the other hand, other studies conducted in Ohio, Kentucky, Oklahoma, North Carolina, New Jersey, Maryland, Florida, and Pennsylvania allowed researchers to estimate the value of the turfgrass industry for the entire state. Also, there have been studies that focused on the sod production industry, as was the case in Alabama and Florida. Each of these studies used various survey techniques to collect the necessary primary data.

#### Sampling Techniques Used in Previous Turfgrass Surveys

Three different sampling techniques were used in the turfgrass studies summarized in this section. The main procedure used was simple random sampling from a list frame. This procedure involved the selection or generation of a list of all participants within a particular defined component. The intent was to

attain a suitable list that would adequately represent the total, true population of a particular component. These lists were acquired by using the yellow and white pages of a phone book, published listings provided by departments within state and federal governments, or provided by associations that have members that belong to the industry component that was being surveyed. Once the list frame was obtained, the sample size and method of collecting the primary data could be determined.

Another sampling technique researchers used in turfgrass studies in other states was area frame sampling. When surveys involve populations in large areas such as several counties or an entire state, the land area could be divided into strata based on geographic determinants to facilitate sampling and data collection. The survey area was divided into segments that are often based on agricultural land use. Selected segments would then be identified as the sample and would be used to represent the population [Hansen, Hurwitz, and Madow]. This type of sampling allows areas to be represented proportionately, e.g., densely populated suburban areas located around cities may need more representation than areas located in farming communities or areas located in dense urban environments. With this method of sample selection, enumerators were used to personally collect the desired information.

The third sampling technique used in prior turfgrass industry surveys was stratified random sampling. Stratified random sampling involves the use of past data to divide the population into groups that are more homogenous than if the

groups in the population were left as a single population list [Hansen, Hurwitz, and Madow]. After the stratification was determined, then simple random sampling was used to draw the sample from the stratified groups. This approach was used when it was considered desirable to ensure proportionate representation of identified components of a certain population. The total turfgrass expenditures, sampling procedures, and percentages of each category surveyed in prior studies in several states are presented in Table 2.1 and discussed in the next section of this thesis.

### Expenditures In Other States Based on Maintenance Intensity

#### Intense Care

Many of the costs that are associated with turfgrass are based on the generalized intensity of maintenance. Daniel and Freeborg defined eight main categories of turf care, with the first category being termed **Intense Care**. This type of turf care includes areas such as golf courses, grass courts for tennis, croquet courts, and lawn bowling. The desired goal of achieving perfect turfgrass quality is matched by the intended skillful use of the area. The way different types of balls react to the way grass is maintained is of concern to many people. Players want the grass surface to give the perfect bounce, the perfect putt, or the perfect backspin and roll. This type of perfection means the playing fields must be groomed daily with specialized equipment under the specialized management of professionals.

**Table 2.1 Turfgrass expenditures, sampling procedures, and percentages of stratum totals as compared to the state's overall turfgrass expenditures by states from previous studies.**

States	Categories Surveyed	Cost of Lawn Maintenance (\$000)	Percentage of Total
Ohio 1989	Airports <sup>a</sup>	774	*
	Cemeteries <sup>a</sup>	12,823	1.1
	Churches <sup>a</sup>	12,656	1.1
	Commercial <sup>b</sup>	51,493	4.5
	Counties <sup>a</sup>	5,024	*
	Garden Centers <sup>a</sup>	15,015	1.3
	Golf Courses <sup>a</sup>	97,091	8.4
	Home Lawns <sup>b</sup>	737,318	63.7
	Institutions <sup>a</sup>	13,449	1.2
	Land Scapers <sup>a</sup>	81,924	7.0
	Lawn Care <sup>a</sup>	64,902	5.6
	Multiple Dwellings <sup>b</sup>	21,120	1.8
	Municipalities <sup>a</sup>	16,809	1.5
	Racetracks <sup>a</sup>	1,209	*
	Roadsides <sup>a</sup>	7,101	*
	Schools <sup>a</sup>	14,887	1.3
Sod Producers <sup>a</sup>	<u>4,707</u>	<u>*</u>	
	<b>Total</b>	<b>1,158,304</b>	<b>100</b>
Kentucky 1989	Airports <sup>a</sup>	666	0.3
	Cemeteries <sup>a</sup>	5,683	2.5
	Child Care <sup>a</sup>	52	*
	Churches <sup>a</sup>	1,978	0.9
	Golf Courses <sup>a</sup>	22,162	9.8
	Home Lawns <sup>b</sup>	126,950	56.2
	Lawn Care <sup>a</sup>	36,906	16.3
	Nursing Homes <sup>a</sup>	1,434	0.6
	Parks <sup>a</sup>	5,324	2.4
	Public Utilities <sup>a</sup>	545	0.2
	Roadsides <sup>a</sup>	14,992	6.6
	Schools <sup>a</sup>	6,774	3.0
	Sod Producers <sup>a</sup>	<u>2,640</u>	<u>1.2</u>
	<b>Total</b>	<b>226,106</b>	<b>100</b>
Oklahoma 1987	Airports <sup>a</sup>	1,660	0.6
	Golf Courses <sup>a</sup>	21,465	7.4
	Home Lawns <sup>c</sup>	241,429	82.8
	Highways <sup>a</sup>	8,300	2.8
	Parks <sup>a</sup>	5,800	2.0
	Schools <sup>a</sup>	4,914	1.6
	Sod Producers <sup>a</sup>	5,475	1.9
	Universities <sup>a</sup>	<u>2,656</u>	<u>0.9</u>
	<b>Total</b>	<b>291,699</b>	<b>100</b>

**Table 2.1 (cont.)**

States	Categories Surveyed	Cost of Lawn Maintenance (\$000)	Percentage of Total
Oklahoma 1977	Airports <sup>a</sup>	270	*
	Golf Courses <sup>a</sup>	12,328	17.7
	Home Lawns <sup>a</sup>	44,244	63.7
	Highways <sup>a</sup>	7,062	10.2
	Parks <sup>a</sup>	3,553	5.1
	Schools <sup>a</sup>	1,262	1.8
	Universities <sup>a</sup>	<u>776</u>	<u>1.1</u>
	<b>Total<sup>d</sup></b>	69,495	100
North Carolina 1986	Airports <sup>a</sup>	2,687	0.4
	Athletic Fields <sup>a</sup>	1,855	0.3
	Cemeteries <sup>a</sup>	1,983	0.3
	Churches <sup>a</sup>	5,489	0.7
	Commercial/Multiple Dwellings <sup>b</sup>	168,599	23.0
	Golf Courses <sup>a</sup>	51,899	7.1
	Home Lawns <sup>b</sup>	338,594	46.1
	Institutions <sup>a</sup>	22,057	3.0
	Landscapers <sup>a</sup>	76,368	10.4
	Lawn Care <sup>a</sup>	25,882	3.5
	Parks <sup>a</sup>	16,331	2.2
	Roadsides <sup>a</sup>	13,920	1.9
	Schools <sup>a</sup>	5,672	0.8
	Sod Producers <sup>a</sup>	<u>2,426</u>	<u>0.3</u>
	<b>Total</b>	733,762	100
New Jersey 1983	Airports <sup>a</sup>	1,874	0.4
	Cemeteries <sup>a</sup>	19,776	4.4
	Churches <sup>a</sup>	11,066	2.4
	Commercial <sup>o</sup>	70,000	15.6
	Golf Courses <sup>a</sup>	49,417	11.1
	Highways <sup>a</sup>	4,805	1.2
	Home Lawns <sup>c</sup>	215,899	48.3
	Institutions <sup>a</sup>	7,944	1.8
	Multi-Family Dwellings <sup>c</sup>	20,397	4.6
	Parks <sup>a</sup>	24,711	5.5
	Schools <sup>a</sup>	<u>20,943</u>	<u>1.2</u>
	<b>Total<sup>d</sup></b>	446,832	100

**Table 2.1 (cont.)**

States	Categories Surveyed	Cost of Lawn Maintenance (\$000)	Percentage of Total
Maryland 1979	Airports <sup>a</sup>	1,659	0.8
	Cemeteries <sup>a</sup>	13,808	7.2
	Churches <sup>a</sup>	248	0.1
	Golf Courses <sup>a</sup>	20,642	10.7
	Home Lawns <sup>a</sup>	95,226	49.3
	Miscellaneous: <sup>a</sup>		
	State Health	503	0.3
	State Buildings	73	*
	Lawn Care <sup>a</sup>	33,500	17.4
	Parks: <sup>a</sup>		
	State	157	*
	County	4,363	2.3
	Roadsides: <sup>a</sup>		
	State	3,775	2.0
	County	1,255	0.7
	Schools: <sup>a</sup>		
	Comm. Colleges	421	0.2
	Priv. Colleges	810	0.4
	Priv. Schools	7,046	3.6
	Public Schools	5,971	3.1
	State Colleges	538	0.3
Sod Producers <sup>a</sup>	<u>3,069</u>	<u>1.6</u>	
<b>Total<sup>f</sup></b>	<b>193,064</b>	<b>100</b>	
Florida 1974	Airports <sup>a</sup>	1,655	0.4
	Colleges <sup>a</sup>	2,857	0.6
	Golf Courses <sup>a</sup>	50,417	11.2
	Highways <sup>a</sup>	8,170	1.8
	Home Lawns <sup>b</sup>	344,883	76.5
	Hotels/Motels <sup>a</sup>	2,064	0.5
	Multi-Family Dwellings <sup>a</sup>	13,964	3.1
	Parks <sup>a</sup>	5,601	1.2
	Others	16,604	3.7
	Schools <sup>a</sup>	<u>4,373</u>	<u>1.0</u>
<b>Total<sup>d</sup></b>	<b>450,588</b>	<b>100</b>	



**Table 2.1 (cont.)**

States	Categories Surveyed	Cost of Lawn Maintenance (\$000)	Percentage of Total
Pennsylvania 1966	Airports <sup>a</sup>	386	0.2
	Athletic Fields <sup>a</sup>	24,790	10.7
	Cemetery/Church <sup>a</sup>	11,294	4.9
	Golf Courses <sup>a</sup>	18,465	8.0
	Highways <sup>a</sup>	3,639	1.6
	Home Lawns <sup>b</sup>	119,729	51.8
	Motels/Hotels <sup>a</sup>	1,833	0.7
	Multi-Family Dwellings <sup>a</sup>	973	0.4
	Other <sup>a</sup>	1,170	0.5
	Parks <sup>a</sup>	44,165	19.1
	Schools <sup>a</sup>	4,187	1.8
	Sod Producers <sup>a</sup>	488	0.2
	Turnpikes <sup>a</sup>	211	0.1
<b>Total</b>	<b>231,330</b>	<b>100</b>	

Source: 1989 Ohio Turfgrass Survey, 1989 Kentucky Turfgrass Survey, 1987 and 1977 Oklahoma Turfgrass Survey, 1986 North Carolina Turfgrass Survey, An Economic Survey of New Jersey Turfgrass, 1983, 1979 Maryland Turfgrass Report, 1974 Florida Turfgrass Survey, and 1966 Pennsylvania Turfgrass Survey.

<sup>a</sup> List frame sampling procedure.

<sup>b</sup> Area frame sampling procedure.

<sup>c</sup> Stratified random sampling procedure.

<sup>d</sup> The overall state totals did not include sod producers.

<sup>e</sup> Commercial establishments expenditure data taken from secondary sources such as lawn care companies' commercial accounts.

<sup>f</sup> State totals are truncated so the overall totals in chart do not match the totals correctly as given in original survey.

Bowling greens, grass tennis courts, and croquet courts have to be kept well groomed to ensure the appropriate response of the balls used during the game. These three sports are played on very limited areas, and their maintenance expenses are usually included in the overall turfgrass expenses listed in the parks where they are maintained. These areas are so small otherwise that they were not included within any known study as a unique strata within a comprehensive survey.

Golf courses have been around since the 1500's, but golf in the United States began with the first course built in 1890. Since this time, golf has become a popular sport for the American public. In 1986, there were 13,181 golf courses in the United States. These courses were built on 1,330,000 acres of land with an estimated capital investment of 5 billion dollars. In 1966 the turfgrass industry was estimated to comprise \$4 billion of the U.S. GNP [Daniel and Freeborg].

Total turfgrass industry maintenance estimates in other states reveal the importance of this intensive care category. Researchers in the 1989 Ohio study reported after using a list frame sampling procedure that golf courses accounted for \$97.1 million of the estimated \$1.2 billion in total maintenance expenditures across all surveyed strata [Sporleder, Synder, and Distad]. These expenses occurred on the 615 golf courses that existed on 97,000 acres. The major expense category for golf course maintenance was labor. The total labor expense for Ohio golf courses was estimated to be \$49 million [Sporleder et al.]. The second major expense category was for mowing supplies and equipment purchased during the year. This expense category was estimated at \$18 million,



which emphasizes that maintenance of a golf course requires expensive specialized equipment. The other areas that contributed to the overall maintenance expense for golf courses in Ohio were chemicals, which accounted for \$10.5 million, irrigation at \$6.4 million, and fertilizer at \$5.7 million.

A Kentucky turfgrass survey was conducted by researchers in 1989 using list frame sampling procedures and reported that the 216 golf courses had a total turf area of 20,800 acres and accounted for an estimated \$22.2 million of the \$226.1 million total maintenance cost for turf in the state [Kentucky Agricultural Statistical Service]. Labor for golf courses was estimated to be \$13.2 million. Approximately 60 percent of every dollar spent on golf course maintenance was for labor. The second highest expense category was for equipment maintenance and repair, \$1.4 million. The third highest cost category was for supplies purchased in 1989, \$1.3 million.

The 164 golf courses surveyed by researchers using list frame sampling procedures in the 1987 Oklahoma turfgrass survey were located on 24,609 acres, in comparison to the 155 courses located on 16,829 acres in the 1977 Oklahoma Turfgrass Survey [Martin]. The researchers concluded that golf courses represented \$21.5 million or 7.4 percent of the estimated \$291.7 million of the total turfgrass maintenance cost for the state. This compared to the 1977 results that reported the maintenance cost for golf courses was 17.7 percent of the total turf maintenance cost of \$ 69.4 million for the state [Oklahoma Agricultural Experiment Station]. Labor was estimated to be 57.4 percent of the total cost in golf course

maintenance in 1987, and the second highest expense was fertilizer at 7.1 percent [Martin].

Researchers in North Carolina surveyed 478 golf courses using list frame sampling procedures in 1986 and found that these courses were located on 204,600 acres of land and had an annual maintenance cost of \$51.9 million [North Carolina Crop and Livestock Reporting Service]. This represented 7.1 percent of the estimated \$733.8 million total turf maintenance expense for North Carolina. Labor represented the highest golf course expense at \$23.4 million, and equipment purchased in 1986 was in second place with an estimated \$7.8 million [North Carolina Crop and Livestock Reporting Service].

Based on a turfgrass survey conducted in New Jersey in 1983, researchers using list frame sampling procedures estimated that the 227 golf courses in New Jersey had a total acreage of 25,717 acres [Price, Rossi, Dhillon, Hailey]. These courses had a total maintenance cost of \$49.4 million. The state's total turf maintenance costs across all strata were estimated at \$452.4 million; therefore, golf courses represented 10.9 percent of the state's total. Labor costs accounted for 58.4 percent of the total costs for golf courses, and the second highest cost category was in the area of repairs, \$3.8 million [Price, Rossi, Dhillon, Hailey].

Researchers in a Maryland turfgrass study using list frame procedures in 1979 reported that there were 132 golf courses located in Maryland with a total acreage of 21,978 acres [Maryland Turfgrass Council, Inc.]. The total maintenance cost for this strata was \$20.6 million, which accounted for 10.7 percent of the total turf

maintenance cost of \$193 million for entire state. The study did not list maintenance costs separately for each category.

A 1974 study conducted by researchers using a list frame sampling procedure in Florida reported that the 512 courses maintained 50,000 acres and accounted for \$50.4 million or 11.2 percent of the estimated \$450.6 million total turf maintenance expenditure for the state [Florida Crop and Livestock Reporting Service]. The largest expense category for golf courses was labor, which was estimated at \$28.3 million or 56 percent. The second largest expense category was irrigation equipment purchased in 1974, which accounted for 12 percent. Other major categories included fertilizer at 11 percent, turf and irrigation equipment maintenance at 4 percent, and fuel/oil costs at 3 percent.

In 1966, researchers in a study conducted in Pennsylvania surveyed 474 golf courses using list frame procedures and found that the courses occupied 44,632 acres and had a total estimated turf maintenance cost of \$18.5 million [Pennsylvania Crop Reporting Service]. This maintenance cost for golf courses represented around 8.0 percent of the total turf maintenance costs of \$231.3 million for the entire state. The highest cost associated with golf courses in Pennsylvania was in the area of labor, estimated at \$10,357,000. This figure accounted for 56 percent of the total expenditure for golf courses turf maintenance in 1966. Fertilizer expenses and irrigation expenses each represented 9 percent of the total spent on golf course maintenance. One other major cost category was for equipment purchased that year, which was valued at \$41,119,000.



## Intense Wear

The second major turf-care category defined by Daniel and Freeborg is termed **Intense Wear**. The major turfgrass areas in this category are athletic areas, such as the large areas used for football, baseball, rugby, lacrosse, and etc. These areas do not include the small fields used for recreation at small schools or at certain parks, but are those fields used by the professionals or maintained at colleges that usually have TV coverage of sports events.

The main concern for proper turfgrass care within the **Intense Wear** category is primarily for the 'footing' of the players with less emphasis on ball response [Daniel and Freeborg]. Most of the sports played on these types of fields require some sort of body contact, running, and falling. With these types of actions taking place, these playing surfaces need to 'give' to alleviate the stress on body parts. Turfgrasses help to absorb or reduce some of these stresses.

Turfgrass specialists dealing with these types of fields are concerned with three areas: condition or health of the turfgrass, the firmness and uniformity of footing for the player, and the color and grooming of the turf surface for aesthetic value to the spectator [Daniel and Freeborg]. Maintenance for this type of turf requires larger equipment and the expertise of a professional grounds manager.

Universities, colleges and schools are considered to be included in the **Intense Wear** category because of the existing playing fields. Most of the expenditure data for this category also includes the maintenance of regular lawn areas at these institutions.

Researchers in the Ohio turfgrass study using a list frame sampling procedure on schools reported that the total turfgrass maintenance cost for schools was estimated at \$14.9 million. The largest category of expense, which accounted for 49 percent, was labor, \$7.3 million [Sporleder, Synder, and Distad]. The second major expense category was mowing supplies and equipment purchased that year, \$4.4 million. This represented 29 percent of the total expenditure by schools.

Researchers in Kentucky using list frame sampling procedures in 1989 reported that the 1,657 schools spent \$6.8 million to maintain their estimated 25,600 turf acres. This study was unique in that expenses for athletic fields were estimated separately from the expenses for school lawns. The athletic fields alone accounted for \$1.8 million of this total and were located on 2,900 acres. Again labor was the highest expense item and accounted for 76 percent of the total expenses [Kentucky Agricultural Statistics Service]. The second major expense was for equipment supplies, which represented 5 percent of total expenditures.

Oklahoma researchers estimated that the 524 schools and universities surveyed using list frame sampling procedures in 1977 spent \$2.0 million on maintenance, when in 1987 the cost of maintaining turf for 684 schools and universities was estimated at \$7.6 million. Labor represented 73 percent of the expenditures for 1977 [Oklahoma Agricultural Experiment Station]. In 1987, labor represented 71 percent of the total [Martin]. The second major expense in 1977 was for water, \$116,000. In 1987, the second major maintenance cost was for fertilizer, \$479,000.

In North Carolina, researchers surveyed a strata called athletic field complexes in 1986 using list frame sampling procedures. There were 202 of these complexes, and the turf area was estimated to be 9,450 acres. Maintenance costs for these complexes were estimated to be \$1.9 million. Labor, which was estimated to be \$1.2 million, made up 64 percent of these expenses. Equipment and the supplies (fuel, oil, etc.) purchased in 1986 were estimated to cost \$219,000. The schools in North Carolina were also surveyed using list frame sampling procedures and researchers reported that an estimated 34,100 acres of turf were being maintained at an estimated cost of \$5.7 million. Labor was estimated to be 36.4 percent of this total cost of maintenance [North Carolina Crop and Livestock Reporting Service].

New Jersey researchers using list frame sampling procedures reported that in 1983 a sample of 100 school districts surveyed from the 592 operating school districts estimated the total maintenance cost for this strata at \$20.9 million. Labor was estimated to be \$13.5 million, which was 64 percent of the total spent. The second major cost in this category was fertilizer. Fertilizer was estimated to cost \$1.7 million [Price, Rossi, Dhillon, Hailey].

Researchers in Maryland using list frame sampling procedures found that the estimated total cost for turf maintenance for the estimated 2,000 schools to be \$14.8 million in 1979. The expenses were not listed individually.

In the 1974 Florida turf study researchers using list frame sampling procedures found that both colleges and schools had a combined total of \$7.2 million for turf

maintenance. Both had labor as the highest expense with colleges having \$2.2 million and schools having \$2.9 million [Florida Crop and Livestock Reporting Service]. The second major expense for both was equipment purchased in 1974. Colleges spent an estimated \$170,000 for new equipment and schools spent an estimated \$223,000 for new equipment.

In Pennsylvania the 4,111 existing were sampled using a list frame sampling procedure by researchers in 1966. Results from the study showed that an estimated turf maintenance expenditure of \$4.2 million was used for schools. The total turf area maintained for the school systems was estimated to be 34,193 acres, with athletic fields occupying 10,302 acres. Labor, which cost the school systems \$2.3 million, was the largest turfgrass maintenance expense [Pennsylvania Crop Reporting Service]. The estimated new equipment expense in 1966 was the second largest expense at \$324,982. Another major category included in the Pennsylvania study was athletic fields. There were 1,952 athletic fields included in the survey and the cost of maintaining the 165,920 acres of turf was estimated to be \$24.8 million. The largest expense was for labor which cost an estimated \$23.4 million. This represented more than 94 percent of the total cost of maintenance

### Medium Wear

The third major category of turf care is termed **Medium Wear**. This category is concerned with caring for turfgrass in areas such as parks, playgrounds, and campgrounds. Because more people are visiting parks and recreational facilities,



there has been an emphasis to establish and maintain good turfgrass quality in these types of areas. The main purpose of turf care for these areas is to make the recreational facilities more attractive and enjoyable to the users [Daniel and Freeborg]. To achieve these objectives, these types of areas may need the advice or even the employment of a professional manager, but these objectives are not always possible because of the budgeting problems associated with these types of areas.

The federal government controls an estimated 19 million acres in 309 parks and 286 park "areas". State governments control an estimated 8.6 million acres in 3,500 state parks. Municipalities and county governments control an estimated one million acres in 31,000 parks [Daniel and Freeborg]. All of the acres controlled by both the federal, state, county, and city governments are not necessarily maintained turfgrass; however, a substantial portion of the total area is covered in grass that must be maintained.

The 1989 turfgrass survey conducted by researchers using a list frame sampling procedure in Kentucky found that parks maintained an estimated 24,000 acres of turf. The estimated maintenance cost was \$5.3 million. This value represented only 2 percent of the total turfgrass expenditures for the state. The largest expense for parks was for labor, \$3.8 million, which accounted for 71 percent of the total park budget allocated to turf maintenance [Kentucky Agricultural Statistical Service].



Oklahoma researchers surveyed 95 parks in 1987 using list frame sampling procedures and found that an estimated 18,050 acres were maintained in the state at a cost of \$5.8 million. This value represented 2 percent of the total turfgrass maintenance expenditure for Oklahoma. In 1977, an estimated 35,300 acres were maintained at a cost of \$3.6 million. Labor represented 79 percent of the total costs in 1987 and 82 percent in 1977 [Oklahoma Agricultural Experiment Station].

North Carolina researchers using a list frame sampling procedure reported that 128,590 acres of turf were maintained on the 385 parks that existed in 1986. Total maintenance expenditures for the parks were estimated at \$16.3 million. Labor was again the largest cost category for maintaining turf. This cost was estimated to be \$7.2 million, which was 44 percent of the total spent on park turf maintenance.

In New Jersey, the state park system and the county and municipal park systems were surveyed by researchers separately in 1983 using a list frame sampling procedure. The state park system controlled an estimated 30 parks that accounted for more than 2,453 acres of turf area. The county and municipal park system controlled an estimated 3,062 parks and maintained an estimated 42,750 acres of turf. The state park expenditures for turf maintenance was an estimated \$810,000. Turf maintenance costs for the county and municipal park systems totaled an estimated \$23.9 million. Labor represented the largest expense in both sectors. Labor costs for turf maintenance in state and municipal parks accounted for 64 and 61 percent of the total cost, respectively [Price, Rossi, Dhillon, Hailey].

Researchers in the Maryland using list frame sampling procedures accounted for 34 state parks and 889 county parks in 1979. These two sectors combined maintained an estimated 6,670 acres of turf. The state parks total expenditures for turfgrass maintenance was \$157,000, and the county park total expenditure was estimated to be \$4.4 million. Expenditures for specific items were not listed separately.

Florida maintained an estimated 16,846 acres in 1,190 parks in 1974 according to researchers. The researchers used list frame sampling procedures to sample these parks and found that the total maintenance expenditure for the parks was an estimated \$5.6 million. Labor costs were the highest expense item, accounting for 57 percent of the total expenditures used for turf maintenance [Florida Crop and Livestock Reporting Service].

Researchers using list frame sampling procedures in the 1966 Pennsylvania survey reported that 1,503 parks in the state had 56,163 acres of maintained lawn area. Lawns in the parks required an annual maintenance expenditure of \$44.2 million. Labor cost estimated at \$37.9 million, represented 86 percent of the total turf expenditures [Pennsylvania Crop Reporting Service].

### Limited Wear

The fourth major category of turf care is termed **Limited Wear**. This category includes lawns found in areas such as industrial lawns, institutional and government areas, churches, and cemeteries. These areas usually require a wide

diversity in care, technology, and equipment. These lawns are primarily established and maintained for aesthetic value rather than for vigorous wear [Daniel and Freeborg].

Ohio researchers surveyed 119,890 commercial establishments using an area frame sampling technique and determined that an estimated \$51.5 million was spent for turfgrass maintenance on an estimated 68,700 acres. There were an estimated 1,531 institutions, but only 796 institutions were sampled using list frame sampling procedure. The lawn area associated with the institutions was estimated to be 15,600 acres, and the cost of maintaining this area was estimated to be \$13.4 million [Sporleder, Synder, and Distad]. The 382 municipalities sampled using list frame sampling procedure spent an estimated \$16.8 million for turfgrass maintenance on an estimated 60,700 acres, and the 88 counties spent an estimated \$5.9 million on an estimated 64,000 acres of turf. The 1,274 churches surveyed using list frame sampling procedure maintained 31,700 acres and spent an estimated \$12.7 million, with the 351 cemeteries surveyed using list frame sampling procedure maintained an estimated 24,500 acres and spent an estimated \$12.8 million for turf maintenance.

Kentucky researchers surveyed the churches by using a list frame procedure and found that an estimated 5,300 acres were being maintained in 1989 with an expenditure of around \$2.0 million [Kentucky Agricultural Statistical Service]. The cemeteries surveyed using list frame sampling procedures maintained 5,100 acres with the cost of turfgrass maintenance being \$5.7 million. There were 248 child

care facilities also surveyed using list frame sampling procedure, and an estimated 100 acres of turf was maintained at a cost of \$52,000. The 318 nursing homes surveyed using list frame sampling procedures reported that there were 1,600 acres maintained at a maintenance cost of \$1.4 million.

The 1987 or 1977 Oklahoma surveys did not include commercial establishments, governmental agencies, institutions, churches, or cemeteries.

In North Carolina researchers used an area frame sampling procedure to sample the estimated 130,900 commercial/multiple dwellings establishments. In 1986, an estimated lawn area of 144,000 acres was maintained at an annual cost of \$168.6 million. There were 707 institutional facilities sampled using a list frame procedure and researchers found that an estimated 96,000 acres was being maintained at an annual maintenance cost of \$22.1 million. Churches were sampled using list frame sampling technique. Based on a sample of 695 churches of the 6,900 that existed, an estimated 29,800 acres of turf was maintained at a cost of \$5.5 million. There were also 158 cemeteries surveyed using a list frame procedure. An estimated 5,700 acres were being maintained at a cost of \$2.0 million.

Researchers in New Jersey used list frame sampling procedures to obtain the data needed for institutions, churches, and cemeteries in 1983. All existing public and private institutions were grouped together into one strata. This strata included colleges, universities, private schools, correctional facilities, mental health agencies, and veteran hospitals. A sample of 80 institutions was taken and researchers



reported that an estimated 8,135 acres were maintained. The total cost of maintaining these acres was estimated to be \$7.9 million. Researchers took a sample of 155 churches and estimated the land area used for turf was 9,250 acres and the cost of maintaining this turfgrass was estimated to be \$11.0 million. The 400 cemetery lawns sampled in New Jersey had an estimated turf area of 16,500 acres. The cost of maintaining this acreage was estimated at \$19.8 million. Commercial establishment data was obtained from secondary sources such as lawn care companies' commercial accounts. The cost of maintaining the estimated 40,000 acres of turf in 1983 was \$70.0 million

In Maryland, churches, cemeteries, and state buildings were all surveyed using list frame procedures. Researchers concluded that the 2,595 churches spent an estimated \$248,000 on turfgrass maintenance in 1979. The total lawn area for churches in Maryland was an estimated 1,298 acres. The individuals in charge of turf maintenance at the 133 cemeteries surveyed maintained an estimated 27,398 acres with an estimated cost of turf maintenance at \$13.8 million. State building employees reported that an estimated 32 acres of turf was maintained at an estimated cost of \$73,000. The state institutions such as health agencies were also surveyed. The cost of maintaining the estimated 129 acres of turf was estimated to be \$503,000.

The Florida study conducted in 1974 did not include specified strata such as commercial establishments, institutions, churches, cemeteries, and/or governmental agencies.

The Pennsylvania turfgrass survey conducted in 1966 combined churches and cemeteries together into one strata, and this strata was surveyed using list frame sampling procedures. There were 14,838 churches/cemeteries located in Pennsylvania, and the researchers reported an estimated 65,584 acres of lawn area in use. The associated maintenance cost was an estimated \$11.3 million.

### Small Areas

The fifth major category of turf care is termed **Small Areas**. These areas are usually managed by individuals or professional lawn care specialists. These areas that are termed **Small Areas** often requires small equipment. Use of technology in this area of turf care may be limited. Areas that are termed **Small Areas** include home lawns, apartments, condominiums, motels/hotels, and resorts. These areas of maintenance are usually small and numerous in every state. A well kept lawn improves the aesthetics and increases the monetary value of a home. The O.M. Scott Company found realtors in several cities considered a good lawn to contribute approximately 3 percent of the value of a house. Healthy trees and shrubs offer another 3 percent in the selling value [Daniel and Freeborg].

Ohio researches, using an area frame sampling technique, reported that in 1989 the 2,518,772 home lawns totaled 1,490,500 acres and were maintained at a cost of \$737.3 million [Sporleder, Synder, and Distad]. Home lawn maintenance expenditures represented 64 percent of the estimated \$1.2 billion in total turfgrass expenditures for all strata surveyed. The 161,429 apartments or multiple dwellings,

were also surveyed using an area frame sampling technique. An estimated 11,500 acres of turf were maintained at a cost of \$21.1 million. The multiple dwellings strata represented only 2 percent of the state total expenditure on turfgrass. Motels, hotels, and resorts were included in the commercial establishments strata listed earlier in **Limited Wear**.

An area frame sample was used to survey home owners in Kentucky in 1989. The lawn area was estimated to be 522,000 acres [Kentucky Agricultural Statistical Service]. Maintenance of home lawns was estimated to cost \$127.0 million, which was 56.2 percent of the state total expenditures for turfgrass maintenance. Multiple dwellings, motels/hotels, and resorts were not included in the Kentucky report.

The Oklahoma study completed by researchers in 1977 showed that the 1,200 homeowners surveyed by stratified random sampling maintained an estimated 94,313 acres of lawn. By 1987, researchers reported that the lawn acreage increased to an estimated 298,140. The cost of maintaining the lawns in 1977 was an estimated \$44.2 million. In 1987, the cost of lawn maintenance was estimated to be \$241.4 million. In 1977, the estimated cost of home lawn maintenance was 64 percent of the state's total turfgrass expenditure, and in 1987 the estimated lawn maintenance cost was 83 percent of the total turf expenditures for the state. Motels/hotels, and resorts were not included either survey conducted in 1977 or 1987.

The North Carolina survey conducted in 1986 by researchers using an area frame technique estimated the home lawn turf acreage at 1.3 million acres. The cost of maintaining this turf was \$338.6 million or 46 percent of the total spent for turf maintenance state wide. The multiple dwellings were included in the strata termed commercial/multiple dwelling establishments, which were recorded earlier in the turf care category termed **Limited Wear**.

Based on a stratified random sample of 375 New Jersey homeowners in 1983, researchers estimated that 660,000 acres of turf were maintained in the state. The total cost of maintaining this turf was estimated to be \$215.9 million, representing 48 percent of the total expenditures for turfgrass maintenance in New Jersey. According to a stratified random sample of multi-family dwellings, the total acreage maintained for this group was estimated at 9,850. The cost of maintaining the turf was estimated at \$20.4 million.

Researchers in Maryland using a list frame sampling procedure reported that in 1979 an estimated 1,042,200 homeowners spent \$95.2 million for annual lawn maintenance on 208,440 acres. Multiple dwellings, motels/hotels, and resorts were not included in this study.

In 1974, Florida researchers used an area frame sampling technique and estimated that 2,494,452 homeowners spent \$344.9 million maintaining the estimated 592,802 acres. The multiple dwellings and motels/hotels were surveyed using a list frame sampling procedure. The individuals in charge of turf maintenance for 30,670 multiple dwelling facilities, in which only 3,067 were actually



surveyed, maintained an estimated 7,044 acres at a cost of \$14.0 million. Based on a list frame sampling procedure survey of 650 of the 6,498 existing motels/hotels, an estimated 5,698 acres of turf were maintained at a cost of \$2.1 million.

In Pennsylvania an area frame sampling procedure was used to estimate the total turf expenditures for home owners in 1966. There were an estimated 2,250,309 homes in the state. The total acreage maintained in turf was estimated at 435,379 acres. The total cost of maintaining this turfgrass was estimated to be \$119.7 million. The 3,281 multiple dwellings using a list frame sampling procedure had an estimated lawn area of 1,090 acres, for which maintenance costs were estimated to be \$973,000. The motel/hotel strata using a list frame sampling procedure had 1,819 facilities with an estimated total lawn area of 3,929 acres that cost \$1.8 million for annual turf maintenance.

### Limited Care

The sixth major category of turf care is termed **Limited Care**. This type of turf care deals with areas such as roadside, airports, fairgrounds, reserve land, dams, levees, pond embankments and flood plains. These turf areas usually require only limited or minimal maintenance. After establishment of such areas, turf is usually mowed two to three times annually and receives a herbicide application every two to four years [Daniel and Freeborg]. The maintenance of turf in this category usually requires large equipment and herbicide application.

Ohio researchers using a list frame sampling procedure in 1989 reported that an estimated 50,000 acres of roadside turf was maintained at an estimated annual cost of \$7.1 million [Sporleder, Synder, and Distad]. Labor, which was estimated to cost \$5.6 million, accounted for 89 percent of the total spent on roadside turf maintenance. Ohio researchers using list frame sampling procedures also reported an estimated 10,500 acres were maintained at the 96 existing airports. The cost of maintaining this turf was estimated to be \$774,000 with the largest expense category being mowing supplies and equipment purchased. This category cost an estimated \$419,000. Researchers in Ohio surveyed the racetracks in the state by using list frame sampling procedure and estimated that 2,600 acres of turf was being maintained at a cost of \$1.2 million.

In Kentucky researchers using list frame sampling procedure reported that 279,000 acres of roadside turf were maintained in the state in 1989. The estimated maintenance cost was \$15.0 million. The largest expense category in the maintenance of roadside turf was labor, \$9.2 million, which accounted for 61 percent of the total maintenance expenses for roadside turf [Kentucky Agricultural Statistical Service]. The 75 operating airports surveyed using list frame sampling procedure reported that 11,100 acres of turf was being maintained at a cost of \$666,000. The largest expense for airports was for labor, \$189,000. Kentucky researchers also included public utilities in the survey in 1989. This category was surveyed using list frame sampling procedures and the researchers reported an estimated 700 acres of turf was being maintained at a cost of \$545,000.

In 1977, researchers in Oklahoma using list frame sampling procedures estimated roadside turf at 232,864 acres with a maintenance cost of \$7.1 million. The 1987 study reported an estimated 232,864 turf acres maintained at an estimated cost of \$8.3 million. The 105 Oklahoma airports surveyed in 1977 using list frame sampling procedure resulted in an estimate of 10,303 acres of turf maintained at a cost of \$270,000. The 1987 survey of 125 airports also using a list frame procedure resulted in an estimated 81,875 acres maintained at a cost \$1.7 million. Labor was the leading expense in both 1977 and 1987. Labor cost was estimated to be 57 and 76 percent of the total cost in 1977 and 1987, respectively.

In North Carolina researchers using list frame sampling procedure reported that an estimated 297,000 acres of roadside turf was maintained in 1986. The estimated total maintenance cost was \$13.9 million. The largest expense category for roadside turf care was labor, estimated to be \$5.2 million. The 144 airports surveyed using list frame sampling procedures were estimated to have maintained a turf area of 41,000 acres, at a cost of \$2.7 million. The largest expense category for these airports was labor, estimated at \$1.1 million.

Researchers in New Jersey using list frame sampling procedure reported an estimated 19,650 acres were maintained by roadside crews in 1983, at an annual cost of \$4.8 million. The highest expense category associated with roadside turf care in New Jersey was labor, estimated to be 44 percent of the total cost [Price, Rossi, Dhillon, Hailey]. An estimated 3,854 acres was maintained at the 76 existing

airports at a maintenance cost of \$1.9 million. The largest expense category associated with airports was also labor, estimated at 79 percent of the total.

Maryland researchers using list frame sampling procedures reported that an estimated 29,546 acres of roadside turf was maintained at an annual maintenance cost of \$5.0 million. There were no individual expense categories listed in the Maryland survey. The 124 airports surveyed using list frame sampling procedures by researchers reported that an estimated 3,968 acres were being maintained at a cost of \$1.7 million.

The study conducted by researchers in Florida in 1974 using list frame sampling procedures reported that 126,055 acres were being maintained on the roadside. The maintenance cost for this turf was estimated to be \$8.2 million. The largest expense within the category of roadside maintenance was labor, which represented 70 percent of the maintenance costs [Florida Crop and Livestock Reporting Service]. The 281 airports surveyed using list frame sampling procedures in 1974 maintained an estimated 26,787 acres of turf. The cost associated with maintaining this turf was estimated to be \$1.7 million, with the largest single expense being labor, 66 percent.

For Pennsylvania, researchers using list frame sampling procedures estimated that 133,700 acres of turf were being maintained on the highways and turnpikes in 1966. The total annual cost of maintaining this turfgrass was estimated to be \$3.6 million, with labor accounting for 77 percent of the total [Pennsylvania Crop Reporting Service]. The 627 airports surveyed using list frame sampling

procedures maintained an estimated 19,489 acres of turf at a cost of \$368,000. The largest expense in the area of turf maintenance at airports was labor, which represented 42 percent of total.

### Production

The seventh area associated with turf care is **Production**. Sod production has been the focus of individual studies in Alabama and Florida as well as being included in other overall turfgrass industry surveys.

Researchers using a list frame procedure reported that 53 Ohio producers had an estimated overall maintenance expenditure of \$4.7 million for the estimated 19,400 acres used for turf production. The highest expense category was labor, which had an estimated cost of \$1.7 million [Sporleder, Synder, and Distad]. The second major expense associated with sod production was for fertilizer, \$760,000.

Researchers in Kentucky in 1989 using list frame sampling procedures reported that 23 turf producers had an estimated 4,900 acres in sod production and an estimated annual production/maintenance expenditure of \$2.6 million. The largest maintenance expense was in the area of labor and management, which cost an estimated \$1.4 million [Kentucky Agricultural Statistical Service]. The second major expense was for equipment maintenance and repair, \$249,000.

Researchers used list frame sampling procedure to survey the 108 sod producers in Oklahoma in 1987. A reported 14,148 acres were being used for sod production. This had an estimated annual maintenance cost of \$5.5 million. The



largest expense was in the area of labor, \$3.0 million, and the second largest being equipment repairs, \$995,000.

North Carolina surveyed 11 producers with the list frame sampling procedure in 1986 and found that an estimated 1,900 acres were in production with an estimated maintenance cost of \$2.4 million annually. Fertilizer was the largest expense in sod production with an estimated cost of \$461,000. The second major expense was mowing equipment purchased in 1986, \$425,000.

New Jersey researchers using a list frame sampling procedure reported that 27 sod producers harvested an estimated 5,500 acres in 1983 with an associated maintenance cost of \$5.6 million. Labor, \$1.9 million, was the largest expense [Price, Rossi, Dhillon, Hailey]. The second largest expense was for repairs, \$753,000. The sod producers were not included in the total turf expenditures for the overall state.

There were 32 sod producers in Maryland surveyed by researchers in 1981 using a list frame sampling procedure. The researchers estimated a total of 6,369 acres in sod production. This turf had an estimated annual maintenance cost of \$3.1 million. Individual expenses were not identified in the survey.

Florida researchers using list frame sampling procedure reported that 58 sod producers in 1974 maintained an estimated 44,150 acres of sod. The total estimated annual turf maintenance expenditures for sod production was \$15.6 million. Labor represented the largest expense category, \$7.5 million and a fertilizer cost of \$1.6 million was the second major expense [Florida Crop and

Livestock Reporting Service]. Florida sod producers were also not included in the overall state expenditure totals.

In 1966, Pennsylvania researchers using list frame sampling procedure reported that 25 sod producers had an estimated 2,926 acres in sod production. The estimated maintenance cost for these sod production facilities was \$488,000. The largest expense associated with sod production was labor, \$275,000, and the second major expense was fertilizer, \$72,000 [Pennsylvania Crop Reporting Service].

Alabama researchers surveyed the sod industry for the state in 1981, 1985, and 1991 using list frame sampling procedure. The sod production study in 1981 indicated that in 1978 there were 26 sod producers maintaining an estimated 2,871 acres of turf. The annual cost for maintaining this sod was estimated to be \$1.9 million [Adrian, Yates, and Dickens]. The largest expense item was labor, \$1.0 million, and the second highest was fuel and lubricants, \$325,000. There were an estimated 39 sod producers in business in 1983 with a total of 5,454 acres of sod [Adrian, Lokey, and Dickens]. The maintenance cost associated with production was not estimated in this study. In 1988, 79 growers reported that 15,062 acres were in sod production [White, Adrian, and Dickens]. This sod had an estimated annual maintenance cost of \$11.6 million. The largest expense was labor, which was estimated to be \$5.2 million. Repairs were the second largest expense, estimated to be \$1.8 million.

Florida researchers also completed a sod production survey using list frame sampling procedure and reported between 100 and 125 sod firms were in operation as of 1991 [Haydu and Cisar]. An estimated 61,276 acres were in sod production. The annual maintenance expenditures associated with sod production were not included in the report.

### Custom Care Services

The final major area of turf care deals with **Custom Care Services**. This category includes professional lawn care and ground management. This category has grown rapidly since 1960. Professionals who work in the lawn service industry are expected to provide maintenance and products associated with turf care. More than 7,000 professionally trained employees treat less than 6 percent of the 90 million lawns in the U.S. [Daniel and Freeborg].

Researchers in Ohio reported that there were an estimated 419 lawn and ground care firms in 1989. These lawn and ground care firms state wide were surveyed using a list frame procedure. The annual estimated turfgrass maintenance expenditure was \$64.9 million. The largest expense for these firms was labor, which cost an estimated \$36.0 million [Sporleder, Synder, and Distad]. The second largest expense was for fertilizer, \$13.0 million. Landscapers and garden centers were also surveyed using list frame sampling procedure in Ohio in 1989. Landscapers had an estimated cost of lawn maintenance of \$81.9 million and garden centers contributed an estimated \$15.0 million to the total.



In Kentucky, an estimated 920 lawn care companies were existing in 1989. These firms surveyed via a list frame sampling procedure, had an estimated annual maintenance cost of \$36.9 million. The largest expense for these firms was labor, \$21.6 million, and the second largest expense was fertilizer, \$3.3 million [Kentucky Agricultural Statistical Service].

In North Carolina, researchers used a list frame sampling procedure to obtain the necessary data from 110 lawn care firms in 1986. These firms were responsible for maintaining an estimated 16,170 acres of turf at an annual cost of \$25.9 million. The main expense was for labor, estimated at \$15.6 million, and the second largest expense was for fertilizer, \$4.0 million. Landscapers were also surveyed by researchers using list frame sampling procedures. The annual maintenance cost for turf was estimated to be \$76.4 million.

In Maryland, researchers using list frame sampling procedures estimated the annual maintenance cost for lawn firms to be \$33.5 million . The expenses were not broken out in this study.

The Oklahoma, New Jersey, Florida, and Pennsylvania studies did not include the lawn care strata.

## CHAPTER III

### PROCEDURE

The Tennessee turfgrass industry survey was constructed to collect information on turfgrass maintenance expenditures for the calendar year of 1991. The statewide survey included all of the components that were deemed relevant for the use and maintenance of turfgrass. Turfgrass surveys from other states were used to help identify the components that may be important in Tennessee. Fifteen different components were defined for reporting and sampling purposes. The components chosen were: (1) airports, (2) cemeteries, (3) churches, (4) commercial establishments (industrial facilities and motels/hotels), (5) counties, (6) golf courses, (7) homes, (8) institutions, (9) lawn and ground care firms, (10) multiple dwellings (apartments and condominiums), (11) municipalities, (12) parks, (13) roadsides, (14) schools (colleges), and (15) sod producers. Some of these fifteen components also contained subcomponents. Each component and its subcomponents are presented in Table 3.1.

#### Sampling Procedure Used

Because of the size of the turfgrass industry and the funds available for the project, the decision was made to use mail surveys to collect the desired data from survey samples generated with simple random sampling. There are various other sampling and interview techniques that could have been chosen for this particular

**Table 3.1 The strata and substrata that will be included in the Tennessee turfgrass industry, 1991.**

Strata	Substrata
Airports	Public, Private
Cemeteries	Private, Church
Churches	Cemeteries, Athletic Fields
Commercial Establishments	Industrial, Motels/Hotels
Counties	Government Maintained Buildings, Parks, Roadsides
Golf Courses	Private, Semi-private, Public, Municipal
Homes	None
Institutions	Correctional, Hospitals, Mental, Nursing Homes
Lawn and Ground Care Firms	None
Multiple Dwellings	Apartments, Condominiums
Municipalities	Government Maintained Buildings, Parks, Roadsides
Parks	Federal, State
Roadsides	None
Schools	Universities, Colleges, High Schools, Elementary Schools
Sod Producers	None

project if greater resources had been available. Sampling techniques such as stratified random sampling, systematic sampling, cluster sampling, area frame sampling, etc., could have been used to select the samples. However, to be more effective than simple random sampling, each of these more complex procedures would necessitate more expensive data collection procedures and/or greater a priori information regarding statistical properties of the populations to be sampled. When North Carolina researchers were contacted about the survey that was completed in that state in 1986, they estimated that an area frame sampling of the homeowners in Tennessee with personal interviews would cost more than \$100,000. The key criterion is to use an efficient sampling plan that maximizes precision given the available resources to be expended [Snedecor and Cochran]. The turfgrass industry components for which complete list frames were obtained and were relatively small permitted the entire list frame to be included in the sample. Hence, a complete census was attempted for 13 components. For airports, colleges and universities, cemeteries, counties, golf courses, institutions, lawn and ground care firms, motels/hotels, municipalities, parks, roadsides, schools, and sod producers, each of the facilities or individuals identified as part of a list frame was mailed a questionnaire.

For the four remaining components, churches, commercial establishments, homes, and multiple dwellings, the size of each sample was based on two factors. One, the sample size required to attain a specified level of sampling precision, and two, the cost of conducting the survey. The selected level of sampling precision

was set at a higher level for homes than for the other turf components. This decision was based on the fact that the "homes" component of the turfgrass industry in other states ranged from 47 to 83 percent of the total expenditure value. Hence, this was judged to be a potentially important if not the most important component. On the other hand, churches, commercial establishments, and multiple dwelling combined together accounted for less than 5 percent of total expenditures.

The goal of sampling is to pick a set of elements from a population so that the description of the elements chosen accurately portrays the parameters of the total population from which the elements were selected. The best way of accomplishing this task is to use probability sampling. This procedure also provides methods for estimating the degree of probable success of accurately representing a population [Babbie]. Simple random sampling is designed to take advantage of all the information that is known about the population and to make sure the costs of the sample is taken into account [Snedecor and Cochran]. A random sampling procedure was used for churches, commercial establishments, single dwelling homes, and multiple dwellings. The random selection process allows each element to have an equal chance of being selected and for the selection of one element being totally independent of the other selections in the drawing process [Babbie]. Using this procedure ensures that the selection of the sample is entirely left up to chance [Snedecor and Cochran]. The simple random sampling technique avoids selection bias, which usually exists when there is a systematic



tendency to underrepresent or overrepresent some part of the population, which may be associated with nonrandom sampling techniques [Ott]. Because of the source of the list frames used for churches, commercial establishments, homes, and multiple dwellings, the sample to be drawn from each component was distributed among all Tennessee counties in proportion to the share of single dwelling homes in each county.

#### Determination of Sample Size

Finding estimators of the parameters that could be used to determine statistically the required sample size, such as the mean and variance comprised the second step. Because the standard error was not known a priori, this step was accomplished by using a binomial distribution. A binomial distribution was selected because of the assumptions made about the populations of the components to be sampled. While other important information was desired, the basic question of the survey was whether a lawn was maintained, i.e., yes or no. Hence, a binomial distribution is logical, and perhaps even more importantly, is considered conservative, because other distributions would permit the use of smaller sample sizes to attain the same level of precision.

Selection of confidence levels for the population parameters was the third step to consider in the process of determining sample size. The confidence interval was determined mainly as a result of the survey resources available for the study. When sampling large populations, the goal is to avoid making the sample so large

that the estimate is more accurate than required, while on the other hand, avoid making the sample so small that the sample is too inaccurate [Snedecor and Cochran]. Based on consideration of cost limitations and need for the information to be as accurate as possible, a 95-percent confidence level was chosen and the precision level set at  $\pm .025$  for the homes component and  $\pm .05$  for churches, commercial establishments, and multiple dwellings.

The 1990 United States Census listed 1,108,320 single dwelling detached homes in Tennessee. However, a single source of names and addresses could not be discovered. For the purpose of this study, the telephone books offered the best source for generating a list frame of Tennessee single-dwelling residents. There are obvious weaknesses in using phone books, but this source was presumed to be more consistent across the state and would permit the selection of a better representative sample than other known sources. The yellow pages of the telephone books were the source of the list frames developed for churches and multiple dwellings (apartments and condominiums).

Because the size of the list frames or populations generated to represent churches, commercial establishments, homes, and multiple dwellings precluded a census approach, samples were drawn for examination. However, use of an appropriate statistical procedure requires information regarding the variance of the variable to be estimated. Letting  $x_i$  ( $i = 1, 2, \dots, N$ ) denote the variable being examined where  $N$  represents the total number of observations within a population, then the variance,  $\sigma^2$ , of the population is defined as:

$$\sigma^2 = \frac{\sum (X_i - \bar{X})^2}{N},$$

where  $\bar{X}$  is the population mean. Because  $\bar{x}$  represents the population mean,  $\bar{x}$  is used to represent the sample mean. With a sample size of  $n$ , the standard error of  $\bar{x}$  is defined as:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \sqrt{(1-\Phi)},$$

where  $\Phi = n/N$ , is the sampling fraction. The term,  $\sqrt{(1-\Phi)}$ , is the finite population correction factor. When  $n=N$ , the term makes the standard error of  $\bar{x}$  equal to zero. When the sample is less than 10 percent of the population, the finite population factor can be omitted [Snedecor and Cochran].

In this study, the members of a population could be placed into one of two groups, i.e., they maintained a lawn or they did not maintain a lawn. The estimated standard error of the sample mean is:

$$s_{\bar{x}} = \frac{s}{\sqrt{n}} \sqrt{(1-\Phi)},$$

where  $s$  is the standard deviation of the sample. With simple random sampling for attributed (two groups), the estimated standard error is:

$$s_p = \sqrt{\frac{pq}{n}} \sqrt{(1-\Phi)}, \quad q=1-p,$$

where  $p$  is the proportion of the sample that fits into one of the groups.

Given that the 95-percent confidence limits calculated from a sample mean, assuming an approximately normal distribution, yields:



$$\bar{x} \pm \frac{1.96\sigma}{\sqrt{\eta}},$$

where 1.96 equals the z value for an 95-percent confidence limit, assuming a large sample size. The finite population factor has been omitted. Setting the desired level of precision, or allowable error, L, at  $\pm 5$  percent and allowing 1.96 to be rounded to 2 gives:

$$L = \frac{2\sigma}{\sqrt{\eta}}.$$

Rearranging the terms to solve for sample size yields:

$$\eta = \frac{4\sigma^2}{L^2}.$$

Use of this formula to determine the sample size requires an estimate of the population standard deviation,  $\sigma$ .

In this study, a priori knowledge of an estimate of the population standard deviation is not available. However, because the fundamental attribute allows the use of a binomial proportion,  $\sigma$  can be replaced by  $pq$ . Therefore, the sample size can be determined by using:

$$\eta = \frac{4pq}{L^2},$$

where:

$\eta$  = sample size

$p$  = probability that a lawn is maintained

$q$  = probability that a lawn is not maintained

L = allowable error in the sample mean

The  $p$ ,  $q$ , and  $L$  can represent proportions or percentages in the equation, just as long as they are all expressed in the same units [Snedecor and Cochran]. The allowable error,  $L$ , was set equal to  $\pm 2.5$  percent. The  $p$  and  $q$  were both set equal to 50 percent because the individual or institution contacted either maintained a lawn or did not maintain a lawn. This probability was used because, just like tossing a coin, there is a 50-percent probability of landing on heads or 50-percent chance of landing on tails. If  $p$  were set at .6, then  $q$  would equal  $(1-p)$ , or .4. Use of any other value other than .5 in the formula would yield a smaller required sample size. Because a priori knowledge of the population standard deviation was unavailable, this conservative approach was preferred. Therefore, setting  $p = .5$ ,  $q = .5$ , and  $L = .025$  yields:

$$\eta = \frac{4 (.5) (.5)}{(.025)^2}, \text{ SO } \eta = 1,600.$$

Based on a concern that many of the mailed questionnaires would be discarded by home residents, it was predicted that a 25-percent return rate could be anticipated. Because 1,600 questionnaires had to be returned to obtain the desired level of accuracy and a 25-percent return rate was predicted, the 1,600 was multiplied by four to get a total mailing number of 6,400. This relatively large number was used for this particular stratum because previous turfgrass studies conducted in other states revealed that the homes stratum was the major contributor to the overall turfgrass maintenance expenses.

The churches, commercial establishments, and multiple dwellings sample sizes were determined by the same process. When dealing with a finite population less

than 10,000, a 95-percent confidence interval, and a precision value of  $\pm 5$  percent, the sample size was adjusted to the finite population correction factor [Arkin and Colton]. Setting  $p = .5$ ,  $q = .5$ , and  $L = .05$  yields:

$$\eta = \frac{4 (.5) (.5)}{(.05)^2}, \text{ so } \eta = 400.$$

Adjusting the sample size by the finite population correction factor reduces the required sample size. With:

$$\eta' = \frac{\eta}{1 + \Phi}, \text{ where } \Phi = \frac{\eta}{N}, \text{ then}$$

$$\eta' = \frac{\eta}{1 + \frac{\eta}{N}}.$$

With a list frame for churches of 7,649, the desired sample size is:

$$\eta' = \frac{400}{1 + \frac{400}{7,649}}$$

$$\eta' = 380.$$

For the factories and businesses in the commercial component the list frame contained 5,379 facilities. The desired sample size is :

$$\eta' = \frac{400}{1 + \frac{400}{5,379}}$$

$$\eta' = 372.$$

Finally, the total count of 1,936 in the list frame for multiple dwellings required a sample size of:

$$\eta' = \frac{400}{1 + \frac{400}{1,936}}$$

$$\eta' = 331.$$

Given an assumed response rate in the range 25 to 35 percent for mail surveys, the mailing sample would need to be much larger than the specified sample size required for the specified level of precision and confidence. Hence, the mailing sample was set at 1,000, roughly three times the specified sample, for churches, commercial establishments, and multiple dwellings.

All of the listings in each of these three strata were grouped by county. The household populations in each county [U.S. Census, 1990] were used as a basis for distributing the total sample among the counties in Tennessee. This assured proportional representation based on the distribution of households across the 95 counties in Tennessee.

Self-administered questionnaires were sent by mail to individuals or facilities, and the information returned by the respondents was coded into electronic data files. These data were then checked for inconsistencies either in data entry by the responder, such as the property size being larger than the turf area maintained, etc., or by the data entry clerk. After the data were deemed usable, the totals for the various categories listed for each component were computed. These sample totals were expanded to state totals by multiplying the average dollar or acreage

value by the total population within each stratum for each question [Sporleder, Snyder, Distad].

### Source of List Frames

List frames were obtained through various state offices for airports, cemeteries, counties, golf courses, institutions, motels/hotels, municipalities, parks, roadsides, schools, and sod producers (Table 3.2). The Tennessee Turfgrass Association provided some information regarding golf courses, lawn and ground-care firms, and sod producers. The population of commercial establishments was obtained from the 1991 Directory of Tennessee Manufacturers. For churches, homes, and multiple dwellings, a single published source could not be discovered. The only available source that covered the entire state, and for which the coverage would be relatively consistent from county to county, was the white and yellow pages of telephone books. Telephone books from every city and/or appropriate county were used so that every church, home, and multiple dwelling in Tennessee with a listed telephone number would have an equal probability of being selected in the sampling process. The number of listings in each county comprised the list frame for that county. For example, if county xyz had 15,000 individuals listed in the white pages of the telephone book, and county xyz had two percent of the state's single-dwelling homes in 1990, then 300 names were randomly selected from the white pages of the phone book. A computer program was used to randomly

**Table 3.2 The strata, substrata and populations of each within the Tennessee turfgrass industry, 1991.**

Strata	Substrata	Populations of Substrata	Total Population of Strata
Airports <sup>a</sup>	Public	76	
	Private	13	
<b>Total</b>		<b>89</b>	<b>89</b>
Cemeteries <sup>b</sup>			176
Churches <sup>c</sup>			7,649
Commercial Establishments	Industrial <sup>d</sup>	5,379	
	Motels/Hotels <sup>e</sup>	1,017	
<b>Total</b>		<b>6,396</b>	<b>6,396</b>
Counties <sup>f</sup>			95
Golf Courses <sup>g</sup>			240
Homes(single dwelling) <sup>c</sup>			1,108,320
Institutions	Health Agencies <sup>h</sup>	51	
	Hospitals <sup>i</sup>	188	
	Mental Agencies <sup>h,j</sup>	56	
	Nursing Homes <sup>i</sup>	534	
<b>Total</b>		<b>794</b>	<b>794</b>
Lawn and Ground Care Firms <sup>c</sup>			252
Multiple Dwellings <sup>c</sup>	Apartments	1,810	
	Condominiums	126	
<b>Total</b>		<b>1,936</b>	<b>1,936</b>
Municipalities <sup>f</sup>			339
Parks	Federal <sup>k</sup>	9	
	State <sup>l</sup>	49	
<b>Total</b>		<b>58</b>	<b>58</b>



**Table 3.2 (cont.)**

Strata	Substrata	Populations of Substrata	Total Population of Strata
Roadsides			---
Schools	Colleges <sup>m</sup>	131	
	School Superintendents <sup>n</sup>	269	
<b>Total</b>		<b>400</b>	<b>400</b>
Sod Producers <sup>o</sup>			24

<sup>a</sup> List provided by Tennessee Office of Aeronautics.

<sup>b</sup> List provided by the Tennessee Assessments Division.

<sup>c</sup> List obtained by using white and yellow pages in Tennessee phone books.

<sup>d</sup> List provided by 1991 Directory of Tennessee Manufactures.

<sup>e</sup> List provided by the Department of Tennessee Tourist Development.

<sup>f</sup> List provided by the 1991 Directory of Tennessee Municipal Officials.

<sup>g</sup> Lists provided by the Tennessee Golf Association, The East and Middle Tennessee Golf Course Superintendent's Association, and the Tennessee Turfgrass Association.

<sup>h</sup> Lists provided by the Tennessee Department of Mental Health and Mental Retardation.

<sup>i</sup> Lists provided by the Tennessee Board of Licensing Health Care Facilities.

<sup>j</sup> List provided by the Tennessee Department of Corrections.

<sup>k</sup> List provided by the Federal Park Service.

<sup>l</sup> List provided by the Tennessee Department of Parks and Recreation.

<sup>m</sup> List provided by the 1983-84 Accredited Institution of Postsecondary Education Programs Candidates.

<sup>n</sup> List provided by the Tennessee Department of Education.

<sup>o</sup> List provided by the University of Tennessee Agricultural Extension Service and the Tennessee Turfgrass Association.

select the page of the phone book, the column, and the row. To ensure proportionate coverage of all counties, this same procedure was used for drawing the sample of churches and multiple dwellings from the yellow pages.

A list of airports in Tennessee was provided by the Office of Aeronautics, which is part of the Tennessee Department of Transportation's Aero Division. The list contained 89 airports. These airports were separated into two groups: publicly owned and privately owned for public use. Privately-owned airports that are limited to private use were not included in the study because a listing could not be discovered.

A list of 176 privately-owned cemeteries in Tennessee was obtained from the Assessments Division, which is part of the Public Service Commission for Tennessee. A list of church-owned cemeteries could not be found; therefore, church questionnaires included questions about cemeteries. This inclusion would provide an estimate of how many churches maintain cemeteries while also providing information on expenditures for turfgrass from these churches.

The 1991 Directory of Tennessee Municipal Officials provided a list of Tennessee County Executives. There were 95 County Executives on the list. The directory also provided the 339 municipalities that exist in Tennessee.

Separate lists of golf courses were provided by the Tennessee Golf Association, the East and Middle Tennessee Golf Course Superintendent's Association, and the Tennessee Turfgrass Association. When combined, 240 golf courses comprised the total population of courses in Tennessee.

The institution strata had five substrata: (1) correctional facilities, (2) hospitals, (3) mental retardation facilities, (4) mental health facilities, and (5) nursing homes. A list of 20 correctional facilities was provided by the Tennessee Department of Corrections; a list of 188 hospitals and 534 nursing homes for the aged was obtained from the Tennessee Board of Licensing Health Care Facilities. A list of 51 mental retardation facilities and 56 mental health facilities was provided by the Tennessee Department of Mental Health and Mental Retardation.

A single source of the lawn and ground care firms in Tennessee could not be found. To acquire the firm names and mailing addresses, and to determine a population estimate, the yellow pages in the phone books were used. There were 252 lawn care facilities listed in the yellow pages from the city and county phone books in Tennessee.

The Tennessee Department of Parks and Recreation provided the list of 49 state parks in Tennessee. The list of nine federal parks in Tennessee was obtained from the Federal Park Service.

A list of 269 school superintendents was obtained through the Tennessee Department of Education. School superintendents were chosen instead of individual principals because superintendents are familiar with the budgeting of the individuals schools within a school district. Universities and colleges were also included in the school stratum. The 1983-84 Accredited Institution of Postsecondary Education Programs Candidates provided the list of 131 universities and colleges in the state.

A list of 24 sod producers in Tennessee was provided by Dr. Thomas J. Samples, Associate Professor in Ornamental Horticultural & Landscape Design in the University of Tennessee Agricultural Extension Service and by the Tennessee Turfgrass Association.

A list of 1,017 motels/hotels was provided by the Tennessee Department of Tourist Development. The motels/hotels were included in the commercial establishments stratum as a substratum. Because the population of factories was so large, a sample of this part of the strata was selected. The list of factories in Tennessee, 5,379, was provided by the 1991 Directory of Tennessee Manufactures.

The churches and multiple dwelling strata had no lists available; therefore, the addresses for these strata were taken from the yellow pages of city and county phone books in Tennessee. There were 7,649 churches, and 1,936 multiple dwellings listed.

The 1990 Census of Population and Housing/Summary Population and Housing Characteristics Tennessee reported an estimated 1,108,320 owner occupied single dwelling detached households existing in Tennessee. The white pages in the city and county phone books were used to draw the names needed for the sample. Results in Table 3.3 shows the total amounts of the populations of the stratum in question and the samples selected from different strata listed.

**Table 3.3 Strata, populations identified, and survey size for the survey of the Tennessee turfgrass industry, 1991.**

Stratum	Population Size	Survey Size
Airports	89	89 <sup>a</sup>
Cemeteries	176	176 <sup>a</sup>
Churches	7,649	381 <sup>b</sup>
Commercial Establishments:		
Industrial	5,379	375 <sup>b</sup>
Motels/Hotels	1,017	1,017 <sup>a</sup>
Counties	95	95 <sup>a</sup>
Golf Courses	240	240 <sup>a</sup>
Homes	1,108,320	1,600 <sup>c</sup>
Institutions	794	794 <sup>a</sup>
Lawn and Ground Care Firms	252	252 <sup>a</sup>
Multiple Dwellings	1,936	333 <sup>b</sup>
Municipalities	339	339 <sup>a</sup>
Parks	58	58 <sup>a</sup>
Roadsides	---	---
Schools	400	400 <sup>a</sup>
Sod Producers	24	24 <sup>a</sup>

<sup>a</sup> Complete census attempted.

<sup>b</sup> Sample size based on desire for estimate of the percentage of units that maintain a lawn to be correct within  $\pm 5$  percent, with 95 percent confidence.

<sup>c</sup> Sample size based on desire for estimate of the percentage of units that maintain a lawn to be correct within  $\pm 2.5$  percent, with 95 percent confidence.



## Questionnaire Design

Each stratum had a customized questionnaire designed to answer the unique questions that arise in the area of maintenance of turfgrass. Because all of the questionnaires were to be mailed, they were designed to be self-administered. Each of the questionnaires was accompanied by a cover letter from the University of Tennessee Institute of Agriculture (UT), except for the golf courses, lawn and ground care firms, and the sod producers. The cover letter for the golf courses was from the Tennessee Turfgrass Association (TTA), and the lawn and ground care firms and the sod producers cover letter was from the Agricultural Extension Service (UT). Each of the questionnaires had a phone number for the University of Tennessee Department of Agricultural Economics & Rural Sociology if there was any question about the survey an individual wanted answered.

The questionnaire for the turfgrass survey was designed so the individuals would be able to answer questions dealing with expenditures for turfgrass in 1991. Some questionnaires were different only in defining the area of turfgrass maintained, but the questions dealing with expenditures were the same over all the strata. The homes and institutions questionnaires are presented in Appendix A.

Most of the questionnaires dealt with the total area of turf maintained at the facility. There was also the common question of asking for the amount and cost of new turf established during 1991. Turfgrass practices, common problems associated with turfgrass care, and where individuals found answers to the problems were usually asked next. The amount of turf irrigated and the primary

water source were asked to reveal the importance of irrigation. Equipment values were estimated for replacement and for current values for equipment used for turf care. The questions of who is responsible for the turf and the number of employees used in maintenance of this turf were also questions common across all strata. Also included was a question about turf supplies purchased within Tennessee during 1991. The expenditure questions dealt with areas such as: 1) turf equipment maintenance, 2) fertilizers, chemicals, and other soil amendments, 3) irrigation, and 4) labor. These questions varied little from one stratum to the next.

Turf equipment maintenance dealt with three types of expenses. The first was how much was spent on parts and hired outside labor. The second was how much was spent on an in-house mechanic. The third focused on expenditures for supplies such as gasoline, blades, oil, etc..

Questions about fertilizers, chemicals, and other soil amendments dealt with the materials used to provide acceptable lawn quality. Questions dealing with how much was spent on fertilizers, weed control products, insect and disease control products, growth retardants, seed, lime, and other items not specifically listed comprised the second section of questions.

In the third area, questions dealt with how much was spent on water, electricity, and irrigation equipment and supplies in 1991. The fourth area dealt with the cost of labor. Five areas of labor were mowing costs, irrigation costs,

fertilizer, chemical and other materials application costs, turf renovation/aeration costs, and any other labor costs not listed.

While the Dilman procedure for mail questionnaires would be preferred, a modified Dilman technique was used to enhance the response rate. Dilman recommends that a post card be mailed two weeks after the first questionnaire mailing and a second cover letter and questionnaire mailed two weeks after the post card. In this study, a second cover letter and questionnaire was mailed to all nonrespondants during the third week after the initial mailing. To spread out the mailing task, the first questionnaires were mailed on February 7, 1992 and the final second mailing was completed on May 15, 1992. A total of 23,044 individuals and/or organizations comprised the total number of questionnaires distributed during the first mailing period.

To avoid unnecessary expense in postage, when a questionnaire was received after the first mailing, the address was removed from the master list so that individual would not receive another. The response rates varied for each stratum. The list of response rates are presented in Table 3.4. A record was maintained as to whether the respondent returned the first or second questionnaire. While this measure is in precise, it is interesting that 48.7 percent of the returned questionnaires appeared to be in response to the second mailing.

**Table 3.4** Number of questionnaires mailed and the response rate for each component of the Tennessee turfgrass industry, 1991.

Strata	Number Mailed	Number Returned	Response Rate
Airports	89	33	37.1
Cemeteries	176	46	26.1
Churches	1,000	216	21.6 <sup>a</sup>
Commercial Establishments:			
Industrial	1,000	258	25.8 <sup>b</sup>
Motels/Hotels	1,017	236	23.2
Counties	95	48	50.5
Golf Courses	240	75	31.3
Homes	6,400	1,458	22.8 <sup>c</sup>
Institutions:			
Correctional	20	8	40.0
Hospitals	188	45	23.9
Mental/Health	107	47	43.9
Nursing Homes	535	103	19.3
Lawn and Ground Care Firms	252	42	16.7
Multiple Dwellings	1,000	201	20.1 <sup>d</sup>
Municipalities	339	192	56.6
Parks	58	35	60.3
Roadsides	---	---	---
Schools:			
Colleges	131	40	30.5
Superintendents	269	117	43.5
Sod Producers	24	10	47.6

<sup>a</sup>Obtained 56.8 percent of the targeted 380.

<sup>b</sup>Obtained 69.4 percent of the targeted 372.

<sup>c</sup>Obtained 91.1 percent of the targeted 1,600.

<sup>d</sup>Obtained 60.7 percent of the targeted 331.

## CHAPTER IV

### RESULTS OF THE STUDY

#### Analysis of Turfgrass Industry Data

In order to provide the results of this study in an orderly fashion, each category of the Tennessee turfgrass industry was analyzed separately. The data from each category, after being entered into the computer, were then analyzed statistically by taking the sample mean of each question dealing with an estimated acre or dollar value. Before the sample mean was used, the number of facilities that maintained turf in each category had to be determined. If for instance 530 nursing homes were being analyzed, and there were 103 questionnaires returned in total, but only 96 marked that a lawn was maintained, then the number of facilities that maintained a lawn was determined from the sample of questionnaires returned. From this example, 93 percent of the nursing homes in Tennessee would maintain a lawn in Tennessee theoretically. The 93 percent would then be multiplied by the 530 nursing homes existing, which would give an estimate of 439 nursing homes in Tennessee that maintain a lawn.

To arrive at the sample mean, the sum of the question's responses was divided by the number of questionnaires that were returned that had marked the response that a lawn was maintained at the property in question. This mean was then multiplied by the estimated amount of the population that maintained a lawn.



The result would then be an estimate of the amount of acres or the dollar values expended in 1991.

The following are the categories used in the Tennessee turfgrass industry survey in 1991. Each of the categories has the total acreage, total amount spent on annual turfgrass maintenance, and the breakdown of the annual expenditures for labor, materials purchased, and lawn care services used.

### Analysis of the Categories of the Tennessee Turfgrass Industry

#### Airports

The list of airports obtained from the Tennessee Office of Aeronautics included 89 airports in operation. Nine of these airports had been closed since the list was published. The remaining 80 airports comprised the survey sample. Based on the information obtained, the total airport acreage was estimated at 23,048 acres of property with 10,608 acres of this being maintained turf for an average of 132.6 acres of turf per airport (Table 4.1). The total cost of maintaining this turf was estimated at \$463,000 with the average cost of maintenance per airport at \$5,788. An estimated \$310,000 was spent on new turf maintenance equipment in 1991.

The largest reported expense for turf maintenance was on turf-related materials (Table 4.2). There was an estimated \$270,000 spent on these materials and represented 58.3 percent of the total turf maintenance expenses for airports. Labor was the second largest expense item at \$178,000. This turf-related labor represented 38.5 percent of the total turf maintenance expenditures in 1991.

**Table 4.1 Number of airports, property size, turf area, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Airport
Number of Airports	No.	80	---
Total Property Size	Acres	23,048	288.1
Total Turf Acres	Acres	10,608	132.6
Total Turf Acres Irrigated	Acres	528	6.6
New Turf Established in 1991	Acres	840	10.5
Annual Maintenance Expense	Dollars	463,000	5,788
Current Value of Turf Maintenance Equipment	Dollars	1,497,000	18,713
Replacement Value of Turf Maintenance Equipment	Dollars	2,257,000	28,213
Annual New Equipment Expenditure	Dollars	310,000	3,875

**Table 4.2 Airport turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	270	58.3
Turf Related Labor	178	38.5
Lawn Service Companies	15	3.2
<b>Total</b>	<b>463</b>	<b>100.0</b>

Of the turf related-labor expenses, the largest labor expense was for equipment maintenance and repair by the in-house mechanic (Table 4.3). This labor cost was estimated at \$105,000, or 59.0 percent of the total labor expense. The second largest expense in the area of labor was for mowing, which amounted to 38.2 percent of the total labor expenses.

Expenditures for labor were also one of the categories included in the grouping of turf-related materials and practices. Expenses for hired outside labor for equipment maintenance and repair were estimated at 29.2 percent of the total spent on turf related materials (Table 4.4). The second largest expense was for equipment supplies which accounted for 24.1 percent of the total. Fertilizer and lime combined accounted for 35.5 percent of the total for materials and practices.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.3 Turf-related labor expense by airports, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	68	38.2
Equipment Maintenance and Repair: In-house Mechanic	105	59.0
Irrigation	---	---
Fertilizer, Chemical, and Other Material Applications	1	0.6
Turf Renovation/Aeration	---	---
Other	4	2.2
<b>Total</b>	<b>178</b>	<b>100.0</b>

**Table 4.4 Airport expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	79	29.2
Equipment Supplies (Gasoline, Blades, Oil, etc)	65	24.1
Fertilizers	47	17.4
Weed Control Products	14	5.2
Insect and Disease Control Products	1	0.4
Growth Retardants	3	1.1
Seed	6	2.2
Lime	49	18.1
Irrigation: Water (includes electricity)	1	0.4
Irrigation: Equipment and Supplies	---	---
Other Expenses	5	1.9
<b>Total</b>	<b>270</b>	<b>100.0</b>

## Cemeteries

The list of cemeteries obtained from the Tennessee Assessments Division included 176 privately-owned cemeteries. Five of these cemeteries had gone out of business since the list was published. The remaining 171 cemeteries comprised the survey sample. The total property size of cemeteries was estimated at 6,036 acres with 3,437 acres being maintained turf (Table 4.5). This turf cost the owners an estimated \$2,173,000 to maintain in 1991 with the average cost per cemetery being \$12,708. Cemetery owners also spent an estimated \$700,000 for new turf maintenance equipment in 1991. Information regarding nonregulated cemeteries owned by churches is presented within the church component.

When the estimated \$2,173,000 for turf maintenance is broken down, the largest expense was for turf-related labor (Table 4.6). This labor cost cemetery owners an estimated \$1,369,000 or 63.0 percent of the total. The second largest expense was for turf-related materials, which had an estimated cost of \$683,000 and comprised 31.4 percent of the total spent for annual turfgrass maintenance.

The largest expense, when the turf-related labor expenses are broken down, was for mowing (Table 4.7). Cemetery owners estimated mowing costs to be \$1,147,000 or 83.8 percent of the total for labor expenses. The second largest labor expense was for equipment maintenance and repair for an in-house mechanic, which cost an estimated \$143,000. The labor expense for maintenance and repair represented 10.4 percent of the total labor costs.



**Table 4.5 Number of cemeteries, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Cemetery
Number of Cemeteries	No.	171	---
Total Property Size	Acres	6,036	35.3
Total Turf Acres	Acres	3,437	20.1
Total Turf Acres Irrigated	Acres	530	3.1
New Turf Established in 1991	Acres	222	1.3
Annual Maintenance Expense	Dollars	2,173,000	12,708
Current Value of Turf Maintenance Equipment	Dollars	2,781,000	16,263
Replacement Value of Turf Maintenance Equipment	Dollars	3,571,000	20,883
Annual New Equipment Expenditure	Dollars	700,000	4,094

**Table 4.6 Cemetery turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	683	31.4
Turf-Related Labor	1,369	63.0
Lawn Service Companies	121	5.6
<b>Total</b>	<b>2,173</b>	<b>100.0</b>

**Table 4.7 Turf-related labor expenses by cemeteries, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,147	83.8
Equipment Maintenance and Repair: In-house Mechanic	143	10.4
Irrigation	22	1.6
Fertilizer, Chemical, and Other Material Applications	28	2.1
Turf Renovation/Aeration	29	2.1
Other	---	---
<b>Total</b>	<b>1,369</b>	<b>100.0</b>

The largest expense for turf-related materials was for equipment supplies, which cost cemetery owners an estimated \$282,000 (Table 4.8). The purchases of equipment supplies represented 41.3 percent of the total spent for turf-related materials. The second largest expense was for equipment maintenance and repair using hired outside labor and parts. This hired outside labor cost the owners an estimated \$226,000 or 33.1 percent of the total for materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.8 Cemetery expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	226	33.1
Equipment Supplies (Gasoline, Blades, Oil, etc)	282	41.3
Fertilizers	44	6.4
Weed Control Products	23	3.4
Insect and Disease Control Products	3	0.4
Growth Retardants	---	---
Seed	28	4.1
Lime	5	0.7
Irrigation: Water (includes electricity)	31	4.5
Irrigation: Equipment and Supplies	28	4.2
Other Expenses	13	1.9
<b>Total</b>	<b>683</b>	<b>100.0</b>

## Churches

The list frame for churches was obtained from the yellow pages in phone books for Tennessee. The list contained 7,649 churches, but only 7,554 were judged by the researcher to be operating at the time of the survey because of the number of church questionnaires that were returned marked return to sender. Of these churches sampled, 85 percent maintained a lawn so an estimated 6,420 of the 7,554 churches existing maintained a lawn. Hence, an estimated 13,482 acres of turf was maintained at the 6,420 churches located in Tennessee with an average of 2.1 acres of turf maintained at each church (Table 4.9). To maintain this acreage, it cost the members of the churches an estimated \$8,540,000 or \$1,330 per church. There also was an estimated \$2,985,000 spent on new turf maintenance equipment in 1991.

When breaking down the overall expense for turf maintenance, the largest expense was for turf-related labor (Table 4.10). This cost the members of the churches an estimated \$3,833,000. This labor category comprised 44.9 percent of the total overall expenses for turf maintenance. The second largest expense was for lawn service companies. These services cost an estimated \$2,645,000 and represented 31.0 percent of the total for turf care maintenance.

The labor expenses when broken down listed mowing as the largest expense (Table 4.11). Mowing was estimated to cost \$3,358,000 or 87.6 percent of the total labor expense category. Equipment maintenance and repair for in-house

**Table 4.9 Number of churches, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Church
Number of Churches <sup>a</sup>	No.	6,420	---
Total Property Size	Acres	---	---
Total Turf Acres <sup>b</sup>	Acres	13,482	2.1
Total Turf Acres Irrigated	Acres	385	0.06
New Turf Established in 1991	Acres	1,027	0.1
Annual Maintenance Expense	Dollars	8,540,000	1,330
Current Value of Turf Maintenance Equipment	Dollars	6,099,000	950
Replacement Value of Turf Maintenance Equipment	Dollars	9,123,000	1,421
Annual New Equipment Expenditure	Dollars	2,985,000	465

<sup>a</sup> This number based on 85 percent of the questionnaires returned from churches answered yes for maintaining a lawn.

<sup>b</sup> This total turf acreage consists of 12,228 acres of general turf, 688 acres of church owned athletic fields, and 566 acres of church owned cemeteries.

**Table 4.10 Church turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	2,062	24.1
Turf-Related Labor	3,833	44.9
Lawn Service Companies	2,645	31.0
<b>Total</b>	<b>8,540</b>	<b>100.0</b>



**Table 4.11 Turf-related labor expenses by churches, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	3,358	87.6
Equipment Maintenance and Repair: In-house Mechanic	122	3.2
Irrigation	19	0.5
Fertilizer, Chemical, and Other Material Applications	103	2.7
Turf Renovation/Aeration	51	1.3
Other	180	4.7
<b>Total</b>	<b>3,833</b>	<b>100.0</b>

mechanic was the second largest expense at \$122,000. This accounted for 3.2 percent of the total spent for labor.

Equipment maintenance and repair for hired outside labor and parts, which was \$738,000, was the largest expense in the area of turf-related materials expenses (Table 4.12). The \$738,000 represented 35.8 percent of the total spent for turf related materials. The second largest expense was for equipment supplies. It was estimated that \$411,00 was spent on supplies.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.12 Church expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	738	35.8
Equipment Supplies (Gasoline, Blades, Oil, etc)	411	19.9
Fertilizers	161	7.8
Weed Control Products	71	3.4
Insect and Disease Control Products	26	1.3
Growth Retardants	13	0.6
Seed	141	6.8
Lime	6	0.3
Irrigation: Water (includes electricity)	161	7.8
Irrigation: Equipment and Supplies	315	15.3
Other Expenses	19	1.0
<b>Total</b>	<b>2,062</b>	<b>100.0</b>

### Commercial Establishments (Industrial Facilities)

There are 5,379 factories located in Tennessee according to the 1991 Directory of Tennessee Manufacturers, but only an estimated 2,246 of these facilities maintained a lawn. There was an estimated 153,626 acres of property with 28,075 acres being maintained turf according to the lawn superintendents for the factories (Table 4.13). This maintained turf acreage averaged out to be 12.5 acres of turf at each factory. The cost of maintaining this turf for a year was estimated to be \$16,546,000. This annual maintenance expense averaged \$7,367 per factory in 1991. Based on information from lawn superintendents there was an estimated \$1,862,000 spent on new turf maintenance equipment in 1991.

The largest expense when the annual maintenance expense was broken down was for turf-related labor, \$9,669,000 (Table 4.14). The turf-related labor expenses represented 58.4 percent of the total annual maintenance expense. The second largest expense was for lawn service companies. This service cost an estimated \$4,872,000 or 29.5 percent of the total annual maintenance expenditures for labor and materials.

The largest expense within the turf-related labor expenditures was the cost of labor used in mowing (Table 4.15). This mowing labor cost an estimated \$6,857,000 or 70.9 percent of the total labor costs. The second major cost associated with labor was for equipment maintenance and repair by in-house mechanic, which cost an estimated \$1,579,000 and accounted for 16.3 percent of

**Table 4.13 Number of industrial commercial establishments, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Factory
Number of Industrial Commercial Establishments <sup>a</sup>	No.	2,246	---
Total Property Size	Acres	153,626	68.4
Total Turf Acres	Acres	28,075	12.5
Total Turf Acres Irrigated	Acres	674	0.3
New Turf Established in 1991	Acres	1,123	0.5
Annual Maintenance Expense	Dollars	16,546,000	7,367
Current Value of Turf Maintenance Equipment	Dollars	10,810,000	4,813
Replacement Value of Turf Maintenance Equipment	Dollars	13,918,000	6,197
Annual New Equipment Expenditure	Dollars	1,862,000	829

<sup>a</sup> This number based on 42 percent of the questionnaires returned from industrial facilities answered yes for maintaining a lawn.

**Table 4.14 Commercial industrial establishments turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	2,005	12.1
Turf-Related Labor	9,669	58.4
Lawn Service Companies	4,872	29.5
<b>Total</b>	<b>16,546</b>	<b>100.0</b>

**Table 4.15 Turf-related labor expenses by commercial industrial establishments, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	6,857	70.9
Equipment Maintenance and Repair: In-house Mechanic	1,579	16.3
Irrigation	101	1.1
Fertilizer, Chemical, and Other Material Applications	380	3.9
Turf Renovation/Aeration	723	7.5
Other	29	0.3
<b>Total</b>	<b>9,669</b>	<b>100.0</b>

the total spent on labor. The largest expense for turf-related materials purchased was for equipment maintenance and repair for hired outside labor and parts (Table 4.16). These repairs cost an estimated \$782,000 or 39.0 percent of the total spent for turf-related materials purchased. The next largest expense was for equipment supplies, which cost an estimated \$499,000. This equipment supplies purchased represented 24.9 percent of the total amount spent on turf related materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.



**Table 4.16 Commercial industrial establishments expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	782	39.0
Equipment Supplies (Gasoline, Blades, Oil, etc)	499	24.9
Fertilizers	272	13.6
Weed Control Products	130	6.5
Insect and Disease Control Products	76	3.8
Growth Retardants	11	0.5
Seed	76	3.8
Lime	24	1.2
Irrigation: Water (includes electricity)	70	3.5
Irrigation: Equipment and Supplies	61	3.0
Other Expenses	4	0.2
<b>Total</b>	<b>2,005</b>	<b>100.0</b>

### Commercial Establishments (Motels/Hotels)

A list of 1,017 motels/hotels was obtained from the Department of Tennessee Tourist Development. All of these motels/hotels were included in the survey sample. Of the 1,017 motels/hotels surveyed only 73 percent of the number of questionnaires returned reported that the facility maintained a lawn. From the information obtained from these facilities the total property size was determined to be 125,802 acres with 4,687 acres being maintained turf (Table 4.17). The annual maintenance expense for caring for the turf cost an estimated \$4,412,000 or \$6,119 per motel/hotel. An estimated \$594,000 was spent on new turf maintenance equipment in 1991.

The largest reported expense for annual turf maintenance was for turf-related labor (Table 4.18). The expense associated with turf related labor expense was \$1,997,000 and comprised 48.2 percent of the total spent for annual maintenance. The second largest expense was for turf-related materials expense which cost an estimated \$1,401,000. This materials expense represented 33.8 percent of the total.

The greatest labor expense category was mowing which cost an estimated \$1,158,000 or 58.0 percent of the total labor expenses (Table 4.19). The next major labor expense was for equipment maintenance and repair by in-house mechanic. This labor cost an estimated \$249,000 and represented 12.5 percent of the total expenses for labor.

**Table 4.17 Number of commercial motel/hotel establishments, total property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Motel/Hotel
Number of Motels/Hotels <sup>a</sup>	No.	721	---
Total Property Size	Acres	125,802	174.5
Total Turf Acres	Acres	4,687	6.5
Total Turf Acres Irrigated	Acres	649	0.9
New Turf Established in 1991	Acres	216	0.3
Annual Maintenance Expense	Dollars	4,412,000	6,119
Current Value of Turf Maintenance Equipment	Dollars	3,012,000	4,118
Replacement Value of Turf Maintenance Equipment	Dollars	4,862,000	6,743
Annual New Equipment Expenditure	Dollars	594,000	824

<sup>a</sup> This number based on 73 percent of the questionnaires returned from motels/hotels answered yes for maintaining a lawn.

**Table 4.18 Motels/hotels turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	1,401	33.8
Turf-Related Labor	1,997	48.2
Lawn Service Companies Expenses	744	18.0
<b>Total</b>	<b>4,142</b>	<b>100.0</b>

**Table 4.19 Turf-related labor expenses by motels/hotels, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,158	58.0
Equipment Maintenance and Repair: In-house Mechanic	249	12.5
Irrigation	136	6.8
Fertilizer, Chemical, and Other Material Applications	105	5.3
Turf Renovation/Aeration	24	1.2
Other	325	16.2
<b>Total</b>	<b>1,997</b>	<b>100.0</b>

The turf-related materials purchased listed equipment maintenance and repair by hired outside labor and parts as the largest expense with \$497,000 used for this category (Table 4.20). This equipment repair represented 35.5 percent of the total. The second major expense for materials was for water used for irrigation. These purchases costs motels/hotels an estimated \$211,000 and accounted for 15.1 percent of the total spent for turf materials purchased. Equipment supplies and fertilizer purchases also represented 25.4 percent of the purchases of turf-related materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.20 Commercial motel/hotel establishment expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	497	35.5
Equipment Supplies (Gasoline, Blades, Oil, etc)	187	13.3
Fertilizers	170	12.1
Weed Control Products	73	5.2
Insect and Disease Control Products	65	4.6
Growth Retardants	25	1.8
Seed	69	4.9
Lime	11	0.8
Irrigation: Water (includes electricity)	211	15.1
Irrigation: Equipment and Supplies	50	3.6
Other Expenses	43	3.1
<b>Total</b>	<b>1,401</b>	<b>100.0</b>



## Counties

The 95 county executives contacted for turfgrass maintenance information was obtained from the 1991 Directory of Tennessee Municipal Officials. All 95 County Executives were contacted for the survey sample. The estimated total amount of turf maintained for all counties was 32,114 acres (Table 4.21). This total turf acreage was made up of 4,366 acres of parks and athletic fields, 23,408 acres of roadways, and 4,340 acres of general turf located around government buildings. An average of 338 acres of turf is maintained by each county in Tennessee. To maintain this turf, it costs an estimated \$3,779,000 a year or \$39,779 per county a year. In 1991, the county executives spent an estimated \$742,000 for new turf maintenance equipment.

When the total turf maintenance expense is broken down, the largest expense incurred by counties was for turf-related labor (4.22). This labor cost an estimated \$2,871,000, which represented 76.0 percent of the overall total. The second largest expense was for turf-related materials. These materials cost an estimated \$908,000 in 1991. This turf material expense represented 24 percent of the total spent for turf maintenance.

The total turf-related labor expense was estimated at \$2,871,000 (Table 4.23). The largest labor expense was for mowing, which cost \$2,087,000. This mowing expense comprised 72.7 percent of the total spent for labor. The second largest labor expense was for equipment maintenance and repair by a in-house mechanic. The executives estimated this labor expense to cost at \$420,000. This equipment

**Table 4.21 Number of counties, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per County
Number of Counties	No.	95	---
Total Property Size	Acres	---	---
Total Turf Acres <sup>a</sup>	Acres	32,114	338.0
Total Turf Acres Irrigated	Acres	371	3.9
New Turf Established in 1991	Acres	648	6.8
Annual Maintenance Expense	Dollars	3,779,000	39,779
Current Value of Turf Maintenance Equipment	Dollars	3,931,000	41,379
Replacement Value of Turf Maintenance Equipment	Dollars	6,479,000	68,200
Annual New Equipment Expenditure	Dollars	742,000	7,811

<sup>a</sup> The total turfgrass acreage maintained by counties consists of 4,366 acres of parks and athletic fields, 23,408 acres of roadways, and 4,340 acres of general turf located around government buildings.

**Table 4.22 County turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	908	24.0
Turf-Related Labor	2,871	76.0
Lawn Service Companies	---	---
<b>Total</b>	<b>3,779</b>	<b>100.0</b>

**Table 4.23 Turf-related labor expenses by counties, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	2,087	72.7
Equipment Maintenance and Repair: In-house Mechanic	420	14.6
Irrigation	47	1.6
Fertilizer, Chemical, and Other Material Applications	128	4.5
Turf Renovation/Aeration	169	5.9
Other	20	0.7
<b>Total</b>	<b>2,871</b>	<b>100.0</b>

maintenance and repair expense represented 14.6 percent of the total spent for labor.

When the turf related materials were broken down, the largest expense associated with turf materials purchased was for equipment supplies. County executives spent an estimated \$406,000 for equipment supplies in 1991 (Table 4.24). These equipment supply purchases represented 44.7 percent of the total spent on turf related materials. The second largest expense was for equipment maintenance and repair by hired outside labor and parts purchased, which cost an estimated \$258,000 or 28.4 percent of the total spent on turf materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and

**Table 4.24 County expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	258	28.4
Equipment Supplies (Gasoline, Blades, Oil, etc)	406	44.7
Fertilizers	55	6.1
Weed Control Products	26	2.9
Insect and Disease Control Products	34	3.7
Growth Retardants	5	0.6
Seed	29	3.2
Lime	20	2.2
Irrigation: Water (includes electricity)	47	5.2
Irrigation: Equipment and Supplies	24	2.6
Other Expenses	4	0.4
<b>Total</b>	<b>908</b>	<b>100.0</b>

also the number of persons employed with turfgrass responsibilities are located in Appendix B.

## Golf Courses

The lists of golf courses obtained from the Tennessee Golf Association, the East and Middle Tennessee Golf course Superintendent's Association, and the Tennessee Turfgrass Association included 240 golf courses in operation. Ten of these golf courses since these lists were published had been closed. The 230 remaining golf courses comprised the survey sample. There was an estimated 44,712 acres of property with 25,990 acres of maintained turf for the golf courses in Tennessee (Table 4.25). An average of 113 acres of turf was maintained at each golf course in 1991. The annual maintenance costs for the total maintained turf for golf courses was estimated to be \$38,098,000 or an average of \$165,644 per course. There was also \$6,556,000 spent on new turf maintenance equipment in 1991.

The expenses for annual turf maintenance costs listed turf-related materials as the largest expense, which cost an estimated \$23,465,000 (Table 4.26). This material expense represented 61.6 percent of the total spent on annual turf maintenance. Labor cost an estimated \$14,633,000 or 38.4 percent of the total.

Of the turf-related labor expenses, labor for mowing cost an estimated \$6,676,000 (Table 4.27). This labor for mowing represented 45.6 percent of the total spent on labor for golf courses. The second largest labor expense was for equipment maintenance and repair by in-house mechanic. This labor for repairs cost an estimated \$2,913,000 or 19.9 percent of the total.

**Table 4.25 Number of golf courses, years in operation, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Course
Number of Golf Courses	No.	230	---
Years in Operation	Years	---	30
Total Property Size	Acres	44,712	194.4
Total Turf Acres	Acres	25,990	113.0
Total Turf Acres Irrigated	Acres	15,111	65.7
New Turf Established in 1991	Acres	1,127	4.9
Annual Maintenance Expense	Dollars	38,098,000	165,644
Current Value of Turf Maintenance Equipment	Dollars	49,993,000	217,361
Replacement Value of Turf Maintenance Equipment	Dollars	85,966,000	373,765
Annual New Equipment Expenditure	Dollars	6,556,000	28,504

**Table 4.26 Golf courses turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	23,465	61.6
Turf-Related Labor Expenses	14,633	38.4
<b>Total</b>	<b>38,098</b>	<b>100.0</b>



**Table 4.27 Turf-related labor expenses by golf courses, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	6,676	45.6
Equipment Maintenance and Repair: In-house Mechanic	2,913	19.9
Irrigation	1,327	9.1
Fertilizer, Chemical, and Other Material Applications	1,522	10.4
Turf Renovation/Aeration	1,198	8.2
Other	997	6.8
<b>Total</b>	<b>14,633</b>	<b>100.0</b>

Irrigation equipment and supplies was the largest expense for turf related materials purchased. This equipment cost an estimated \$4,188,000 and accounted for 17.9 percent of the total spent for turf related materials (Table 4.28). The second largest expense was for equipment maintenance and repair by hired outside labor, \$3,531,000. This hired outside labor represented 15.0 percent of the total.

Information concerning types of courses, number of holes, the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.28 Golf courses expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
<b>Equipment Maintenance:</b>		
Equipment Maintenance and Repair: Hired Outside Labor and Parts	3,531	15.0
Parts - (Blades, Spark Plugs, Belts, Etc.)	3,172	13.5
Equipment Supplies (Gasoline, Blades, Oil, Etc.)	1,541	6.6
<b>Fertilizers, Chemicals, and Other Soil Amendments:</b>		
Fertilizers	772	3.3
Weed Control Products	2,623	11.2
Insect Control Products	242	1.0
Disease Control Products	1,275	5.4
Topdressing Sand	661	2.8
Lime	1,900	8.1
Seed	1,083	4.6
<b>Irrigation:</b>		
Irrigation: Water (includes electricity)	2,135	9.1
Irrigation: Equipment and Supplies	4,188	17.9
<b>Other Expenses:</b>	342	1.5
<b>Total</b>	<b>23,465</b>	<b>100.0</b>

## Homes

According to the 1990 Census, there are 1,108,320 single dwelling detached homes in the state of Tennessee, of which, 886,656 of these homes was determined to maintain a lawn. The total property size was estimated at 4,787,942 acres for homeowners (Table 4.29). The total turf acres maintained was estimated to be 620,659 acres with each home maintaining 0.6 acres. The total annual maintenance cost for maintaining the total turf acres was estimated to be \$221,664,000. This annual maintenance expense gave an average expenditure of \$250 for each home in Tennessee. Homeowners also spent an estimated \$149,845,000 on new turf maintenance equipment in 1991.

When the expenses that make up the annual maintenance expense are broken down, turf-related materials cost an estimated \$203,044,000 or 91.6 percent of the total spent (Table 4.30). Labor expenses represented 7.6 percent of the annual maintenance expenses. Family labor wages cost an estimated \$10,640,000 and other paid wages cost an estimated \$6,207,000.

Home expenses for turf-related materials purchased listed equipment maintenance and repair by hired outside labor and parts as the largest expense. This equipment repair cost an estimated \$62,066,000 or 30.6 percent of the total spent for turf related materials (Table 4.31). Irrigation equipment and supplies cost was the second largest expense for turf materials purchased. This equipment cost an estimated \$29,260,000 or 14.4 percent of the total. Equipment supplies represented 13.5 percent of the total turf related materials purchased in 1991.



**Table 4.31 Homes expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
<b>Equipment:</b>		
Equipment Maintenance and Repair: Hired Outside Labor and Parts	62,066	30.6
Equipment Supplies (Gasoline, Blades, Oil, etc)	27,486	13.5
Irrigation: Equipment and Supplies	29,260	14.4
<b>Pesticide Products Purchased:</b>		
Weed Control Products	10,640	5.2
Insect Control Products	6,207	3.1
Disease Control Products	1,773	0.9
<b>Other Products Purchased:</b>		
Fertilizer	19,506	9.6
Mulch	19,506	9.6
Seed	10,640	5.2
Sod	3,547	1.8
Lime	1,773	0.9
<b>Other Expenses:</b>	10,640	5.2
<b>Total</b>	203,044	100.0

Information concerning who has turfgrass responsibilities at single dwelling homes for Tennessee are located in Appendix B.

### Institutions (Health Agencies)

The list of health agencies obtained from the Tennessee Department of Mental Health and Mental Retardation included 51 operating agencies. Of these 51 agencies, 35 facilities maintained a lawn based on the information received from the survey. Based on the information from the operators of the agencies, the total property size of the agencies was estimated at 28,815 acres (Table 4.32). The turf acreage was estimated to be 609 acres or 17.4 acres per agency. The annual maintenance expense for maintaining this turf was estimated to be \$297,000. This total annual maintenance expense averaged \$8,486 for each agency a year. There was also an estimated \$19,000 spent on new turf maintenance equipment in 1991.

The largest expense for annual turf maintenance expenditures was for turf-related labor. This labor cost an estimated \$216,000 or 72.7 percent of the total spent annually for turf maintenance (Table 4.33). The second largest expense was for turf related materials at \$73,000. These purchases represented 24.6 percent of the total spent in 1991.

The turf related labor expenses when broken down had mowing as the largest labor expense at \$145,000 or 67.1 percent of the total spent for labor (Table 4.34). The second largest expense in the labor bracket was for equipment maintenance and repair by in-house mechanic at \$59,000. This equipment repair labor represented 27.3 percent of the total spent for turf related labor.

The largest expense for turf related materials purchased for turf was for equipment supplies, which cost an estimated \$26,000 or 35.6 percent of the total



**Table 4.32 Number of health agencies, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Agency
Number of Health Agencies <sup>a</sup>	No.	35	---
Total Property Size	Acres	28,815	823.3
Total Turf Acres	Acres	609	17.4
Total Turf Acres Irrigated	Acres	18	0.5
New Turf Established in 1991	Acres	1	0.03
Annual Maintenance Expense	Dollars	297,000	8,486
Current Value of Turf Maintenance Equipment	Dollars	429,000	12,257
Replacement Value of Turf Maintenance Equipment	Dollars	662,000	18,914
Annual New Equipment Expenditure	Dollars	19,000	543

<sup>a</sup> This number based on 69 percent of the questionnaires returned from health agencies answered yes for maintaining a lawn.

**Table 4.33 Health agencies turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	73	24.6
Turf-Related Labor	216	72.7
Lawn Service Companies	8	2.7
<b>Total</b>	<b>297</b>	<b>100.0</b>

**Table 4.34 Turf-related labor expenses by health agencies, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	145	67.1
Equipment Maintenance and Repair: In-house Mechanic	59	27.3
Irrigation	2	0.1
Fertilizer, Chemical, and Other Material Applications	7	3.2
Turf Renovation/Aeration	---	---
Other	3	1.3
<b>Total</b>	<b>216</b>	<b>100.0</b>

spent for turf-related materials (Table 4.35). Equipment maintenance and repair by hired outside labor and parts cost an estimated \$19,000. This equipment repair represented 26.0 percent of the total. Fertilizers and weed control products represented 19.2 percent of the total spent for turf-related materials purchased.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.35 Health agencies expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	19	26.0
Equipment Supplies (Gasoline, Blades, Oil, etc)	26	35.6
Fertilizers	7	9.6
Weed Control Products	7	9.6
Insect and Disease Control Products	---	---
Growth Retardants	---	---
Seed	2	2.7
Lime	---	---
Irrigation: Water (includes electricity)	7	9.6
Irrigation: Equipment and Supplies	5	6.9
Other Expenses	---	---
<b>Total</b>	<b>73</b>	<b>100.0</b>

### Institutions (Hospitals)

The list of hospitals was obtained from the Tennessee Board of Licensing Health Care Facilities. There were 188 hospitals comprising the survey sample and 149 of these hospitals was determined to maintain a lawn. The total property size of the hospitals in Tennessee was 7,235 acres of which 1,997 acres was maintained turf (Table 4.36). This maintained turf averaged 13.4 acres per hospital. The annual maintenance expense was estimated to be \$4,095,000, which averaged \$27,483 per hospital. There was also an estimated \$443,000 spent on new turf maintenance equipment in 1991.

Of the annual maintenance expenses, the largest expense was for turf-related labor. This turf-related labor cost an estimated \$2,505,000 or 61.2 percent of the total annual maintenance cost (Table 4.37). The second largest annual maintenance expense was for turf-related materials purchased. These materials cost an estimated \$968,000. This materials cost represented 23.6 percent of the annual maintenance cost.

The largest labor expense was for mowing, which cost hospitals an estimated \$1,961,000 or 78.3 percent of the total cost of labor (Table 4.38). The next largest labor expense was for equipment maintenance and repair by in-house mechanic. This labor expense cost an estimated \$236,000 or 9.4 percent of the total spent for labor.

**Table 4.36 Number of hospitals, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Hospital
Number of Hospitals <sup>a</sup>	No.	149	---
Total Property Size	Acres	7,235	48.6
Total Turf Acres	Acres	1,997	13.4
Total Turf Acres Irrigated	Acres	283	1.9
New Turf Established in 1991	Acres	134	0.9
Annual Maintenance Expense	Dollars	4,095,000	27,483
Current Value of Turf Maintenance Equipment	Dollars	2,645,000	17,751
Replacement Value of Turf Maintenance Equipment	Dollars	3,670,000	24,630
Annual New Equipment Expenditure	Dollars	443,000	2,973

<sup>a</sup> This number based on 80 percent of the questionnaires returned from hospitals answered yes for maintaining a lawn.

**Table 4.37 Hospitals turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	968	23.6
Turf-Related Labor	2,505	61.2
Lawn Service Companies	622	15.2
<b>Total</b>	<b>4,095</b>	<b>100.0</b>

**Table 4.38 Turf-related labor expenses by hospitals, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,961	78.3
Equipment Maintenance and Repair: In-house Mechanic	236	9.4
Irrigation	49	1.9
Fertilizer, Chemical, and Other Material Applications	94	3.8
Turf Renovation/Aeration	165	6.6
Other	---	---
<b>Total</b>	<b>2,505</b>	<b>100.0</b>

The largest expense associated with turf-related materials was for equipment supplies which cost an estimated \$266,000 and represented 27.5 percent of the total spent in this category (Table 4.39). The second largest expense went for equipment maintenance and repair by hired outside labor and parts. This equipment repair and materials cost and estimated \$192,000 or 19.8 percent of the total. Fertilizer costs made up 11.1 percent of the total spent for materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.



**Table 4.39 Hospitals expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	192	19.8
Equipment Supplies (Gasoline, Blades, Oil, etc)	266	27.5
Fertilizers	107	11.1
Weed Control Products	30	3.1
Insect and Disease Control Products	12	1.2
Growth Retardants	9	0.9
Seed	45	4.7
Lime	6	0.6
Irrigation: Water (includes electricity)	75	7.8
Irrigation: Equipment and Supplies	127	13.1
Other Expenses	99	10.2
<b>Total</b>	<b>968</b>	<b>100.0</b>

### Institutions (Mental Health Agencies)

There were 56 agencies on the list obtained from the Tennessee Department of Mental Health and Mental Retardation. All 56 facilities made up the survey sample. There was 34 of these facilities that was determined to maintain a lawn. There was an estimated 2,722 acres of property used by the facilities with 843 acres being maintained turf (Table 4.40). This maintained turf averaged 24.8 acres per facility and had an total annual maintenance cost of \$258,000 or \$7,588 per agency. An estimated \$86,000 was spent on new turf maintenance equipment in 1991 for mental health agencies.

The largest expense that made up the annual maintenance expense was for turf-related labor. This labor cost an estimated \$196,000 or 76.0 percent of the total (Table 4.41). The second largest expense was for turf-related materials which cost an estimated \$45,000 and represented 17.4 percent of the total annual maintenance expense.

The turf-related labor expense when broken down, listed labor used for mowing as the largest. Labor used for mowing cost an estimated \$181,000 or 92.4 percent of the total spent on labor (Table 4.42). The next largest labor expense went for equipment maintenance and repair by in-house mechanic which cost an estimated \$11,000 or 5.6 percent of the total labor costs.

Equipment supplies was the largest expense for turf-related materials purchased. An estimated \$30,000 or 66.7 percent of the total was spent for these

**Table 4.40 Number of mental health agencies, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Agency
Number of Mental Health Agencies <sup>a</sup>	No.	34	---
Total Property Size	Acres	2,722	80.1
Total Turf Acres	Acres	843	24.8
Total Turf Acres Irrigated	Acres	0	0.0
New Turf Established in 1991	Acres	0	0.0
Annual Maintenance Expense	Dollars	258,000	7,588
Current Value of Turf Maintenance Equipment	Dollars	293,000	8,618
Replacement Value of Turf Maintenance Equipment	Dollars	402,000	11,824
Annual New Equipment Expenditure	Dollars	86,000	2,529

<sup>a</sup> This number based on 60 percent of the questionnaires returned from mental health agencies answered yes for maintaining a lawn.

**Table 4.41 Mental health agencies turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	45	17.4
Turf-Related Labor	196	76.0
Lawn Service Companies	17	6.6
<b>Total</b>	<b>258</b>	<b>100.0</b>

**Table 4.42 Turf-related labor expenses by mental health agencies, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	181	92.4
Equipment Maintenance and Repair: In-house Mechanic	11	5.6
Irrigation	---	---
Fertilizer, Chemical, and Other Material Applications	4	2.0
Turf Renovation/Aeration	---	---
Other	---	---
<b>Total</b>	196	100.0

supplies (Table 4.43). The second largest expense was for equipment maintenance and repair by hired outside labor and parts which cost an estimated \$11,000 or 24.4 percent of the total. Weed control products also represented 8.9 percent of the total spent for turf related materials purchased.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.43 Mental health agencies expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	11	24.4
Equipment Supplies (Gasoline, Blades, Oil, etc)	30	66.7
Fertilizers	---	---
Weed Control Products	4	8.9
Insect and Disease Control Products	---	---
Growth Retardants	---	---
Seed	---	---
Lime	---	---
Irrigation: Water (includes electricity)	---	---
Irrigation: Equipment and Supplies	---	---
Other Expenses	---	---
<b>Total</b>	<b>45</b>	<b>100.0</b>

### Institutions (Nursing Homes)

The list of nursing homes in Tennessee was obtained from the Tennessee Board of Licensing Health Care Facilities. The list was comprised of 535 nursing home facilities and all made up the survey sample. Of the questionnaires returned, 493 facilities was determined to maintain a lawn. The total property size for nursing homes was estimated to be 7,261 acres, and the total turf acres for nursing homes was estimated to be 1,676 acres for an average of 3.4 acres per facility (Table 4.44). The total annual maintenance expenditure for turf maintenance was estimated to be \$3,002,000, and there was an estimated \$6,089 spent on new turf maintenance equipment in 1991.

The annual maintenance cost had turf related labor as the largest expense for nursing homes in 1991. This labor cost an estimated \$1,407,000 and represented 46.9 percent of the total (Table 4.45). The next largest expenditure associated with turf was for lawn service companies. These services cost an estimated \$981,000 and represented 32.6 percent of the total spent for annual turf maintenance.

Of the turf-related labor costs, the largest was for labor associated with mowing. This labor used in mowing cost nursing homes an estimated \$1,233,000 and represented 87.6 percent of the total spent for labor (Table 4.46). Fertilizer, chemical, and other material applications labor was the second highest labor cost with an estimated \$65,000 being used for this type of labor.

The largest cost associated with turf-related materials and practices was for



**Table 4.44 Number of nursing homes, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Home
Number of Nursing Homes <sup>a</sup>	No.	493	---
Total Property Size	Acres	7,261	14.7
Total Turf Acres	Acres	1,676	3.4
Total Turf Acres Irrigated	Acres	148	0.3
New Turf Established in 1991	Acres	39	0.08
Annual Maintenance Expense	Dollars	3,002,000	6,089
Current Value of Turf Maintenance Equipment	Dollars	1,416,000	2,872
Replacement Value of Turf Maintenance Equipment	Dollars	1,578,000	3,201
Annual New Equipment Expenditure	Dollars	196,000	398

<sup>a</sup> This number based on 93 percent of the questionnaires returned from nursing homes answered yes for maintaining a lawn.

**Table 4.45 Nursing homes turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	614	20.5
Turf-Related Labor	1,407	46.9
Lawn Service Companies	981	32.6
<b>Total</b>	<b>3,002</b>	<b>100.0</b>

**Table 4.46 Turf related labor expenses by nursing homes, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,233	87.6
Equipment Maintenance and Repair: In-house Mechanic	58	4.1
Irrigation	31	2.2
Fertilizer, Chemical, and Other Material Applications	65	4.7
Turf Renovation/Aeration	20	1.4
Other	---	---
<b>Total</b>	<b>1,407</b>	<b>100.0</b>

equipment maintenance and repair by hired outside labor and parts (Table 4.47). This hired labor cost an estimated \$234,000 and represented 38.1 percent of the total spent for materials. The next major cost was for equipment supplies, which represented 16.9 percent of the total spent on materials in 1991.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.47 Nursing homes expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	234	38.1
Equipment Supplies (Gasoline, Blades, Oil, etc)	104	16.9
Fertilizers	102	16.6
Weed Control Products	27	4.4
Insect and Disease Control Products	11	1.8
Growth Retardants	1	0.2
Seed	17	2.8
Lime	26	4.2
Irrigation: Water (includes electricity)	55	9.0
Irrigation: Equipment and Supplies	31	5.0
Other Expenses	6	1.0
<b>Total</b>	614	100.0

## Lawn Care Companies

A list of lawn care firms was obtained from the yellow pages in Tennessee phone books. The list had 252 firms, but there were only 202 of the lawn companies that comprised the survey sample because 50 of the firms had gone out of business. The total turf maintained by lawn care companies was estimated to be 46,460 acres (Table 4.48). The total gross revenue from maintaining these lawns was estimated to be \$49,374,000 or \$244,426 per firm. The cost of operating and maintaining these lawns care firms was estimated at \$28,932,000. The lawn care firms owners also spent an estimated \$2,580,000 for new turf maintenance equipment in 1991.

When breaking down the annual maintenance expense, both the turf-related materials and the turf-related labor were about the same. Turf-related materials cost an estimated \$14,566,000 or 50.3 percent of the total and turf-related labor cost an estimated \$14,366,000 (Table 4.49). This labor expense represented 49.7 percent of the total spent for annual maintenance expense.

The largest labor expense for lawn companies went for fertilizer, chemical, and other material applications. This labor used for these applications cost an estimated \$5,711,000 or 39.8 percent of the total (Table 4.50). Labor cost for mowing was the second largest expense with \$5,240,000 used for this practice. This mowing labor represented 36.5 percent of the total spent for labor by lawn care companies.

**Table 4.48 Number of lawn care companies, turf acres maintained, number of clients, gross revenue, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Company
Number of Lawn Care Companies	No.	202	---
Total Turf Acres Maintained	Acres	46,460	230.0
Total Number of Clients	No.	78,780	390
Total Gross Revenue	Dollars	49,374,000	244,426
Annual Maintenance Expense	Dollars	28,932,000	143,228
Current Value of Turf Maintenance Equipment	Dollars	13,023,000	64,470
Replacement Value of Turf Maintenance Equipment	Dollars	51,061,000	252,777
Annual New Equipment Expenditure	Dollars	2,580,000	12,772

**Table 4.49 Lawn care companies turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	14,566	50.3
Turf-Related Labor	14,366	49.7
<b>Total</b>	<b>28,932</b>	<b>100.0</b>

**Table 4.50 Turf-related labor expenses by lawn care companies, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	5,240	36.5
Equipment Maintenance and Repair: In-house Mechanic	802	5.6
Irrigation	570	3.9
Fertilizer, Chemical, and Other Material Applications	5,711	39.8
Turf Renovation/Aeration	664	4.6
Other	1,379	9.6
<b>Total</b>	<b>14,366</b>	<b>100.0</b>

The turf-related materials purchases cost a total of \$14,566,000 with the largest expense being equipment maintenance and repair by hired outside labor and parts (Table 4.51). This equipment repair cost an estimated \$2,913,000 or 20.0 percent of the total. The next largest expense for materials purchased was for fertilizers, which cost an estimated \$1,585,000 or 10.9 percent of the total. Mulch, equipment supplies, and weed control products together represented 28.7 percent of the total.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.



**Table 4.51 Lawn care companies expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
<b>Equipment Maintenance:</b>		
Equipment Maintenance and Repair: Hired Outside Labor and Parts	2,913	20.0
Parts - (Blades, Spark Plugs, Belts, Etc.)	1,021	7.0
Equipment Supplies (Gasoline, Oil, Lubricants, Etc)	1,338	9.2
<b>Fertilizers, Chemicals, And Other Soil Amendments Purchased:</b>		
Fertilizers	1,585	10.9
Lime	336	2.3
Weed Control Products	1,327	9.1
Insect Control Products	262	1.8
Disease Control Products	247	1.7
<b>Other Purchases:</b>		
Seed	529	3.6
Sod	519	3.6
Mulch	1,519	10.4
Excavating/Grading	96	0.7
<b>Irrigation:</b>		
Irrigation: Water (includes electricity)	820	5.6
Irrigation: Equipment and Supplies	902	6.2
<b>Other Expenses:</b>	1,152	7.9
<b>Total</b>	<b>14,566</b>	<b>100.0</b>

### Multiple Dwellings (Apartments and Condominiums)

The yellow pages from the phone books in Tennessee listed 1,936 apartments and condominiums. Many of these multiple dwellings had been out of business since the telephone books had been published. There were an estimated 1,899 multiple dwellings that comprised the total number dwellings used for the turfgrass survey. The estimated number of these apartments that maintained a lawn was determined to be 1,500. An estimated total property size of 26,396 acres with 6,450 acres of maintained turf was estimated from the information given by the apartment owners (Table 4.52). This total turf acres maintained gave an average of 4.3 acres per facility. An estimated \$20,711,000 or an average of \$13,807 per multiple dwelling was expended to maintain this turf. There was an estimated \$651,000 spent by the owners of the multiple dwellings on new turf maintenance equipment in 1991.

The largest expense for turf maintenance was for lawn service companies. Multiple dwellings owners spent an estimated \$10,110,000, which represented 48.8 percent of the total for this service (Table 4.53). The second largest expense was for turf-related labor. This labor expense cost the owners an estimated \$6,801,000 and represented 32.8 percent of the total spent for turf maintenance.

When the turf related labor expenses were broken down for multiple dwellings the largest labor expense was for mowing (Table 4.54). This mowing expense was estimated to be \$5,672,000 or 83.4 percent of the total for labor. The second largest labor expense was for irrigation at \$287,000.

**Table 4.52 Number of multiple dwellings, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Facility
Number of Multiple Dwellings <sup>a</sup>	No.	1,500	---
Total Property Size	Acres	26,396	17.6
Total Turf Acres	Acres	6,450	4.3
Total Turf Acres Irrigated	Acres	1,350	0.9
New Turf Established in 1991	Acres	300	0.2
Annual Maintenance Expense	Dollars	20,711,000	13,807
Current Value of Turf Maintenance Equipment	Dollars	4,743,000	3,162
Replacement Value of Turf Maintenance Equipment	Dollars	5,419,000	3,613
Annual New Equipment Expenditure	Dollars	651,000	434

<sup>a</sup> This number based on 79 percent of the questionnaires returned from multiple dwellings answered yes on maintaining a lawn.

**Table 4.53 Multiple dwellings turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	3,800	18.4
Turf-Related Labor	6,801	32.8
Lawn Service Companies	10,110	48.8
<b>Total</b>	<b>20,711</b>	<b>100.0</b>

**Table 4.54 Turf-related labor expenses by multiple dwellings, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	5,672	83.4
Equipment Maintenance and Repair: In-house Mechanic	161	2.4
Irrigation	287	4.2
Fertilizer, Chemical, and Other Material Applications	143	2.1
Turf Renovation/Aeration	95	1.4
Other	443	6.5
<b>Total</b>	<b>6,801</b>	<b>100.0</b>

The expenses for turf-related materials lists water used for irrigation as the largest expense. An estimated \$1,488,000 was spent and represented 39.2 percent of the total for turf-related materials expenses (Table 4.55). The second largest expense was for equipment supplies, which cost an estimated \$530,000 or 13.9 percent of the total.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.55 Multiple dwellings expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	426	11.2
Equipment Supplies (Gasoline, Blades, Oil, etc)	530	13.9
Fertilizers	315	8.3
Weed Control Products	245	6.4
Insect and Disease Control Products	111	2.9
Growth Retardants	6	0.2
Seed	182	4.8
Lime	26	0.7
Irrigation: Water (includes electricity)	1,488	39.2
Irrigation: Equipment and Supplies	387	10.2
Other Expenses	84	2.2
<b>Total</b>	<b>3,800</b>	<b>100.0</b>

## Municipalities

The list of municipalities was obtained from the 1991 Directory of Tennessee Municipal Officials included 339 municipalities in Tennessee. All 339 were included in the survey sample. The total turf maintained was estimated to be 42,793 acres with 17,760 acres being parks and athletic fields, 20,381 acres being roadways, and 4,652 acres being maintained turf around government buildings (Table 4.56). The annual maintenance expense for maintenance of this turf was estimated at \$10,512,000 or an average of \$31,009 for each municipality. There was also an estimated \$2,014,000 spent on new turf maintenance equipment in 1991.

The largest expense in the annual maintenance expense for turf was for turf-related labor (Table 4.57). This labor cost an estimated \$7,764,000 or 73.9 percent of the total expenditures spent for turf maintenance. The next largest cost was for turf-related materials, which cost \$2,748,000. These turf-related materials represented 26.1 percent of the total expenditures spent on turf by municipalities.

The major cost associated with the turf-related labor went for mowing (Table 4.58). Labor used for just mowing purposes cost an estimated \$5,956,000 or 76.7 percent of the total. The next major cost was for equipment maintenance and repair by in-house mechanic, which represented 10.2 percent of the total spent for turf-related labor.

Of the turf-related materials purchased, the largest expense was for equipment



**Table 4.56 Number of municipalities, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per City
Number of Municipalities	No.	339	---
Total Property Size	Acres	---	---
Total Turf Acres	Acres	42,793 <sup>a</sup>	126.2
Total Turf Acres Irrigated	Acres	160	0.5
New Turf Established in 1991	Acres	610	1.8
Annual Maintenance Expense	Dollars	10,512,000	31,009
Current Value of Turf Maintenance Equipment	Dollars	10,524,000	31,044
Replacement Value of Turf Maintenance Equipment	Dollars	17,501,000	51,625
Annual New Equipment Expenditure	Dollars	2,014,000	5,941

<sup>a</sup> The total turf acreage for municipalities consists of 17,760 acres of parks and athletic fields, 20,381 acres of roadways, and 4,652 acres of turf maintained around government buildings.

**Table 4.57 Municipalities turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	2,748	26.1
Turf-Related Labor	7,764	73.9
Lawn Service Companies	---	---
<b>Total</b>	<b>10,512</b>	<b>100.0</b>

**Table 4.58 Turf-related labor expenses by municipalities, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	5,956	76.7
Equipment Maintenance and Repair: In-house Mechanic	794	10.2
Irrigation	211	2.7
Fertilizer, Chemical, and Other Material Applications	479	6.2
Turf Renovation/Aeration	206	2.7
Other	118	1.5
<b>Total</b>	<b>7,764</b>	<b>100.0</b>

maintenance and repair by hired outside labor and parts (Table 4.59). This hired outside labor and parts cost an estimated \$873,000. The next largest cost associated with materials purchased was for equipment supplies. These supply purchases cost an estimated \$690,000 or 25.1 percent of the total spent. Fertilizer and weed control products cost an estimated 18.5 percent of the total spent on turf-related materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.59 Municipalities expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	873	31.8
Equipment Supplies (Gasoline, Blades, Oil, etc)	690	25.1
Fertilizers	238	8.7
Weed Control Products	270	9.8
Insect and Disease Control Products	133	4.8
Growth Retardants	41	1.5
Seed	178	6.5
Lime	36	1.3
Irrigation: Water (includes electricity)	246	9.0
Irrigation: Equipment and Supplies	15	0.5
Other Expenses	28	1.0
<b>Total</b>	<b>2,748</b>	<b>100.0</b>

## State and Federal Parks

A list of 58 state and federal parks in Tennessee was obtained from the Tennessee Department of Parks and Recreation and the U.S. Federal Park Service. All 58 parks were included in the survey sample. There was an estimated 417,948 acres of land used by the park services according to the superintendents of the parks (Table 4.60). Of this total, there was an estimated 9,396 acres of maintained turf, which each park in Tennessee averaged 162 acres of maintained turf. The total cost of maintaining this turf was estimated to be \$2,501,000 or \$43,121 per park. There was also an estimated \$262,000 spent in 1991 on new turf maintenance equipment.

When the total annual maintenance expense is examined, the largest expense was for turf-related labor (Table 4.61). This labor cost an estimated \$1,731,000 and represented 69.2 percent of the total annual maintenance expense. Turf-related materials was the next largest expense and represented 30.8 percent of the total.

The largest labor cost for turf-related labor was for mowing, which cost an estimated \$1,015,000 (Table 4.62). This labor used for mowing purposes represented 58.6 percent of the total spent on labor. The second highest labor expense went for equipment maintenance and repair by in-house mechanic. This type of labor cost an estimated \$310,000 in 1991. Labor used for irrigation, fertilizer, chemical, and other material applications represented 17.9 percent of the total spent for turf-related labor in 1991.

**Table 4.60 Number of federal and state parks, property size, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Park
Number of Federal and State Parks	No.	58	---
Total Property Size	Acres	417,948	7,206.0
Total Turf Acres	Acres	9,396	162.0
Total Turf Acres Irrigated	Acres	1,009	17.4
New Turf Established in 1991	Acres	168	2.9
Annual Maintenance Expense	Dollars	2,501,000	43,121
Current Value of Turf Maintenance Equipment	Dollars	4,203,000	72,466
Replacement Value of Turf Maintenance Equipment	Dollars	5,213,000	89,879
Annual New Equipment Expenditure	Dollars	262,000	4,517

**Table 4.61 Park turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	770	30.8
Turf-Related Labor	1,731	69.2
Lawn Service Companies	---	---
<b>Total</b>	<b>2,501</b>	<b>100.0</b>

**Table 4.62 Turf-related labor expenses by parks, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,015	58.6
Equipment Maintenance and Repair: In-house Mechanic	310	17.9
Irrigation	139	8.0
Fertilizer, Chemical, and Other Material Applications	119	6.9
Turf Renovation/Aeration	72	4.2
Other	76	4.4
<b>Total</b>	<b>1,731</b>	<b>100.0</b>

The expenses for turf-related materials purchased listed equipment maintenance and repair by hired outside labor and parts as the largest expense in this category. These repairs illustrate 27.9 percent of the total (Table 4.63). The next largest expense was for fertilizers which cost an estimated \$156,000 and represented 20.3 percent of the total spent on materials. Equipment supplies represented 19.6 percent of the total spent on materials in 1991.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.



**Table 4.63 Park expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	215	27.9
Equipment Supplies (Gasoline, Blades, Oil, etc)	151	19.6
Fertilizers	156	20.3
Weed Control Products	72	9.4
Insect and Disease Control Products	39	5.1
Growth Retardants	2	0.3
Seed	27	3.5
Lime	14	1.8
Irrigation: Water (includes electricity)	33	4.3
Irrigation: Equipment and Supplies	50	6.4
Other Expenses	11	1.4
<b>Total</b>	<b>770</b>	<b>100.0</b>

## Roadsides

The roadside maintenance crews maintained an estimated 66,000 acres of roadside along both state and federal highways in Tennessee. This turf maintenance cost an estimated \$11,000,000 in 1991. The largest expense in turf maintenance was for labor, which cost an estimated \$10,000,000. The next largest expense was for weed control products which cost an estimated \$1,000,000.

## Schools (Colleges)

The list of 131 colleges and universities in Tennessee was obtained from the 1983-84 Accredited Institution of Postsecondary Education Programs Candidates. All 131 comprised the sample survey. Of these 131 colleges, 102 of these was determined to maintain a lawn. Based of the information provided by the people in charge of lawn maintenance, the turf acreage maintained at the colleges was estimated to be 5,161 acres (Table 4.64). This acreage averaged 50.6 acres per college. The cost of maintaining this turf area was estimated to be \$4,683,000 or an average of \$45,912 per college or university. The lawn maintenance personal from the colleges and universities also spent an estimated \$498,000 was spent on new turf maintenance equipment in 1991.

The largest expense for turf maintenance was for turf-related labor. This cost an estimated \$2,636,000 or 56.3 percent of the total (Table 4.65). The second largest expense was for turf-related materials which cost an estimated \$1,931,000.

**Table 4.64 Number of colleges, turf acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per College
Number of Colleges <sup>a</sup>	No.	102	---
Total Turf Acres <sup>b</sup>	Acres	5,161	50.6
Total Turf Acres Irrigated <sup>c</sup>	Acres	286	2.8
New Turf Established in 1991	Acres	163	1.6
Annual Maintenance Expense	Dollars	4,683,000	45,912
Current Value of Turf Maintenance Equipment	Dollars	3,327,000	32,618
Replacement Value of Turf Maintenance Equipment	Dollars	7,768,000	76,157
Annual New Equipment Expenditure	Dollars	498,000	4,882

<sup>a</sup> This number based on 85 percent of the questionnaires returned from colleges answered yes on maintaining a lawn.

<sup>b</sup> The total turf acres consists of 4,702 acres of general turf and 459 acres of athletic fields.

<sup>c</sup> The total turf acres irrigated consists of 86 acres of irrigated general turf and 200 acres of irrigated athletic fields.

**Table 4.65 College turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	1,931	41.2
Turf-Related Labor	2,636	56.3
Lawn Service Companies	116	2.5
<b>Total</b>	<b>4,683</b>	<b>100.0</b>

The cost of turf-related materials was 41.2 percent of the total amount spent on turf maintenance for colleges and universities.

The labor expenses when broken down showed that the largest labor expense was for mowing (Table 4.66). Labor for mowing purposes only cost an estimated \$1,797,000 or 68.2 percent of the total amount of money spent on labor expenses. The second largest labor expense was for equipment maintenance and repair by an in-house mechanic. There was an estimated \$299,000 spent on this type of labor. This equipment maintenance represented 11.3 percent of the total labor costs.

The largest expense for colleges in turf-related materials expense was for irrigation equipment and supplies which cost an estimated \$726,000 or 37.6 percent of the total spent on materials (Table 4.67). Equipment supplies was the second largest expense in turf-related materials. Equipment supplies cost an estimated \$317,000.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.66 Turf-related labor expenses by colleges, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,797	68.2
Equipment Maintenance and Repair: In-house Mechanic	299	11.3
Irrigation	93	3.5
Fertilizer, Chemical, and Other Material Applications	55	2.1
Turf Renovation/Aeration	113	4.3
Other	279	10.6
<b>Total</b>	<b>2,636</b>	<b>100.0</b>

**Table 4.67 College expenses for selected turf-related materials and services, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	269	13.9
Equipment Supplies (Gasoline, Blades, Oil, etc)	317	16.4
Fertilizers	195	10.1
Weed Control Products	60	3.1
Insect and Disease Control Products	19	1.0
Growth Retardants	3	0.2
Seed	74	3.8
Lime	24	1.2
Irrigation: Water (includes electricity)	115	6.0
Irrigation: Equipment and Supplies	726	37.6
Other Expenses	129	6.7
<b>Total</b>	<b>1,931</b>	<b>100.0</b>

## Schools

There were 269 superintendents included on the lists of schools obtained from the Tennessee Department of Education. All 269 were included in the survey sample and 189 of these schools was determined to maintain a lawn. The total turf acres maintained was estimated to be 15,290 acres (Table 4.68). This turf acreage averaged out to be around 80.9 acres for each school system. The estimated cost of maintaining these acres was \$3,706,000 or an average of \$19,608 per school system. The expenditure for new turf equipment in 1991 for the systems was estimated at \$716,000.

The largest expense associated with the annual turf maintenance expense was turf-related labor which cost an estimated \$2,371,000 and represented 64.0 percent of the total expense (4.69). The next major expense was for turf-related materials. These materials cost an estimated \$1,254,000 or 33.8 percent of the total spent for annual turf expenses.

The labor expenses had the labor associated with mowing as the highest labor expense (Table 4.70). This mowing labor cost an estimated \$1,711,000, which represented 72.2 percent of the total amount spent on labor for turf maintenance. The second largest labor expense was for equipment maintenance and repair by in-house mechanics. This labor for repairs represented 15.5 percent of the total and cost an estimated \$367,000.

Of the turf related-materials purchased, the major category of expenses went



**Table 4.68 Number of school systems, turf acres, maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per School System
Number of Schools Systems <sup>a</sup>	No.	189	---
Total Turf Acres <sup>b</sup>	Acres	15,290	80.9
Total Turf Acres Irrigated <sup>c</sup>	Acres	624	3.3
New Turf Established in 1991	Acres	246	1.3
Annual Maintenance Expense	Dollars	3,706,000	19,608
Current Value of Turf Maintenance Equipment	Dollars	6,144,000	32,508
Replacement Value of Turf Maintenance Equipment	Dollars	8,527,000	45,116
Annual New Equipment Expenditure	Dollars	716,000	3,788

<sup>a</sup> This number based on 85 percent of the questionnaires returned from colleges answered yes on maintaining a lawn.

<sup>b</sup> This total turf acres consists of 14,232 acres of maintained general turf, and 1,058 acres of maintained athletic fields.

<sup>c</sup> This total turf acres irrigated consists of 139 acres of general turf and 485 acres of athletic fields.

**Table 4.69 School systems turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	1,254	33.8
Turf-Related Labor	2,371	64.0
Lawn Service Companies	81	2.2
<b>Total</b>	<b>3,706</b>	<b>100.0</b>

**Table 4.70 Turf-related labor expenses by school systems, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	1,711	72.2
Equipment Maintenance and Repair: In-house Mechanic	367	15.5
Irrigation	207	8.7
Fertilizer, Chemical, and Other Material Applications	70	3.0
Turf Renovation/Aeration	15	0.6
Other	1	---
<b>Total</b>	<b>2,371</b>	<b>100.0</b>

for equipment supplies (Table 4.71). These supplies cost school systems in Tennessee an estimated \$366,000 and represented 29.2 percent of the total spent for materials. The second highest expense was for equipment maintenance and repair by hired outside labor and parts, which cost an estimated \$230,000.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.

**Table 4.71 School systems expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
Equipment Maintenance and Repair: Hired Outside Labor and Parts	230	18.3
Equipment Supplies (Gasoline, Blades, Oil, etc)	366	29.2
Fertilizers	161	12.8
Weed Control Products	104	8.3
Insect and Disease Control Products	18	1.4
Growth Retardants	140	11.2
Seed	35	2.8
Lime	10	0.8
Irrigation: Water (includes electricity)	115	9.2
Irrigation: Equipment and Supplies	53	4.2
Other Expenses	22	1.8
<b>Total</b>	<b>1,254</b>	<b>100.0</b>

## Sod Producers

The list of 24 sod producers was obtained from the Ornamental Horticulture & Landscape Design Department at the University of Tennessee and the Tennessee Turfgrass Association. Since the list had been published, two of the producers had closed down the operation. The remaining 22 producers made up the survey sample. The total size of property was estimated at 10,259 acres according to the information provided by the producers (Table 4.72). Of this property acreage, 6,115 acres were used in the production of sod and an estimated 746 acres of this production acreage was harvested. The annual maintenance expense was an estimated \$3,975,000 or an average of \$180,682 per producer. An estimated \$1,090,000 was spent on new turf maintenance equipment in 1991.

When the annual maintenance expenses are examined, the major expense was for turf-related materials purchased (Table 4.73). An estimated \$2,233,000 was spent on these materials in 1991 and this figure represent 56.2 percent of the total. Turf-related labor cost an estimated \$1,742,000 and represented 43.8 percent of the total spent on annual maintenance expenses.

The highest cost associated with labor that was for coring/aeration and dethatching (Table 4.74). This practice cost an estimated \$429,000 and represented 24.6 percent of the total spent for labor. The second highest cost for labor was for mowing, which cost an estimated \$258,000. This labor used in mowing signify 14.8 percent of the total.

**Table 4.72 Number of sod producers, property size, production acres, turf maintenance expense and value of equipment, Tennessee 1991.**

Item	Unit	Total	Average Per Producer
Number of Sod Producers	No.	22	---
Total Property Size	Acres	10,259	466.3
Total Turf Acres in Production	Acres	6,115	278.0
Total Production Acres Irrigated	Acres	5,479	249.1
New Sod Production Turf Established in 1991	Acres	618	28.1
Acres of Sod Harvested in 1991	Acres	746	33.9
Annual Maintenance Expense	Dollars	3,975,000	180,682
Current Value of Turf Maintenance Equipment	Dollars	6,249,000	284,045
Replacement Value of Turf Maintenance Equipment	Dollars	9,838,000	447,182
Annual New Equipment Expenditure	Dollars	1,090,000	49,546

**Table 4.73 Sod producers turf maintenance expenditures for labor and materials, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Turf-Related Materials	2,233	56.2
Turf-Related Labor	1,742	43.8
<b>Total</b>	<b>3,975</b>	<b>100.0</b>

**Table 4.74 Turf-related labor expenses by sod producers, Tennessee 1991.**

Practice	Total Cost	Percent of Total
	(\$000)	
Mowing	258	14.8
Equipment Maintenance and Repair: In-house Mechanic	131	7.5
Irrigation	48	2.8
Fertilizer, Chemical, and Other Material Applications	92	5.3
Plowing, Planting Bed Preparation, etc.	115	6.6
Coring/Aeration, Dethatching	429	24.6
Other	669	38.4
<b>Total</b>	<b>1,742</b>	<b>100.0</b>

When examining the turf related materials purchased, the largest expense was for equipment supplies. This maintenance expense cost an estimated \$741,000 and represented 33.1 percent of the total (Table 4.75). The next major cost was for equipment maintenance and repair by hired outside labor and parts. This maintenance cost an estimated \$534,000 and represented 23.9 percent of the total spent for materials. Another major cost for sod producers was for fertilizer, which represented 11.9 percent of the total spent on turf related materials.

Information concerning the percent response for turf care practices, selected turf management problems, source of turf management problems answers, and also the number of persons employed with turfgrass responsibilities are located in Appendix B.



**Table 4.75 Sod producers expenses for selected turf-related materials and practices, Tennessee 1991.**

Maintenance Expenses	Total Cost	Percent of Total
	(\$000)	
<b>Turf Equipment Maintenance Costs:</b>		
Equipment Maintenance and Repair: Hired Outside Labor and Parts	534	23.9
Equipment Supplies (Gasoline, Blades, Oil, etc)	741	33.1
Tillage	73	3.2
<b>Fertilizers, Chemicals, and Other Soil Amendments:</b>		
Fertilizers	265	11.9
Weed Control Products	164	7.3
Insect Control Products	16	0.7
Disease Control Products	20	1.0
Seed	44	2.0
Lime	10	0.5
Sprigs/Plugs	14	0.6
Organic Additions (Root Enhancers, Soil Conditioners, Etc.)	2	0.1
<b>Irrigation:</b>		
Irrigation: Water (includes electricity)	109	4.9
Irrigation: Equipment and Supplies	241	10.8
<b>Other Expenses:</b>	0	---
<b>Total</b>	<b>2,233</b>	<b>100.0</b>

### Industry Totals

The maintenance and acreage values for all fifteen surveyed components of the Tennessee turfgrass industry are presented in Table 4.76. The estimated total area of turfgrass maintained in Tennessee in 1991 was 889,382 acres. The estimated value of expenditures for maintenance of this turf area was \$360.415 million. As anticipated, homes was the largest component and accounted for 61.5 percent of the expense total and 69.8 percent of the acreage total.

From a dollar perspective, the next leading component was golf courses, which accounted for 10.6 percent of total expenditures and 2.9 percent of the acreage. Both of the components referred to as commercial establishments and multiple dwellings accounted for 5.8 percent of total expenses. In descending order of economic importance, the other components were roadside, municipalities, churches, schools, institutions, sod producers, counties, parks, cemeteries, and airports.

A total of \$263.480 million was spent for turf-related materials in 1991 (Table 4.77). Expenses for labor were estimated to be \$14.633 million for golf courses and \$14.366 million for lawn-care companies. To guard against double counting, the estimated values for lawn-care companies were not added to the state totals presented in the Table 4.76; however, to reveal the level of involvement by lawn-care companies, the estimated fees paid to lawn-care companies by each turfgrass component is presented in Table 4.77. The multiple dwellings accounted for approximately half of the \$22.105 million paid to lawn-care companies as fees for

Table 4.76 The turf acreage maintained, new turf established, and the annual maintenance expenditures, Tennessee 1991.

Categories	No. Turf Acres Maintained	Percent of Total	New Turf Established 1991	Annual Maintenance Expense	Percent of Total
	(Acres)	%	(Acres)	(\$000)	%
Airports	10,608	1.2	840	463	0.1
Cemeteries	3,437	0.4	222	2,173	0.6
Churches	13,482	1.5	1,027	8,540	2.4
Commercial Establishments	32,762	3.7	1,339	20,958	5.8
Counties	32,114	3.6	648	3,779	1.0
Golf Courses	25,990	2.9	1,127	38,098	10.6
Home Owners	620,659	69.8	53,199	221,664	61.5
Institutions	5,125	0.5	174	7,652	2.1
Lawn Care Companies	---	---	---	---	---
Multiple Dwellings	6,450	0.7	300	20,711	5.8
Municipalities	42,793	4.8	610	10,512	2.9
Parks	9,396	1.1	168	2,501	0.7
Roadsides	60,000	6.8	---	11,000	3.1
Schools	20,451	2.3	409	8,389	2.3
Sod Producers	6,115	0.7	618	3,975	1.1
<b>Total</b>	<b>889,382</b>	<b>100.0</b>	<b>60,681</b>	<b>360,415</b>	<b>100.0</b>

**Table 4.77** The expenses for turf-related materials, turf-related labor and fees paid to lawn service companies, Tennessee 1991.

Categories	Turf-Related Materials (\$000)	Turf-Related Labor (\$000)	Fees to Lawn Service Companies (\$000)
Airports	270	178	15
Cemeteries	683	1,369	121
Churches	2,062	3,833	2,645
Commercial Establishments	3,046	11,666	5,616
Counties	908	2,871	---
Golf Courses	23,465	14,633	---
Home Owners	203,044	16,847	1,773
Institutions	1,700	4,324	1,628
Lawn Care Companies	14,566	14,366	---
Multiple Dwellings	3,800	6,801	10,110
Municipalities	2,748	7,764	---
Parks	770	1,731	---
Roadsides	1,000	10,000	---
Schools	3,185	5,007	197
Sod Producers	2,233	1,742	---
<b>Total</b>	<b>263,480</b>	<b>103,132</b>	<b>22,105</b>

lawn maintenance.

For turf-related labor expenses, as would be expected, mowing was the largest expense category and was estimated at \$73.367 million (Table 4.78). The application of materials was the second highest labor expense category at \$9.106 million. Labor for equipment repair was estimated at \$8.759 million, followed by labor for irrigation and turf renovation following at \$3.289 million and \$3.973 million, respectively.

Estimated expenses for outside labor that was hired to repair equipment was estimated at \$74.093 million, of which \$62.066 million was by home owners (Table 4.79). Besides the single dwelling homes component, which dominated all of the other components simply because of the large number of homes in the state, the golf course component was second in terms of expenditures for equipment, fertilizer, weed control products, insect and disease control products, growth retardants, seed, lime, and irrigation water and equipment. Third in importance was the lawn-care component.

Table 4.78 Turf-related labor expenses by category, Tennessee 1991.

Categories	Mowing (\$000)	Equip. Repair: In-House Mechanic (\$000)	Irrigation (\$000)	Material Application (\$000)	Turf Renovation (\$000)	Other (\$000)
Airports	68	105	---	1	---	4
Cemeteries	1,147	143	22	28	29	---
Churches	3,358	122	19	103	51	180
Commercial Establishments	8,015	1,828	237	485	747	354
Counties	2,087	420	47	128	169	20
Golf Courses	6,676	2,913	1,327	1,522	1,198	997
Home Owners	16,847	---	---	---	---	---
Institutions	3,520	364	82	170	185	3
Lawn Care Companies	5,240	802	570	5,711	664	1,379
Multiple Dwellings	5,672	161	287	143	95	443
Municipalities	5,956	794	211	479	206	118
Parks	1,015	310	139	119	72	76
Roadsides	10,000	---	---	---	---	---
Schools	3,508	666	300	125	128	280
Sod Producers	258	131	48	92	429	784
<b>Total</b>	<b>73,367</b>	<b>8,759</b>	<b>3,289</b>	<b>9,106</b>	<b>3,973</b>	<b>4,638</b>



**Table 4.79 Category expenses for selected turf-related materials and practices, Tennessee 1991.**

Categories	Repair: hired outside Labor	Equip. Supplies	Fertilizer	Weed Control Products	Insect & Disease Control Products	Growth Retardant	Seed	Lime	Irriga- tion: Water	Irriga- tion: Equipment & Supplies	Other Expense
	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)	(\$000)
Airports	79	65	47	14	1	3	6	49	1	---	5
Cemeteries	226	282	44	23	3	---	28	5	31	28	13
Churches	738	411	161	71	26	13	141	6	161	315	19
Commercial Establishments	1,279	686	442	203	141	36	145	35	281	111	47
Counties	258	406	55	26	34	5	29	20	47	24	4
Golf Courses	3,531	4,713	772	2,623	1,517	---	1,083	1,900	2,135	4,188	1,003
Homes Owners	62,066	27,486	19,506	10,640	7,980	---	10,640	1,773	---	29,260	33,693
Institutions	456	426	216	68	23	10	64	32	137	163	105
Lawn Care Companies	2,913	2,359	1,585	1,327	509	---	529	336	820	902	3,286
Multiple Dwellings	426	530	315	245	111	6	182	26	1,488	387	84
Municipalities	873	690	238	270	133	41	178	36	246	15	28
Parks	215	151	156	72	39	2	27	14	33	50	11
Roadsides	---	---	---	1,000	---	---	---	---	---	---	---
Schools	499	683	356	164	37	143	109	34	230	779	151
Sod Producers	534	814	265	164	36	---	44	10	109	241	16
<b>Total</b>	<b>74,093</b>	<b>39,702</b>	<b>24,158</b>	<b>16,910</b>	<b>10,590</b>	<b>259</b>	<b>13,205</b>	<b>4,276</b>	<b>5,719</b>	<b>36,463</b>	<b>38,465</b>

### Confidence Intervals for Sample Means

When random samples are being repeatedly drawn from a population with a true population mean,  $\mu$ , and a standard deviation  $\sigma$ , the relative frequency histogram for the sample means will be normal bell-shaped when sample size,  $n$ , is large. This holds true because of the Central Limit Theorem [Ott]. This information is useful because this can be used to find the distribution of the sample mean,  $\bar{x}$ , to make inferences about the true population mean,  $\mu$ . This means that when checking the distribution of  $\bar{x}$  in a normal curve, that 95 percent of the  $\bar{x}$ 's will be within 1.96 standard errors of their mean. The procedure can not only be used for the sample mean,  $\bar{x}$ , to estimate true population mean,  $\mu$ , but can also be used to see how close to true population mean,  $\mu$ , the estimate will be. This provides a measure of goodness of fit for the estimates determined. To obtain the confidence intervals for the means that were computed for each category in each strata, t-tables had to be used because the standard deviation for the populations were not known. The sample standard deviation had to be determined for each of the categories in each stratum. The equation that was used to determine the confidence intervals was:

$$C. I. = \bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

The  $\bar{x}$  represents the sample mean and the  $s$  represents the sample standard deviation. Standard t-tables were used to determine  $t_{\alpha/2}$  with degrees of freedom

equal to  $df = \eta - 1$  and the confidence coefficient is  $(1 - \alpha)$  [Ott]. The  $\eta$  is the sample taken from the population. As this  $\eta$  becomes larger, the length of the interval is expected to become smaller, hence resulting in a higher degree of precision.

The confidence intervals determined for the different expense and area categories for the turfgrass industry in Tennessee are presented in Tables 4.80 through 4.85. The confidence intervals in these tables do not include negative numbers because the values in question are dollar values (or acreage) and logically should not be allowed to be less than zero. The average home in Tennessee maintained an estimated 0.7 acres of turf.

Because of the number of confidence intervals, and repetitive nature of their interpretation, the homes component will be used to illustrate the interpretation of the confidence intervals. The average home in Tennessee was estimated to maintain 0.7 acres of turf, and the calculated confidence interval ranged from 0.6 to 0.8. This can be interpreted to mean that, with 95 percent confidence, this interval will contain the true mean. This information allows the reader the flexibility to select the lower number if the desire was to be as conservative as possible, or to select the upper number if the desire was to be extremely liberal in projecting acreage and value totals. Similar interpretations are valid for each sample mean of the acreage and expense values estimated.

Table 4.80 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.

Categories	Total Property Size	Area Maintained	New Turf Established 1991	Area Irrigated	Current Value of Equipment
Airports	106<-288->470	42<-133->224	0<-11->29	0<-7->20	0<-18718->37745
Cemeteries	23<-35->47	13<-20->27	.2<-1.3->2.4	0<-3->6	8093<-16265->24437
Churches	---	1.6<-2->2.4	.1<-2->.3	.058<-.06->.062	674<-950->1226
Commercial Establishments: Industrial	0<-68->159	1<-12->23	.1<-5->.9	.1<-3->.5	1943<-4813->7683
Commercial Establishments: Motels/Hotels	0<-123->249	4<-7->10	.1<-3->.5	0<-9->1.8	2047<-4178->6509
Counties	---	---	.2<-7.2->14.2	1<-4->7	22196<-41381->60566
Golf Courses	117<-194->271	99<-113->127	2.2<-4.9->7.6	52<-66->79	156184<-217363->278542
Homes	4<-5->7	.6<-7->.8	.04<-.06->.08	---	954<-1043->1132
Institutions: Health Agencies	0<-565->1434	6<-17->28	0<-.03->.07	0<-.5->.13	5871<-12264->18657
Institutions: Hospitals	6<-39->72	1<-13->25	0<-.9->1.9	0<-2->4	0<-17753->37708
Institutions: Mental Agencies	0<-49->125	0<-25->61	0<-0->0	0<-0->0	0<-8625->19374
Institutions: Nursing Homes	8<-14->20	2<-3->4	0<-.07->.17	.1<-3->.5	1173<-2873->4573
Lawn and Ground Care Firms	---	---	---	---	41104<-64470->87836
Multiple Dwellings	7<-14->21	3<-4->5	0<-.2->.5	.4<-.9->1.4	1474<-3162->4850
Municipalities	---	---	.7<-1.8->2.9	2<-4->6	21279<-31044->40809
Parks	562<-7207->13852	94<-163->232	0<-3->7	0<-17->37	22316<-72457->122598
Roadsides	---	---	---	---	---
Schools: Colleges	30<-51->72	1<-5->9	0.5<-1.5->2.5	1<-3->5	11228<-32618->54008
Schools: School Superintendents	42<-75->109	4<-5->6	0.5<-1.3->2.1	2<-3->4	8377<-32506->56635
Sod Producers	202<-466->730	---	5<-28->51	61<-248->437	13930<-284039->554148

Table 4.81 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.

Categories	Replacement Cost of Equipment	New Equipment Purchased 1991	Lawn Service Fee	No. of Permanent Full-time Employees	No. of Part-time Employees
Airports	1724<-28216->54708	0<-3869->9202	0<-182->443	.3<-1.1->1.9	0<-.7->1.6
Cemeteries	12670<-20885->29100	1195<-4093->6991	0<-705->1867	.9<-1.4->1.9	.7<-1.1->1.5
Churches	1044<-1421->1798	0<-465->1081	267<-413->559	.15<-.2->.25	.3<-.4->.5
Commercial Establishments: Industrial	2027<-6197->10367	0<-829->1661	1222<-2169->3116	.1<-.5->.9	.2<-.4->.6
Commercial Establishments: Motels/Hotels	2889<-6744->10599	322<-824->1326	625<-1032->1439	.6<-.8->1.0	.4<-.6->.8
Counties	37146<-68203->99260	2657<-7806->12955	---	2.3<-4->5.7	1.8<-3->4.2
Golf Courses	284919<-373764->462609	20502<-28506->36510	---	4.9<-6->7.1	3.8<-4.7->5.6
Homes	1527<-1672->1817	137<-169->201	57<-82->107	---	---
Institutions: Health Agencies	9145<-18908->28671	161<-555->949	0<-215->573	1<-2.3->3.6	.1<-.8->1.5
Institutions: Hospitals	0<-24630->53063	0<-2975->6026	1213<-4173->7133	.1<-1.5->2.9	0<-1.1->2.4
Institutions: Mental Agencies	0<-11829->27349	0<-2520->5356	0<-504->1247	0<-1.4->2.9	0<-1.5->3.0
Institutions: Nursing Homes	2168<-3200->4232	223<-397->571	1256<-1990->2724	.4<-.6->.8	.3<-.4->.5
Lawn and Ground Care Firms	0<-252778->593507	7001<-12773->18545	---	2.9<-4.1->5.3	2.2<-3.8->5.4
Multiple Dwellings	2007<-3613->5219	215<-434->653	4409<-6740->9071	.4<-.5->.6	.3<-.4->.5
Municipalities	30800<-51624->72448	3546<-5941->8336	---	1.5<-2.7->3.8	.9<-2.1->3.3
Parks	44428<-89887->135346	0<-4519->9455	---	2.8<-3.6->4.4	1.6<-2.8->4
Roadsides	---	---	---	---	---
Schools: Colleges	10567<-76152->140737	1623<-4886->8149	0<-1141->2421	1.7<-5.8->9.9	.9<-3.7->6.4
Schools: School Superintendents	20190<-45119->70048	1259<-3786->6313	12<-427->843	3.5<-5.9->8.3	0.7<-1.5->2.3
Sod Producers	48784<-447200->845616	11805<-49550->87295	---	1.5<-7.5->13.5	3.9<-7.9->12

**Table 4.82 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.**

Categories	Hired Outside Labor	In-house Mechanic	Supplies	Fertilizers	Weed Control Products
Airports	22<-987->1952	0<-1315->2835	262<-818->1334	0<-591->1525	49<-179->309
Cemeteries	142<-1321->2495	111<-834->1557	98<-1652->3206	98<-258->418	57<-132->207
Churches	59<-115->171	7<-19->31	50<-64->78	17<-25->33	7<-11->15
Commercial Establishments: Industrial	118<-349->580	0<-703->1426	70<-200->330	24<-98->220	30<-58->86
Commercial Establishments: Motels/Hotels	363<-690->1017	0<-345->700	91<-259->427	1<-236->471	32<-101->170
Counties	1155<-2721->4287	1217<-4417->7617	1117<-4278->7439	163<-582->1001	89<-278->467
Golf Courses	0<-15354->32845	10418<-12666->14914	5376<-6700->8024	8314<-11405->14496	4087<-5545->7003
Homes	52<-69->86	---	29<-31->33	18<-22->26	11<-12->13
Institutions: Health Agencies	2<-536->1070	76<-1697->3318	230<-741->1252	29<-192->355	19<-206->393
Institutions: Hospitals	238<-1286->2334	0<-1581->3574	0<-1785->4592	56<-720->1384	49<-198->347
Institutions: Mental Agencies	0<-337->706	0<-531->1615	0<-887->2314	---	0<-125->340
Institutions: Nursing Homes	237<-474->711	63<-117->171	97<-211->325	29<-206->383	30<-55->80
Lawn and Ground Care Firms	6110<-14423->22736	1753<-3972->6191	4125<-6623->9121	3916<-7847->11778	2171<-6569->10967
Multiple Dwellings	154<-284->414	32<-107->182	61<-353->645	70<-210->350	12<-163->314
Municipalities	535<-2576->4617	1346<-2343->3340	1256<-2034->2812	355<-703->1051	354<-797->1240
Parks	744<-3699->6654	2069<-5352->8635	1069<-2598->9127	108<-2684->5260	0<-1244->2742
Roadsides	---	---	---	---	---
Schools: Colleges	946<-2636->4326	916<-2430->4944	41<-3108->6175	212<-1703->3618	239<-586->933
Schools: School Superintendents	673<-1216->1759	180<-1440->2701	809<-1934->3060	4408<-851->1294	124<-549->974
Sod Producers	607<-24284->47961	0<-5950->12276	11418<-33672->55926	2515<-12045->21575	0<-7448->17445



Table 4.83 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.

Categories	Insect and Disease Control Products	Growth Retardants	Seed	Lime	Other
Airports	0<-18->49	0<-38->82	0<-78->171	0<-624->1853	0<-68->203
Cemeteries	4<-16->28	0<-3->9	76<-161->246	0<-28->68	0<-74->221
Churches	2<-4->6	0<-2->4	1<-22->43	0<-1->2	1<-3->5
Commercial Establishments: Industrial	0<-34->72	0<-5->10	13<-34->55	3<-11->19	0<-2->4
Commercial Establishments: Motels/Hotels	0<-90->206	0<-35->93	0<-96->212	6<-15->24	7<-60->113
Counties	0<-361->988	0<-50->133	32<-306->579	41<-215->389	0<-41->124
Golf Courses	1688<-2875->4062	---	3172<-4709->6246	568<-1054->1540	679<-1489->2299
Homes	6<-7->8	---	10<-12->14	1<-2->3	6<-12->18
Institutions: Health Agencies	0<-3->7	0<-0->0	12<-44->76	0<-25->68	0<-8->24
Institutions: Hospitals	1<-83->165	0<-58->117	0<-305->631	0<-37->78	0<-666->1801
Institutions: Mental Agencies	0<-8->26	0<-0->0	0<-6->17	0<-0->0	0<-0->0
Institutions: Nursing Homes	9<-22->34	0<-3->7	18<-34->50	0<-53->135	0<-13->26
Lawn and Ground Care Firms	54<-1295->2536	---	1450<-2621->3792	271<-1662->3053	0<-5702->15324
Multiple Dwellings	25<-74->123	0<-4->9	24<-121->218	1<-17->33	0<-56->157
Municipalities	68<-392->716	21<-121->221	60<-526->992	58<-107->156	9<-85->161
Parks	0<-676->1565	0<-43->102	157<-472->787	0<-233->529	0<-185->533
Roadsides	---	---	---	---	---
Schools: Colleges	58<-189->320	0<-32->67	77<-733->1384	0<-238->539	0<-1261->3194
Schools: School Superintendents	0<-94->191	0<-740->2161	83<-184->285	23<-55->87	20<-119->217
Sod Producers	0<-930->2367	---	115<-1980->3845	0<-440->990	---

Table 4.84 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.

Categories	Water(Irrigation)	Equipment and Supplies (Irrigation)	Labor: Mowing	Labor: Irrigation	Labor: Material Application
Airports	0<-15->61	0<-3->9	0<-855->1886	0<-2->5	0<-17->49
Cemeteries	13<-183->353	2<-163->324	3960<-6707->9454	0<-131->326	54<-161->268
Churches	4<-25->46	0<-49->130	398<-523->648	0<-3->6	2<-16->30
Commercial Establishments: Industrial	7<-31->55	8<-27->46	1654<-3054->4454	5<-45->85	23<-169->315
Commercial Establishments: Motels/Hotels	90<-292->494	11<-70->129	759<-1606->2453	0<-188->478	22<-146->270
Counties	172<-495->818	21<-247->473	7489<-21967->36445	11<-497->983	94<-1350->2606
Golf Courses	6180<-9284->12388	2603<-18210->33817	19276<-29026->38776	3489<-5768->8047	4259<-6619->8979
Homes	---	16<-33->50	---	---	---
Institutions: Health Agencies	0<-197->462	0<-134->270	0<-1452->11574	0<-56->144	0<-211->487
Institutions: Hospitals	0<-501->1007	0<-852->1920	0<-13159->27510	16<-329->642	78<-634->1190
Institutions: Mental Agencies	0<-0->0	0<-0->0	0<-5326->12392	0<-0->0	0<-104->321
Institutions: Nursing Homes	57<-112->167	26<-62->98	1660<-2500->3340	11<-63->115	74<-131->188
Lawn and Ground Care Firms	0<-4060->11267	0<-4466->11704	11598<-25940->40282	0<-2821->7638	8607<-28270->47933
Multiple Dwellings	28<-992->1956	0<-258->517	2159<-3781->5403	2<-191->380	32<-95->158
Municipalities	162<-727->1292	172<-415->658	9107<-17568->26029	121<-622->1123	186<-1412->2638
Parks	0<-574->1191	0<-862->2045	9385<-17497->25609	0<-2400->5537	300<-2059->3808
Roadsides	---	---	---	---	---
Schools: Colleges	0<-1131->2398	0<-7116->19116	2250<-17621->32992	0<-908->2100	183<-541->899
Schools: School Superintendents	366<-611->856	109<-281->453	4621<-9053->13485	0<-1095->2877	102<-369->636
Sod Producers	0<-4950->10398	0<-10950->27939	0<-11724->28804	0<-2200->6691	0<-4200->13200

Table 4.85 95% confidence intervals with the upper and lower bounds for the sample means for the Tennessee turfgrass industry in 1991.

Categories	Turf Renovation	Labor: Other
Airports	0<-0->0	0<-44->134
Cemeteries	28<-169->310	0<-0->0
Churches	0<-8->21	0<-28->21
Commercial Establishments: Industrial	0<-322->955	0<-13->38
Commercial Establishments: Motels/Hotels	8<-33->58	0<-450->1318
Counties	0<-1777->3958	0<-208->627
Golf Courses	3211<-5207->7203	2161<-4337->6513
Homes	---	---
Institutions: Health Agencies	0<-20->62	0<-87->256
Institutions: Hospitals	0<-1109->2824	0<-0->0
Institutions: Mental Agencies	0<-0->0	0<-0->0
Institutions: Nursing Homes	0<-40->87	0<-0->0
Lawn and Ground Care Firms	1052<-3289->5526	2400<-6830->11260
Multiple Dwellings	0<-63->134	40<-295->550
Municipalities	195<-608->1021	0<-348->849
Parks	0<-1240->2755	0<-1314->3642
Roadsides	---	---
Schools: Colleges	0<-1111->2904	0<-2735->6516
Schools: School Superintendents	12<-78->144	0<-7->22
Sod Producers	0<-19500->63569	0<-30422->76770

## CHAPTER V

### SUMMARY AND CLOSING COMMENTS

#### Tennessee Turfgrass Industry Study

The primary purpose of this study of the Tennessee turfgrass industry was to obtain information on the annual value of the industry based on the different strata that comprise the industry. This analysis focused on determination of the total turfgrass acreage and maintenance expenditure in Tennessee for 1991. Specific objectives of the study were the following:

1. to identify the various components that comprise the Tennessee turfgrass industry and to determine the population within each of these components;
2. to determine of the appropriate sampling procedure and the resulting sample size for each component;
3. to collect the required turf-maintenance expense information from each component;
4. to estimate the total amount spent for turfgrass maintenance, the total value of turf maintenance equipment, and the total acreage of turf maintained.

The first objective was accomplished by identifying all of the major components in a comprehensive perspective of the turfgrass industry. Fifteen major categories were identified: (1) airports, (2) cemeteries, (3) churches, (4)

commercial establishments (industrial facilities and motels/hotels), (5) counties, (6) golf courses, (7) single dwelling homes, (8) institutions, (9) lawn care companies, (10) multiple dwellings (apartments and condominiums), (11) municipalities, (12) parks, (13) roadsides, (14) schools (colleges), and (15) sod producers. The members of some of these components were obtained from published lists. For the published lists containing fewer than 1,000 members, a complete census was attempted. For churches, industrial facilities, single dwelling homes, and multiple dwellings, the size of the population precluded a census approach and forced the selection of a sample.

Development of suitable population lists for churches, homes, and multiple dwellings was accomplished by using the white pages of telephone books for homes and the yellow pages for churches and multiple dwellings. City and county phone books were used to identify the populations for each of the 95 counties in Tennessee. Published listings were available for airports, private cemeteries, commercial establishments, colleges, counties, golf courses, institutions, municipalities, parks, roadsides (state highways), and schools.

The second objective was directed toward the determination of the sample size for each component. A complete census was attempted for airports, registered cemeteries, motels/hotels, golf courses, institutions, lawn care companies, municipalities, parks, roadsides, schools, and sod producers. For the four components with large list frames, a simple random sampling technique was used. The sample size was based on the desire to have a precision level of  $\pm 5$

percent for churches, industrial facilities, and multiple dwellings, and  $\pm 2.5$  percent for homes, with 95-percent confidence.

Objective 3 involved getting the turf-maintenance expense information from each component. Mail surveys were selected as the technique for gathering the desired information. Personal and telephone interview techniques were considered to be too expensive. Because of the anticipated response rate for mail surveys, the number of homes included in the mail sample was four times greater than the targeted sample. For churches, industrial facilities, and multiple dwellings, the number of distributed questionnaires was roughly three times greater than the specified sample size. The random sample for these four large components was distributed among the counties in Tennessee in proportion to the number of homes in each county.

Objective 4 dealt with the analysis of the data to estimate the total amount spent for turfgrass maintenance, total value of turf equipment, and total turf acreage maintained by each component within the industry. First, the proportion of the total population that maintained a lawn was calculated by dividing the number of respondents in each component that maintained a lawn by the total number of respondents. Next, acreage and dollar values were expanded to population totals by calculating the sample means and multiplying these values by the share of the population within each component that maintained a lawn.

The total turfgrass maintenance value for all 15 components was estimated to be \$360.4 million. The total turfgrass acreage was estimated at 889,382 acres.



As anticipated from previous studies in other states, the single dwelling homes category accounted for 61.5 percent of the total maintenance estimate. From a dollar perspective, golf courses was the second most important component was golf courses, accounting for 10.6 percent of the total.

When the expenses reported by lawn-care companies were included, annual maintenance expenditures for turf-related materials were estimated to be \$263.5 million and \$103.1 million for turf-related labor. Lawn service companies in Tennessee received an estimated \$22.1 million for their services, according to the information provided by the respondents from all components, which was roughly \$6 million below the projected value of expenses estimated for materials and labor reported by the participating lawn-care companies.

The largest labor expenditure was for mowing. Mowing labor cost an estimated \$73.4 million, which was eight times greater than the labor used for materials application, estimated to be \$9.1 million.

The largest turf-related materials expense was for equipment and repair by hired outside labor, which cost an estimated \$74.1 million. The second major expense in the area of turf-related materials was for equipment supplies, estimated to be \$39.7 million.

Weeds were the most frequently noted turf-care problem identified by respondents at cemeteries, churches, commercial establishments (industrial and motels/hotels), industrial (health agencies and hospitals), multiple dwellings, and sod producers. Respondents for counties, institutions (mental health agencies),

parks, and schools reported that their turf-maintenance budget was the leading problem.

County extension agents were the leading source of information for turf care problems, according to the respondents at airports, cemeteries, counties, lawn care firms, municipalities, parks, and schools. The second major source of information for respondents in these seven turf-industry components was garden centers/nurseries. Respondents representing churches, commercial establishments (motels/hotels), and institutions (health agencies, hospitals, and nursing homes) reported that garden centers/nurseries were the most frequently used source of information. For the remaining components, the major sources of information for turf care problems were reported to be lawn care firms and university specialists.

#### Relative Importance of the Tennessee Turfgrass Industry

The major agricultural crops produced in Tennessee are tobacco, soybeans, and cotton. A comparison between the production values of these major commodities and the estimated expenditure for turf maintenance in Tennessee in 1991 reveals the magnitude of the turf industry.

The total estimated value of expenditures for turfgrass maintenance in 1991 is \$360.4 million. When compared to the 1991 farm production value of tobacco at \$222.8 million, which is the leading cash crop in Tennessee, the value of the turf industry to the economy of the state is impressive. The farm production value of

cotton and soybeans in Tennessee amounted to \$198.3 million and \$181.1 million, respectively. The estimated dollar value of the turfgrass industry was slightly smaller than the combined production value of cotton and soybeans. These comparisons with major agriculture commodities produced in Tennessee signify that the turf industry in Tennessee is of substantial importance. When compared to the 1991 Tennessee total crop production value of \$953.9 million, turf maintenance expenditures in the Tennessee turfgrass industry equal slightly more than one-third of the total cash receipts for all crops.

#### Limitations of the Study

Previous studies from other states were used to the fullest extent possible to facilitate and enhance the accuracy of the estimates presented in this study. However, as with any survey-oriented project, there are several important limitations that need to be considered by the reader. One major limitation was encountered during the development of population lists, referred to as list frames, for each component of the industry. For all surveyed components in this study, there is a sampling problem of noncoverage in that all members of the true population did not have an opportunity to be selected in the sample because they were not part of the list frame. Any published listing of firms or individuals is out of date, simply because of the entrance and departure of participants after the list was compiled for publication. The basic rationale in each case was that the published listings used in this study were the best sources available to the

researchers.

Another major limitation deals with the problem of nonresponse. Nonresponse error is possible for all of the surveyed components, but could be the most serious for the homes component. The assumption was made that the respondents that returned the questionnaire adequately represented the population. Based on the returned questionnaires, 80 percent of Tennessee single dwelling homes were estimated to have lawns. This estimate may be high if a disproportionate number of individuals that do not maintain a lawn simply discarded the questionnaire rather than returning it with a "no" recorded for that particular question. For instance, some bias may be present because the respondents were not equally distributed over the differences in per capita income that exist in the population. Upper income individuals may be more likely to answer the questionnaire because they actually maintain a lawn. Lower income households that do not maintain a lawn may have disposed of the questionnaire because the subject did not relate to them.

#### Future Research Issues

Future research could focus on homeowner demand for a well-maintained lawn; that is, the socio-economic factors that are associated with greater interest in and/or expenditures for lawn maintenance. One factor that would be expected a priori to have a positive impact would be income; however, within various income groups, interest in lawn maintenance could be related to other factors such as

education, location of birth or childhood, and age. Insight regarding the characteristics of homeowners that make larger than average expenditures on lawn care could assist the industry in educational and promotional efforts.

Also, the impact of an attractive lawn, as part of a total landscape, on consumer perceptions of a business firm could be evaluated. The basic question would be whether the lawn (and landscape) of a business establishment helps to attract customers. Previous research has documented the positive impact of attractive landscaping and lawns to enhance the sales value of residential property. The purpose of the proposed research would be to analyze the impact of the lawn and the landscape on the attitude and behaviors of clientele of business firms.

The response from the golf course component of this comprehensive study of the turfgrass industry was disappointing. The 75 golf courses that responded with a returned questionnaire represented 31 percent of the 240 golf courses in the list frame. Because of the association of the Tennessee PGA and the Golf Course Superintendents with the Tennessee Turfgrass Association, a higher level of response was expected. One possible explanation for the low response rate may have been the result of questionnaires not reaching the golf course superintendents. Future attempts at obtaining maintenance information from golf courses should probably be mailed to the superintendent, not the golf pro or general business manager.

Further research with turf growers could include a parallel effort with landscape firms and landscape architects to provide insight regarding marketing patterns and

relationships. An understanding of the market structure associated with turf producers, landscape firms, and wholesale buyers could assist the industry in identifying and resolving marketing problems and perhaps even enhance the total volume of turf produced and sold each year.



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## APPENDICES

## APPENDIX A

## BUSINESS/INDUSTRIAL QUESTIONNAIRE

1. Do you maintain any lawn area at this location?       yes     no  
If no, **please** mark "no" and place this form in the mail.  
Postage is prepaid.
  
2. What is the total size of the property managed at this location?      \_\_\_\_\_Acres
  
3. What is the total area of turfgrass maintained at this location?  
(Exclude roadways, buildings, etc.)      \_\_\_\_\_ Acres or \_\_\_\_\_ Sq.Ft
  
4. For 1991, please estimate the **total** amount spent for  
turfgrass maintenance at this location?      \$\_\_\_\_\_
  
5. How much new turf was established during 1991?      \_\_\_\_\_ Acres or \_\_\_\_\_ Sq.Ft.  
  
What did it cost?      \$\_\_\_\_\_
  
6. Which turf care practices are conducted at this location?  
  
 Fertilization                       Weed Control                       Disease Control  
 Insect Control                       Turf Renovation       Watering/Irrigation  
 Clipping/Leaf Removal       Soil Testing                       Aeration/Coring  
 Dethatching/Power Raking       Other (Specify) \_\_\_\_\_
  
7. What do you consider to be the three most difficult problems for turf  
management at this location? (Please rank 1, 2, and 3, with 1 being the  
most important)  
  
 Poor Soil       Shade       Traffic       Weeds                       Disease  
 Insects                       Thatch       Labor       Equipment                       Budget  
 Erosion                       Nematodes       Other (Specify) \_\_\_\_\_





**18. Please estimate the annual cost for each of the following turf maintenance categories during 1991?**

**TURF MAINTENANCE EQUIPMENT - (mowing, edging, irrigation, etc.):** TURFGRASS  
EXPENSES

Maintenance and repair -  
Hired outside labor and parts \$ \_\_\_\_\_

In-house mechanic \$ \_\_\_\_\_

Supplies - (gasoline, blades, oil, etc.) \$ \_\_\_\_\_

**FERTILIZERS, CHEMICALS, AND OTHER SOIL AMENDMENTS:**

Fertilizers \$ \_\_\_\_\_

Weed Control Products \$ \_\_\_\_\_

Insect and disease control products \$ \_\_\_\_\_

Growth retardants \$ \_\_\_\_\_

Seed \$ \_\_\_\_\_

Lime \$ \_\_\_\_\_

Other (Specify) \_\_\_\_\_ \$ \_\_\_\_\_

**IRRIGATION:**

Water (include electricity cost) \$ \_\_\_\_\_

Equipment and supplies (sprinklers, hoses, etc.) \$ \_\_\_\_\_

**LABOR:**

Mowing \$ \_\_\_\_\_

Irrigation \$ \_\_\_\_\_

Fertilizer, chemical, and other material applications \$ \_\_\_\_\_

Turf renovation/aeration \$ \_\_\_\_\_

Other (Specify) \_\_\_\_\_ \$ \_\_\_\_\_

## HOME OWNER QUESTIONNAIRE

1. Do you rent or own this residence where you are living?

Rent \_\_\_\_\_ Own \_\_\_\_\_

2. Which of the following best describes this residence?

Single family \_\_\_\_\_ Duplex \_\_\_\_\_  
Apartment \_\_\_\_\_ Condominium \_\_\_\_\_

3. Do you maintain any lawn area at this location?

Yes \_\_\_\_\_ No \_\_\_\_\_

4. For 1991, please estimate the total amount that you spent for lawn maintenance.

\$ \_\_\_\_\_

5. What is the total area of property at this location?

\_\_\_\_\_ square feet, or \_\_\_\_\_ acres, or what is the  
measurement of this property? \_\_\_\_\_ feet by \_\_\_\_\_ feet

6. Of the total property area in question 5, how much of this area is maintained lawn?

\_\_\_\_\_ square feet or \_\_\_\_\_ acres

7. Who has the responsibility for maintaining the lawn at this location?

\_\_\_\_ husband      \_\_\_\_ children      \_\_\_\_ gardener  
\_\_\_\_ wife      \_\_\_\_ lawn service company      \_\_\_\_ other

8. In 1991, how much new lawn area was established at this location and what did it cost?

\_\_\_\_\_ square feet or \_\_\_\_\_ acres                      \$ \_\_\_\_\_

9. Labor - (includes mowing, fertilizer and other chemical application, irrigation, etc.)

Hired labor outside the family    \$ \_\_\_\_\_

Wages paid to family members    \$ \_\_\_\_\_

Lawn-care services fee -annual cost-    \$ \_\_\_\_\_

10. Maintenance and repair of equipment    \$ \_\_\_\_\_  
(includes hired labor and parts)

11. New equipment purchased in 1991    \$ \_\_\_\_\_  
(includes mower, trimmers, blowers, etc.)

12. Irrigation equipment purchased in 1991    \$ \_\_\_\_\_  
(includes sprinklers, hoses, etc.)

13. Materials purchased (If nothing purchased, please enter zero)

Insecticides    \$ \_\_\_\_\_

Weed control products    \$ \_\_\_\_\_

Disease control products    \$ \_\_\_\_\_

Fertilizers    \$ \_\_\_\_\_

Seed    \$ \_\_\_\_\_

Sod    \$ \_\_\_\_\_

Lime    \$ \_\_\_\_\_

Mulch    \$ \_\_\_\_\_

Other supplies (gas, oil, etc.)    \$ \_\_\_\_\_

14. Any other lawn-related costs \$ \_\_\_\_\_

Please specify \_\_\_\_\_

15. What is the total **current value** of all the lawn maintenance equipment at this location? (estimate to the nearest \$100)

\$ \_\_\_\_\_

16. What is the estimated **replacement cost** of all lawn equipment at this location? (estimate to the nearest \$100)

\$ \_\_\_\_\_

## APPENDIX B



**Table B.1 Turf care practices conducted by airports, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	31.0
Weed Control	27.6
Clipping/Leaf Removal	13.8
Turf Renovation	10.3
Soil Testing	6.9
Insect Control	3.4
Dethatching/Power Raking	3.4
Other	3.6
<b>Total</b>	<b>100.0</b>

**Table B.2 Major turf care problems for airports, Tennessee 1991.**

Problem	Percent Reporting
Poor Soil	22.6
Budget	22.5
Labor	19.4
Erosion	11.3
Equipment	11.3
Weeds	8.1
Traffic	3.2
Other	1.6
<b>Total</b>	<b>100.0</b>

**Table B.3 Source of answers to turf care problems for airports, Tennessee 1991.**

Source	Percent Reporting
County Extension Office	28.6
Neighbors/Friends	14.3
University Specialist	10.2
Garden Center/Nursery	10.2
Soil Conservation Service/USDA	10.2
Commercial Representatives	6.1
Magazines	4.1
Other	16.3
<b>Total</b>	<b>100.0</b>

**Table B.4 Number of employees at airports with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	89
Part-time Employees	51

**Table B.5 Turf care practices conducted by cemeteries, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	25.2
Clipping/Leaf Removal	19.3
Weed Control	18.5
Turf Renovation	7.4
Watering/Irrigation	7.4
Soil Testing	5.9
Insect Control	5.2
Other	11.1
<b>Total</b>	<b>100.0</b>

**Table B.6 Major turf care problems for cemeteries, Tennessee 1991.**

Problem	Percent Reporting
Weeds	23.4
Budget	15.3
Poor Soil	14.5
Equipment	9.7
Labor	9.0
Traffic	7.3
Shade	4.0
Other	16.8
<b>Total</b>	<b>100.0</b>

**Table B.7 Source of answers to turf care problems for cemeteries, Tennessee 1991.**

Source	Percent Reporting
County Extension Office	22.5
Magazines	16.7
Garden Center/Nursery	13.7
Lawn Care Company	12.8
Neighbors/Friends	9.8
Commercial Representatives	6.9
University Specialist	4.9
Other	12.7
<b>Total</b>	<b>100.0</b>

**Table B.8 Number of employees at cemeteries with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	239
Part-time Employees	188

**Table B.9 Turf care practices conducted by churches, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	36.8
Fertilization	21.5
Weed Control	19.2
Watering/Irrigation	9.5
Insect Control	6.2
Dethatching/Power Raking	2.6
Disease Control	1.6
Other	2.6
<b>Total</b>	<b>100.0</b>

**Table B.10 Major turf care problems for churches, Tennessee 1991.**

Problem	Percent Reporting
Weeds	20.9
Budget	16.7
Labor	15.6
Poor Soil	13.8
Traffic	10.4
Equipment	9.6
Shade	5.3
Other	7.7
<b>Total</b>	<b>100.0</b>

**Table B.11 Source of answers to turf care problems for churches, Tennessee 1991.**

Source	Percent Reporting
Garden Center/Nursery	20.6
Neighbors/Friends	20.6
County Extension Office	17.1
Lawn Care Company	13.6
Private Consultants	4.3
Magazines	4.3
Soil Conservation Service/USDA	4.3
Other	15.2
<b>Total</b>	<b>100.0</b>

**Table B.12 Number of employees at churches with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	642
Part-time Employees	2,568



**Table B.13 Turf care practices conducted by industrial commercial establishments, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	26.2
Fertilization	21.8
Weed Control	21.0
Watering/Irrigation	9.6
Insect Control	7.4
Turf Renovation	4.8
Soil Testing	3.1
Other	6.1
<b>Total</b>	<b>100.0</b>

**Table B.14 Major turf care problems for industrial commercial establishments, Tennessee 1991.**

Problem	Percent Reporting
Weeds	24.4
Poor Soil	21.5
Labor	18.5
Equipment	12.6
Traffic	7.4
Budget	4.4
Shade	3.7
Other	7.5
<b>Total</b>	<b>100.0</b>

**Table B.15 Source of answers to turf care problems for industrial commercial establishments, Tennessee 1991.**

Source	Percent Reporting
Lawn Care Company	24.4
Garden Center/Nursery	16.8
County Extension Office	16.8
Neighbors/Friends	15.3
Magazines	9.2
Commercial Representative	3.8
University Specialist	3.1
Other	10.6
<b>Total</b>	<b>100.0</b>

**Table B.16 Number of employees at industrial commercial establishments with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	1,212
Part-time Employees	1,100

**Table B.17 Turf care practices conducted by motel/hotels, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	22.1
Fertilization	20.6
Weed Control	18.6
Watering/Irrigation	13.2
Insect Control	8.7
Soil Testing	4.2
Turf Renovation	3.6
Other	9.0
<b>Total</b>	<b>100.0</b>

**Table B.18 Major turf care problems for motels/hotels, Tennessee 1991.**

Problem	Percent Reporting
Weeds	21.5
Poor Soil	15.3
Labor	12.4
Budget	11.7
Traffic	9.3
Shade	7.3
Equipment	6.9
Other	15.6
<b>Total</b>	<b>100.0</b>

**Table B.19 Source of answers to turf care problems for motels/hotels, Tennessee 1991.**

Source	Percent Reporting
Garden Center/Nursery	20.7
Neighbors/Friends	16.8
Lawn Care Company	16.6
County Extension Office	11.4
Magazines	8.7
Commercial Representatives	5.9
Private Consultants	4.9
Other	15.0
<b>Total</b>	<b>100.0</b>

**Table B.20 Number of employees at motels/hotels with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	577
Part-time Employees	433

**Table B.21 Turf care practices conducted by counties, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	17.9
Clipping/Leaf Removal	17.9
Weed Control	16.4
Watering/Irrigation	10.7
Soil Testing	8.6
Disease Control	5.7
Insect Control	5.7
Other	17.1
<b>Total</b>	<b>100.0</b>

**Table B.22 Major turf care problems for counties, Tennessee 1991.**

Problem	Percent Reporting
Budget	18.6
Labor	13.6
Traffic	12.7
Weeds	11.9
Equipment	11.9
Poor Soil	11.0
Erosion	10.2
Other	10.1
<b>Total</b>	<b>100.0</b>

**Table B.23 Source of answers to turf care problems for counties, Tennessee 1991.**

Source	Percent Reporting
County Extension Office	35.6
University Specialist	13.5
Soil Conservation Service/USDA	10.6
Garden Center/Nursery	8.7
Commercial Representatives	8.7
Lawn Care Company	7.7
Private Consultants	5.8
Other	9.4
<b>Total</b>	<b>100.0</b>

**Table B.24 Number of employees in counties with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	380
Part-time Employees	257



**Table B.25 Number and types of golf courses and the number of holes at each of the golf courses, Tennessee 1991.**

Item	Number	Percent Reporting
<b>Types of Golf Courses:</b>		
Private	107	46.5
Public	63	27.4
Municipal	21	9.1
Semi-Private	21	9.1
Resort	9	3.9
Other	9	3.9
<b>Total</b>	<b>230</b>	<b>100.0</b>
<b>Number of Holes:</b>		
9	49	21.3
18	169	73.5
27	6	2.6
Other	6	2.6
<b>Total</b>	<b>230</b>	<b>100.0</b>

**Table B.26 Persons responsible for turf maintenance at golf courses, Tennessee 1991.**

Persons	Percent Reporting
Superintendent	46.3
G.C.S.A. Certified-Superintendent	18.3
Pro-Superintendent	12.2
General Manager	11.0
PGA Pro	4.9
Other	7.3
<b>Total</b>	<b>100.0</b>

**Table B.27 Major turf care problems for golf courses, Tennessee 1991.**

Problem	Percent Reporting
Traffic	17.0
Poor Soil	17.0
Weeds	9.9
Disease	9.1
Budget	8.3
Shade	5.9
Equipment	5.9
Labor	5.1
Drought	4.7
Winter Kill	4.7
Other	12.4
<b>Total</b>	<b>100.0</b>

**Table B.28 Source of answers to turf care problems for golf courses, Tennessee 1991.**

Source	Percent Reporting
University Specialist	18.7
Magazines	18.0
U.S.G.A.	16.7
Commercial Representatives	15.1
County Extension Office	8.8
Neighbors/Friends	5.2
Private Consultants	4.4
Garden Center/Nursery	3.6
Other	9.5
<b>Total</b>	<b>100.0</b>

**Table B.29** Number of employees at golf courses with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	1,380
Part-time Employees	1,081

**Table B.30** Person responsible for turf maintenance for homes, Tennessee 1991.

Practice	Percent Reporting
Husband	53.5
Wife	22.7
Children	10.0
Lawn Service Company	8.1
Gardener	2.0
Other	3.7
<b>Total</b>	<b>100.0</b>

**Table B.31 Turf care practices conducted by health agencies, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	32.2
Weed Control	25.4
Fertilization	16.9
Watering/Irrigation	13.6
Insect Control	5.1
Dethatching/Power Raking	3.4
Turf Renovation	1.7
Other	1.7
<b>Total</b>	<b>100.0</b>

**Table B.32 Major turf care problems for health agencies, Tennessee 1991.**

Problem	Percent Reporting
Weeds	18.8
Poor Soil	17.2
Traffic	17.2
Equipment	12.5
Neighbors/Friends	10.9
Lawn Care Company	4.7
Commercial Representatives	3.1
Other	15.6
<b>Total</b>	<b>100.0</b>

**Table B.33 Source of answers to turf care problems for health agencies, Tennessee 1991.**

Source	Percent Reporting
Garden Center/Nursery	28.6
Neighbors/Friends	14.3
County Extension Office	11.9
Lawn Care Company	9.5
Commercial Representatives	9.5
University Specialist	4.8
Newspaper	4.8
Other	16.6
<b>Total</b>	<b>100.0</b>

**Table B.34 Number of employees at health agencies with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	81
Part-time Employees	25

**Table B.35 Turf care practices conducted by hospitals, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	18.4
Clipping/Leaf Removal	18.4
Weed Control	16.2
Watering/Irrigation	13.2
Insect Control	9.6
Disease Control	5.9
Turf Renovation	5.9
Other	12.4
<b>Total</b>	<b>100.0</b>

**Table B.36 Major turf care problems for hospitals, Tennessee 1991.**

Problem	Percent Reporting
Weeds	22.1
Labor	18.9
Poor Soil	17.9
Budget	15.8
Traffic	9.5
Equipment	7.4
Erosion	3.2
Other	5.2
<b>Total</b>	<b>100.0</b>



**Table B.37** Source of answers to turf care problems for hospitals, Tennessee 1991.

Source	Percent Reporting
Garden Center/Nursery	16.5
Lawn Care Company	16.5
County Extension Office	15.3
Private Consultants	10.6
Commercial Representatives	9.4
Magazines	8.2
University Specialists	7.0
Other	16.5
<b>Total</b>	<b>100.0</b>

**Table B.38** Number of employees at hospitals with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	224
Part-time Employees	164

**Table B.39 Turf care practices conducted by mental health agencies, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	50.0
Weed Control	31.2
Insect Control	12.5
Fertilization	6.3
Other	0.0
<b>Total</b>	<b>100.0</b>

**Table B.40 Major turf care problems for mental health agencies, Tennessee 1991.**

Problem	Percent Reporting
Budget	25.8
Weeds	16.1
Equipment	16.1
Labor	12.9
Poor Soil	9.7
Traffic	6.5
Insect Control	3.2
Other	9.7
<b>Total</b>	<b>100.0</b>

**Table B.41** Source of answers to turf care problems for mental health agencies, Tennessee 1991.

Source	Percent Reporting
Lawn Care Company	19.0
Garden Center/Nursery	19.0
County Extension Office	14.3
Magazines	9.5
Neighbors/Friends	9.5
University Specialist	4.8
Commercial Representatives	4.8
Other	19.1
<b>Total</b>	<b>100.0</b>

**Table B.42** Number of employees at mental health agencies with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	48
Part-time Employees	51

**Table B.43 Turf care practices conducted by nursing homes, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	24.5
Fertilization	23.3
Weed Control	19.4
Watering/Irrigation	10.3
Insect Control	7.5
Turf Renovation	4.7
Disease Control	3.2
Other	7.1
<b>Total</b>	<b>100.0</b>

**Table B.44 Major turf care problems for nursing homes, Tennessee 1991.**

Problem	Percent Reporting
Poor Soil	22.5
Weeds	21.3
Budget	15.4
Labor	9.5
Equipment	8.9
Shade	5.9
Erosion	5.3
Other	11.2
<b>Total</b>	<b>100.0</b>

**Table B.45 Source of answers to turf care problems for nursing homes, Tennessee 1991.**

Source	Percent Reporting
Garden Center/Nursery	24.2
Lawn Care Company	20.9
County Extension Office	13.7
Neighbors/Friends	13.7
Commercial Representatives	7.2
Magazines	7.2
Private Consultants	3.3
Other	9.8
<b>Total</b>	<b>100.0</b>

**Table B.46 Number of employees at nursing homes with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	296
Part-time Employees	197

**Table B.47 Turf care practices conducted by lawn care companies, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	11.8
Mowing	10.3
Renovation/Seeding	10.3
Weed Control	9.3
Leaf Removal	9.3
Insect Control	7.2
Plant/Tree Installation	7.2
Disease Control	6.9
Sod Installation	6.9
Landscape Planning	6.9
Other	13.9
<b>Total</b>	<b>100.0</b>

**Table B.48 Major turf care problems for lawn care companies, Tennessee 1991.**

Problem	Percent Reporting
Labor	27.2
Weeds	14.0
Poor Soil	13.2
Budget	10.5
Equipment	8.8
Shade	7.9
Disease	7.0
Other	11.4
<b>Total</b>	<b>100.0</b>



**Table B.49** Source of answers to turf care problems for lawn care companies, Tennessee 1991.

Source	Percent Reporting
County Extension Office	17.5
University Specialist	15.5
Commercial Technical Representative	15.5
Magazines	12.6
Private Consultants	9.7
Garden Center	5.8
Friends	5.8
Other	17.6
<b>Total</b>	<b>100.0</b>

**Table B.50** Number of employees at lawn care companies with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	828
Part-time Employees	768

**Table B. 51 Turf care practices conducted by multiple dwellings, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	20.5
Clipping/Leaf Removal	19.9
Weed Control	19.9
Watering/Irrigation	10.7
Insect Control	8.8
Disease Control	4.0
Dethatching/Power Raking	3.8
Other	12.4
<b>Total</b>	<b>100.0</b>

**Table B.52 Major turf care problems for multiple dwellings, Tennessee 1991.**

Problem	Percent Reporting
Weeds	17.2
Poor Soil	13.6
Budget	12.9
Traffic	12.8
Erosion	11.7
Labor	6.9
Shade	6.7
Other	18.2
<b>Total</b>	<b>100.0</b>

**Table B.53** Source of answers to turf care problems for multiple dwellings, Tennessee 1991.

Source	Percent Reporting
Lawn Care Company	21.5
Garden Center/Nursery	19.4
Neighbors/Friends	10.5
County Extension Office	10.2
Magazines	6.8
Private Consultants	6.3
University Specialist	4.8
Other	20.5
<b>Total</b>	<b>100.0</b>

**Table B.54** Number of employees at multiple dwellings with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	750
Part-time Employees	600

**Table B.55 Turf care practices conducted by municipalities, Tennessee 1991.**

Practice	Percent Reporting
Weed Control	20.4
Clipping/Leaf Removal	19.7
Fertilization	16.1
Watering/Irrigation	10.2
Aeration/Coring	7.2
Turf Renovation	7.1
Soil Testing	5.8
Other	13.5
<b>Total</b>	<b>100.0</b>

**Table B.56 Major turf care problems for municipalities, Tennessee 1991.**

Problem	Percent Reporting
Labor	17.9
Budget	17.6
Weeds	16.1
Traffic	13.5
Equipment	13.0
Poor Soil	11.2
Erosion	6.6
Other	3.1
<b>Total</b>	<b>100.0</b>

**Table B.57** Source of answers to turf care problems for municipalities, Tennessee 1991.

Source	Percent Reporting
County Extension Office	22.3
Magazines	12.7
Commercial Representatives	12.7
University Specialist	10.8
Newspaper	10.0
Garden Center/Nursery	9.6
Neighbors/Friends	7.7
Other	14.9
<b>Total</b>	<b>100.0</b>

**Table B.58** Number of employees at municipalities with turf maintenance responsibilities, Tennessee 1991.

Employees	Number
Permanent Full-time Employees	915
Part-time Employees	712

**Table B.59 Turf care practices conducted by federal and state parks, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	21.4
Fertilization	19.6
Weed Control	17.0
Watering/Irrigation	8.9
Soil Testing	8.0
Turf Renovation	7.1
Aeration/Coring	5.4
Other	12.6
<b>Total</b>	<b>100.0</b>

**Table B.60 Major turf care problems for federal and state parks, Tennessee 1991.**

Problem	Percent Reporting
Budget	18.3
Traffic	15.0
Poor Soil	14.2
Equipment	11.7
Labor	10.0
Shade	9.2
Erosion	8.3
Other	13.3
<b>Total</b>	<b>100.0</b>

**Table B.61 Source of answers to turf care problems for federal and state parks, Tennessee 1991.**

Source	Percent Reporting
County Extension Office	24.1
Magazines	16.1
Commercial Representatives	11.5
Soil Conservation Service/USDA	9.3
Garden Center/Nursery	9.2
University Specialist	8.1
Lawn Care Company	5.7
Other	16.0
<b>Total</b>	<b>100.0</b>

**Table B.62 Number of employees at federal and state parks with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	208
Part-time Employees	162



**Table B.63 Turf care practices conducted by colleges, Tennessee 1991.**

Practice	Percent Reporting
Clipping/Leaf Removal	20.7
Weed Control	18.0
Fertilization	16.6
Watering/Irrigation	9.4
Insect Control	8.7
Soil Testing	7.3
Turf Renovation	5.3
Other	14.0
<b>Total</b>	<b>100.0</b>

**Table B.64 Major turf care problems for colleges, Tennessee 1991.**

Problem	Percent Reporting
Traffic	18.6
Budget	16.7
Equipment	12.7
Weeds	12.7
Labor	9.8
Shade	6.9
Erosion	2.9
Other	19.7
<b>Total</b>	<b>100.0</b>

**Table B.65 Source of answers to turf care problems for colleges, Tennessee 1991.**

Source	Percent Reporting
Magazines	18.6
Commercial Representatives	18.6
County Extension Office	17.4
University Specialist	14.0
Garden Center/Nursery	12.8
Lawn Care Company	8.1
Private Consultants	4.7
Other	5.8
<b>Total</b>	<b>100.0</b>

**Table B.66 Persons responsible for turf care for the athletic fields at colleges, Tennessee 1991.**

Persons	Percent Reporting
Grounds Superintendent	54.5
Coaches	24.2
Lawn Care Service	12.1
Custodian	3.0
Other	6.0
<b>Total</b>	<b>100.0</b>

**Table B.67 Number of employees at colleges with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	592
Part-time Employees	377

**Table B.68 Turf care practices conducted by schools, Tennessee 1991.**

Practice	Percent Reporting
Fertilization	18.6
Clipping/Leaf Removal	15.9
Weed Control	15.9
Watering/Irrigation	15.0
Aeration/Coring	8.3
Soil Testing	5.8
Insect Control	5.5
Other	15.0
<b>Total</b>	<b>100.0</b>

**Table B.69 Major turf care problems for schools, Tennessee 1991.**

Problem	Percent Reporting
Budget	19.7
Traffic	16.1
Labor	14.6
Equipment	13.9
Poor Soil	13.1
Erosion	4.0
Insects	1.8
Other	16.8
<b>Total</b>	<b>100.0</b>

**Table B.70 Source of answers to turf care problems for schools, Tennessee 1991.**

Source	Percent Reporting
County Extension Office	21.7
Lawn Care Company	11.1
Neighbors/Friends	10.6
Garden Center/Nursery	10.1
Commercial Representatives	8.3
University Specialist	7.8
Private Consultants	6.9
Other	23.5
<b>Total</b>	<b>100.0</b>

**Table B.71 Persons responsible for turf care of athletic fields at schools, Tennessee 1991.**

Persons	Percent Reporting
Coaches	38.0
Grounds Superintendent	16.5
Custodian	13.2
Lawn Care Service	9.1
Administrator	7.4
Booster Club	6.6
Other	9.2
<b>Total</b>	<b>100.0</b>

**Table B.72 Number of employees at schools with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	1,115
Part-time Employees	284

**Table B.73 Major turf care problems for sod producers, Tennessee 1991.**

Problem	Percent Reporting
Weeds	25.0
Labor	25.0
Equipment	14.3
Thatch	7.1
Winter Kill	7.1
Poor Soil	3.6
Insects	3.6
Other	14.3
<b>Total</b>	<b>100.0</b>

**Table B.74 Source of answers to turf care problems for sod producers, Tennessee 1991.**

Source	Percent Reporting
University Specialist	30.8
Magazines	15.4
County Extension Office	15.4
Reference Materials	11.5
Commercial Representatives	7.7
Soil Conservation Service/USDA	7.6
Neighbors/Friends	3.8
Other	7.8
<b>Total</b>	<b>100.0</b>

**Table B.75 Principal types of grasses grown for production by sod producers, Tennessee 1991.**

Grass	Acres Grown For Sod
Tall Fescue	1,042.0
Improved Turf-Type Tall Fescue	0.0
Single Cultivar	0.0
Single Dwarf/Semi-Dwarf	145.2
Tall Fescue/Kentucky Bluegrass	217.8
Bluegrass	35.2
Hybrid Bermudagrass	3,471.6
Zoysia	906.4
Other Species	297.0
<b>Total</b>	<b>6,115.2</b>

**Table B.76 Type of irrigation used by sod producers, Tennessee 1991.**

Irrigation System	Percent Reporting
Traveling Gun	53.3
Center-Pivot System	20.0
Permanent Automatic Sprinkler	13.3
None	0.0
Other	13.4
<b>Total</b>	<b>100.0</b>

**Table B.77 Average amount of nitrogen applied per acre by sod producers, Tennessee 1991.**

Average Amount Applied	Percent Reporting
Less Than 88 Lbs. Actual N Per Acre (2Lbs./1000 Sq.Ft.)	0.0
88 To 176 Lbs. Actual N per Acre (2 to 4 Lbs./1000 Sq.Ft.)	50.0
176 to 264 Lbs. Actual N per Acre (4 to 6 Lbs./1000 Sq.Ft.)	33.3
More Than 264 Lbs. Actual N Per Acre (More Than 6 Lbs./1000 Sq.Ft.)	16.7
<b>Total</b>	<b>100.0</b>

**Table B.78 Distribution outlets for sod sales by sod producers, Tennessee 1991.**

Outlets	Percent Reporting
Wholesale to Landscapers/Golf Courses	57.5
Retail Direct to Consumers	11.5
Own Use (Installed)	9.5
Wholesale to Retailers	7.9
Wholesale to Other Growers	5.5
Other	8.1
<b>Total</b>	<b>100.0</b>

**Table B.79 Method of handling sod for production for sod producers, Tennessee 1991.**

Practice	Percent Reporting
Grown, Harvested and Delivered (Not Installed) By This Firm	73.9
Grown and Harvested (Not Delivered or Installed) By This Firm	17.7
Grown, Harvested, Delivered and Installed By This Firm	8.4
<b>Total</b>	<b>100.0</b>



**Table B.80 Average price received for sod by sod producers, Tennessee 1991.**

Practice	Average Price
Grown and Harvested Only	\$ 1.16
Grown, Harvested and Delivered Only	\$ 1.31
Grown, Harvested, Delivered and Installed	\$ 2.06

**Table B.81 Number of employees at sod production facilities with turf maintenance responsibilities, Tennessee 1991.**

Employees	Number
Permanent Full-time Employees	165
Part-time Employees	174

## VITA

Joseph Eric Carson was born in Jackson, Tennessee, on March 20, 1968, to Joe and Jean Carson. He attended Union City High School and graduated in May 1986. In the fall of 1986 he enrolled at the University of Tennessee in Knoxville, Tennessee. After two years he transferred to the University of Tennessee in Martin, Tennessee. He received a Bachelor of Science degree in Agricultural Business in December of 1990. In January of 1991 he accepted a research assistantship from the Department of Agricultural Economics and Rural Sociology at the University of Tennessee, Knoxville in Agricultural Economics. His emphasis was in marketing and he completed his requirements for the Master of Science degree in December of 1992.