NORTHEAST OKLAHOMA

REGIONAL SOLID WASTE MANAGEMENT

STUDY

Prepared for

Oklahoma State Department of Health
Solid Waste Management Services

Prepared by

Ken Purdy
Program Director
Solid Waste Research Institute
of Northeast Oklahoma

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PREFACE AND ACKNOWLEDGMENTS

Management of municipal solid waste is an issue of growing concern throughout the United States. Increasing volumes of trash, rising costs of waste collection, escalating landfill fees, and decreasing numbers of suitable landfill sites are typical of the problems being faced by many communities. Within the State of Oklahoma, such problems are becoming increasingly evident ... and the search for solutions ever more necessary.

This report presents the results of a solid waste management study conducted within a 14-county region of northeast Oklahoma. The primary goal of this study was to initiate development of a database that characterizes municipal solid waste management within the region. This information is intended to assist the efforts of local governments, the Oklahoma State Department of Health, and other public agencies in their planning and decision making related to solid waste management.

The study findings discussed herein are not intended to be definitive-- like many other management issues those related to municipal solid waste management are dynamic, occurring within an ever-changing environment affected by demographic, economic, regulatory, political, and social factors. The information provided does reflect, however, an important beginning for understanding the existing and future challenges faced by northeast Oklahoma's decision makers of managing a growing stream of solid wastes.

This project was conducted and the report prepared by Ken Purdy, Program Director of the Solid Waste Research Institute of Northeast Oklahoma. Deborah Pritchett, Staff Secretary, provided vital support functions during the course of this study. Important direction for this research was provided by the Instituted Board of Directors, members of which are: Larry Adair (State Representative, District #86); George Bearpaw (Cherokee Nation of Oklahoma); Ed Fite (Oklahoma Scenic Rivers Commission); Julian Fite (Attorney-at-Law); Ed Henderson (Oklahoma State University Cooperative Extension Service); John Mozingo (Mayes County Commissioner); Jim Mullin (Grand Gateway Economic Development Association); Fenton Rood (Oklahoma State Department of Health) ; and Linda Walker (Oklahoma Pollution Control Coordinating Board).

The assistance provided throughout this study by many other individuals is gratefully acknowledged. Notable contributions were provided by Monte Boyce, Joe Fitzgibbon, Harriett Muzljakovich, Bill Warden, and other personnel of the Oklahoma State Department of Health. Sandy Houston, Lil Perry and other staff of the Division of Community Development, Cherokee Nation of Oklahoma, provided many contributions to this research. Valuable assistance was also provided by Nick Artz (Franklin Associates, ltd.); Jim Baker and John Robinson, Grand Gateway Economic Development Association; Dave Davis, Eastern Oklahoma Development District; Dr. Robert Deyle, University of Oklahoma; John Westfall, Bartlesville, OK; and Susan Young, The Metropolitan Environmental Trust. Sincere thanks are also extended to the many county and municipal government officials, industry and business representatives, private waste haulers, and landfill operators that provided much of the survey data used in this study.

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BACKGROUND

Description of Study Area

The study encompassed 14 counties in northeast Oklahoma. The counties included were:

Adair	Mayes	Okmulgee	Wagoner
Cherokee	McIntosh	Ottawa	Washington
Craig	Muskogee	Rogers	
Delaware	Nowata	Sequoyah	

As shown in Figure 1, seven of these counties border other states; Sequoyah, Adair, and Delaware border Arkansas to the east; Delaware and Ottawa border Missouri to the northeast; and Ottawa, Craig, Nowata, and Washington border Kansas to the north.

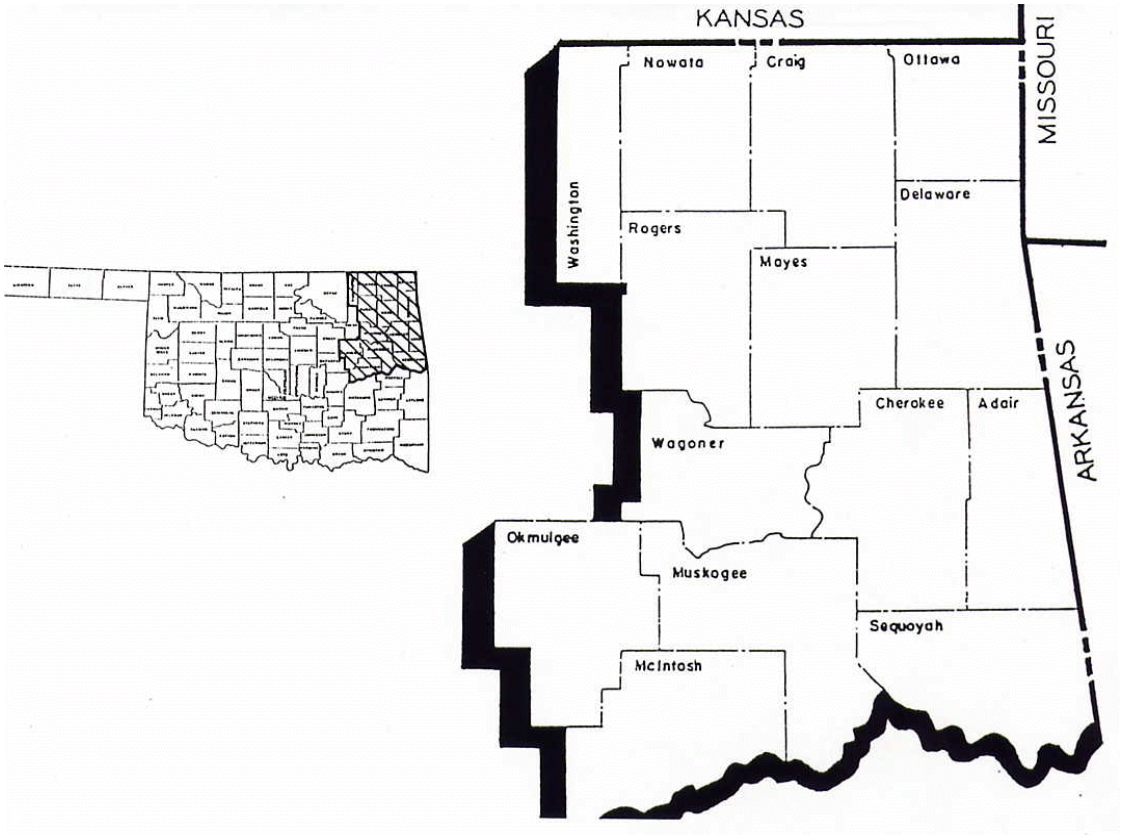


Figure 1. Study Area

The total land area within the 14-county region is approximately 8,900 square miles. Distances traversing the region are about 130 miles north to south and 95 miles east to west.

Northeast Oklahoma, more than most other regions of the state, is a primary destination for tourists. The region's scenic qualities, abundant water resources, and numerous historic sites and cultural attractions draw millions of visitors to the area. A recent Oklahoma tourism study estimated that somewhat over two million persons visited the region in 1990 (Oklahoma Tourism and Recreation Department, 1990). Total travel expenditures in the region have been estimated at over 23 million dollars annually (U.S. Travel Data Center, 1989).

Regional population. According to estimated from the 1990 United States Population Census, 474,859 people reside within the region. The population of each county and its percentage contribution of the region's total population is shown in Table 1. As demonstrated, there is a wide variation between counties with the most populous county (Muskogee) containing nearly seven times the number of people as the least populated county (Nowata).

Table 1. Population of the 14-County Study Region.

County	1990 Population	% of Region Population
Adair	18,421	3.9
Cherokee	34,049	7.2
Craig	14,104	3.0
Delaware	28,070	5.9
Mayes	33,368	7.0
McIntosh	16,779	3.5
Muskogee	68,078	14.4
Nowata	9,992	2.1
Okmulgee	36,490	7.7
Ottawa	30,561	6.4
Rogers	55,170	11.6
Sequoyah	33,828	7.1
Wagoner	47,883	10.1
Washington	48,066	10.1
TOTALS	474,859	100.0

Source: U.S. Bureau of the Census (1990).

Figure 2 illustrates the distribution of the region's 100 incorporated towns and cities. Slightly less than half of the persons residing in the region do so within the boundaries of these towns and cities...the others in rural, unincorporated areas. This

distribution, however, varies greatly between counties. As shown in Figure 3, the percent of the population residing in municipalities ranges from a low of 24% in Adair County to a high of over 80% in Washington county. The number of persons per household and the number of households in each county of the region are also shown in Figure 3.

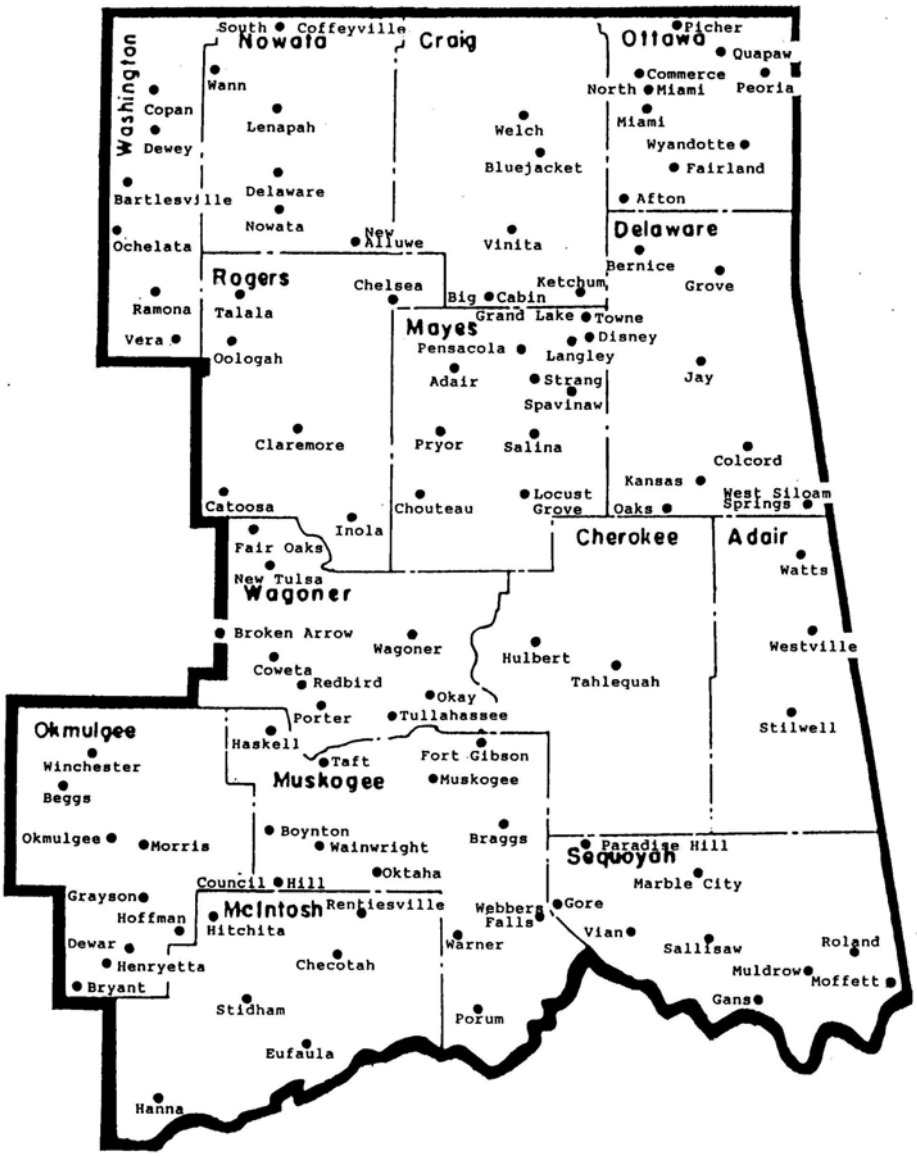


Figure 2. Incorporated Towns and Cities in the 14-County Region.

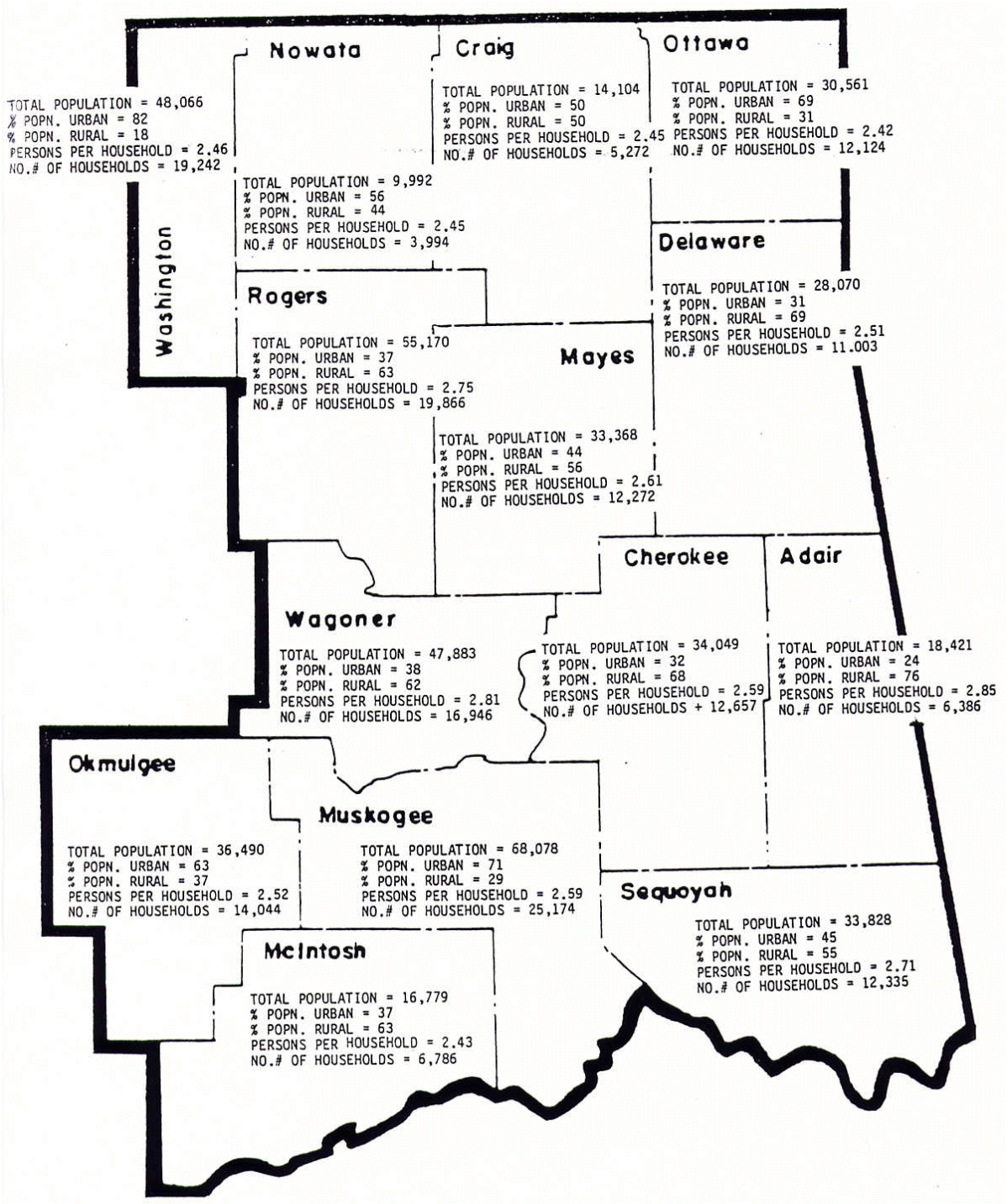


Figure 3. Selected Demographic Characteristics of the 14-County Region.

Overall, the region experienced a net population growth of 4.6% from 1980 to 1990 (Table 2); a rate of growth exceeding the state average of 4.0%. Six of the 14 counties experienced notable larger growth rates with this group lead by Rogers (18.8%), Delaware (17.2%), Wagoner (14.5%) Counties. The Oklahoma of Department of Commerce projects strong growth throughout most of the region for the next 20 years (Selland and Shahidulla, 1988).

Table 2. Northeast Oklahoma Regional Population Change.

County	1990 Population	Change in Population (a) 1980 - 1990 No. #	Change in Population (a) 1980 - 1990 %	Popn Projection (b) 1980 - 2010 % Growth
Adair	18,421	-154	-0.8	21 - 42
Cherokee	34,049	+3,365	11.0	21 - 42
Craig	14,104	-910	-6.1	0 - 10
Delaware	28,070	+4,124	17.2	21 - 42
Mayes	33,368	+1,105	3.4	21 - 42
McIntosh	16,779	+1,217	7.8	11 - 21
Muskogee	68,078	+1,045	1.6	11 - 21
Nowata	9,992	-1,494	-13.1	0 - 10
Okmulgee	36,490	-2,679	-6.8	0 - 10
Ottawa	30,561	-2,309	-7.0	0 - 10
Rogers	55,170	+8,734	18.8	42 - 69
Sequoyah	33,828	+3,079	10.0	21 - 42
Wagoner	47,883	+6,082	14.5	42 - 69
Washington	48,066	-47	-0.1	-20 - 0
	474,859	21,158	4.6	

(a) Source: U.S. Bureau of the Census (1990).
(b) Source: Selland and Shahidullah (1988).

WASTE GENERATION AND COMPOSITION

As used in this report, municipal solid waste (MSW) refers to residential, commercial and nonhazardous industrial wastes.

An understanding of the quantities and composition of MSW generated in northeast Oklahoma is critical for the planning and implementation of effective solid waste management systems. Assessing the adequacy of existing solid waste disposal facilities, determining the need for future facilities, and understanding the potentials for recovery of recyclable materials from the waste stream are all dependant upon such information.

Unfortunately, little data are available that adequately characterize the composition of MSW in Oklahoma. However, recent research in this state and studies conducted at the national and state levels can provide insight to the solid waste characteristics of Oklahoma and its regions.

Estimated Waste Generation

Waste generation estimates are necessary for assessing how much waste is produced from a given community or area. These estimates are affected by many factors and may vary considerably between areas. In a given populations the particular mix of waste generators represented by residential, commercial, and manufacturing sectors all affect the quantity of wastes produced. Composite waste generation estimates typically consider all such sources and provide useful indicators for solid waste management planning.

Based on the most comprehensive national study conducted to date, the rate at which solid waste was generated in 1990 was about 3.7 lbs./person/day (Franklin Associates, 1988). The trend in per capita waste generation has been one of a steady increase since 1960 and it is expected to continue well beyond the Year 2000.

Similar estimates have been developed for Oklahoma. Researchers at the University of Oklahoma, using data obtained from Oklahoma communities, have estimated that solid waste generation in Oklahoma (considering all sources) averages about 4.9 lbs./person/day (Deyle and James, 1991). Four of the six communities used in establishing this estimate, however, are within or near the state's metro areas where abundant sources of commercial waste are more likely to contribute to larger per capita estimates than would be expected in the smaller communities that are more typical of the northeast Oklahoma study region.

Studies from other regions with demographic and economic characteristics more closely related to those of the northeast Oklahoma region may better reflect this area's waste generation. A recent study conducted in northwest Arkansas (a region with a substantial manufacturing sector but similar demographic characteristics to northeast Oklahoma) estimated per capita waste generation at 3.9 lbs./person/day (Franklin Associates, 1989a). Additional research conducted in a largely rural area of Kansas established a rate of waste generation at only 3.3 lbs./person/day (Franklin Associates, 1989b). Thus, for the purposes of this study, an average generation rate was developed based on the data from the aforementioned regional studies – 4.0 lbs./person/day is estimated as the rate of per capita waste generation in the 14-county study region.

Total quantities of MSW within the 14-county region can be developed using this per capita figure. Based on the generation rate of 4.0 lbs./person/day and a population

of 474,859, the total MSW generated in the region during 1990 was 346,647 tons (950 tons/day average). Residential (i.e., household) wastes, as estimated by Deyle and James (1991) for Oklahoma sources at 2.6 lbs./person//day, contributed approximately 220,000 tons to the annual waste stream. About 113,000 tons were generated by persons residing in rural areas of the region.

Waste generation estimates for each of the counties in the region are shown in Figure 4. Estimates provided for commercial (including institutional and industrial) wastes may be conservative for those counties including Mayes, Muskogee, and Wagoner where commercial/industrial sectors are large relative to other regional counties; based on other Oklahoma estimates (Deyle and James, 1991), the relative proportions of commercial wastes in these counties may approach 50%.

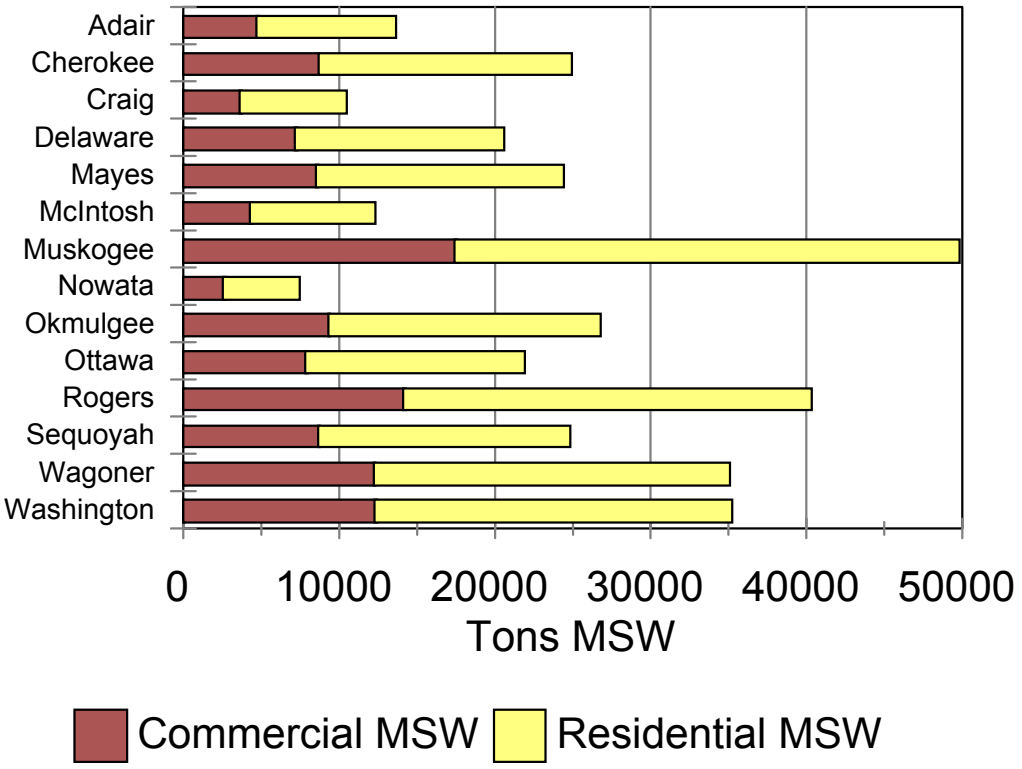


Figure 4. Estimated Waste Generation by County.

Projections of waste quantities indicate that by the Year 2000 per capita generation will have increased by about 7 (Franklin Associates, 1988). Considered with the expected population increase in the 14-county region, the quantity of wastes produced in the area by the Year 2000 will be markedly greater than it is today. Conservative estimates of low to moderate growth in the region (Selland and Shahidullah, 1988) suggest the quantity of MSW generated annually will be between 391,000 and 413,000 tons, the equivalent of 13% to 19% more solid waste than was generated in 1990. In more graphic terms, the projected increase alone will be capable of filling over 5,000 garbage trucks.

Special Generation Considerations

Other characteristics of solid wastes generated within the northeast Oklahoma study region have important implications for management of the waste stream. Special types, sources, and quantities of other wastes generated in the region are discussed below.

Small quantity and household hazardous wastes. Several materials recognized as hazardous wastes are found in the region s MSW stream. Such hazardous materials being disposed in area landfills originate typically from households or from businesses that generate only small quantities. A study conducted for the U.S. Environmental Protection Agency has estimated that over 80% of small quantity generators are related to nonmanufactunng operations — about 50% are businesses that perform vehicle maintenance (ABT Associates, Inc., 1985). Major components of small quantity hazardous wastes include lead-acid batteries (comprising nearly half of all types), cleaning solvents, photographic wastes, and waste formaldehyde.

Much of the hazardous wastes from small quantity generators are typically managed on-site or recycled. Franklin Associates (1989a) reported that nearly 80% of lead-acid batteries are recovered for recycling. Small quantity generation rates for the northeast Oklahoma study region are likely to be similar to those reported for northwest Arkansas at about 90 to 100 tons annually (approximately 0.26 tons/day).

Other hazardous wastes generated in the region include those arising from households. Household products commonly classified as hazardous include:

- Adhesives
- Automotive oil, antifreeze
- Drain cleaners
- Grease and rust solvents
- Herbicides
- Oven cleaners
- Automotive fuel additives
- Paint strippers and thinners
- Pesticides
- Charcoal starter fluid

Although little information exists on generation rates, available estimates suggest that household hazardous wastes comprise approximately 0.15% of all

MSW disposed. Applied to the 14-county study region, the resulting estimate of regional generation is about 520 tons annually (1.4 tons/day).

Bulky wastes. Another component of northeast Oklahoma's MSW that requires special management consideration is that related to items known as bulky wastes. These usually include large appliances, also called "white goods," large packaging materials like wood crates or metal drums, household furniture, and other such materials.

Knowing the quantity of bulky wastes in MSW is important particularly in determining the need for certain collection and handling practices. For example, in a transfer station or other waste processing facility, bulky wastes will typically require separate management procedures such as size reduction and possibly arrangements for diversion of the materials to a scrap metal market. Unfortunately, many bulky wastes are not suitable for recycling.

The quantity of bulky wastes generated in northeast Oklahoma is assumed to be similar to other areas of the country where such items comprise 5% to 15% of the total MSW generated by weight (Franklin Associates (1989a). Assuming an intermediate rate of 10% for the study region equals a total quantity of about 34,600 tons annually (95 tons/day).

Construction/demolition wastes. Generation of construction/demolition wastes is influenced by several factors including a community's age, location, growth rate, and general economic well-being. In many cases throughout northeast Oklahoma, such wastes are used as fill material at development locations. Only one regional community, the City of Miami in Ottawa County, maintained a construction/demolition C & D) landfill permitted by the Oklahoma State Department of Health (OSDH); the facility closed in 1990.

During its operation, quantities of C & D materials generated within the city limits of Miami and disposed at the C & D landfill averaged about 3,000 tons per year; on a per capita basis, about 460 lbs./person/year (Hal Collins, City of Miami, pers. commun., 1991). In northwest Arkansas, C & D generation was estimated at about 340 lbs./person/year (Franklin Associates, 1989a). In both cases, recovery of scrap metals reduced the quantity actually disposed (about 26% reduction in NW Arkansas and >30% in Miami, OK) .

Using intermediate estimates of the above data, an approximate assessment of the quantity of C & D materials generated in the 14-county study region is 94,970 tons (260 tons/day). Materials recovery is estimated to reduce the quantity disposed to about 68,380 tons.

Nonhazardous industrial wastes. Manufacturing industries generate a wide variety of wastes resulting from manufacturing processes. In many areas, the quantities of such wastes are greater than for any other solid waste type. In northeast Oklahoma (as in other areas of the United States), manufacturing sectors

with significant solid waste generation include industries related to food processing, poultry production, primary metals, power generation, and production of miscellaneous plastic goods.

Materials recovery from such sources of solid waste tend to be greater than for other generators, often ranging from 30% to over 75%. In addition, most nonrecovered materials are typically disposed on-site at a landfill permitted for the manufacturing facility.

No systematic study has been conducted regarding generation of nonhazardous industrial wastes in the 14-county study region — such investigation was beyond the scope of this research. Based on findings from other studies, a conservative estimate of the amount of nonhazardous industrial waste generated in the region would be one-third the quantity of the total municipal waste stream. At this level, the quantity generated would be approximately 115,500 tons per year. Perhaps 10 of this amount, or about 11,500 tons/year, requires disposal in off-site, regional landfills.

Wastewater treatment sludge. The treatment of wastewater in many municipalities produces residues referred to as sludge. Sludge consists primarily of water and a lesser fraction of organic solids.

Sludge generation estimates for Oklahoma communities are not compiled by the OSDH and regional inquiries found that reliable information was generally unavailable. Studies conducted in similar geographic areas reflect generation rates of about 30 lbs. to 50 lbs. (dry weight) per person per year (Franklin and Associates, 1989a, 1989b). A mid-point in this range applied to the 14-county study area suggests a total regional generation of about 9,500 tons annually. This is an estimated amount discarded; the quantity land filled is probably substantially less considering the prevalence of land application for disposal of sewage sludges.

Tourism-related wastes. At over two million visitors annually, tourism-generated wastes deserve recognition as a contributor to the region's solid waste stream. Considered as a separate population, the quantity of wastes generated by tourists (at rates equivalent to the estimated per capita generation for residential wastes and assuming that each visitor-day represented one day of waste generation in the area) would equal over 1.5 million tons per year. In fact, however, this is not the case. Although little information evaluating the impact of tourist-generated solid wastes is available, it is reasonable to assume that most of the wastes produced by tourists are incorporated into both the municipal and commercial fractions of the region's waste stream.

Typical expenditures of regional tourists include those related to food, vehicle operation, lodging, event admission fees, and other entertainment expenses (York, 1988) . Solid waste generated from such activities typically becomes the responsibility of the service provider with the quantities reflected as a contribution of the municipal or commercial waste stream. Although not fully quantified, these contributions are substantial.

Public recreation areas serve as one example of the impact of tourism-related wastes on the regional waste stream. Within the 14-county study area there are approximately 160 public campgrounds and day-use recreation areas located principally around the area's lakes and rivers. Solid wastes from the campgrounds generally are collected by using on-site placement of 55-gallon metal barrels. Data provided by the federal and state managing agencies of the recreation areas (Dan Bauman, Jim Montegomery, John Carmichal, and Loyd Isley — U.S. Army Corps of Engineers, pers. commun., 1991; Lee Carvell, Oklahoma State Tourism and Recreation Department, pers. commun., 1991) indicate that in total, nearly 6,000 such receptacles are located in the recreation areas.

Detailed waste collection data provided by a private waste collection company servicing regional public-use areas (Ralph Berg, Oklahoma Production Center, pers. coromun., 1991) in conjunction with information on area visitation were used to develop generation estimates. This information indicated that on average, each waste-collection barrel used in the region's public recreation areas served as a receptacle for about 1,800 pounds of solid waste annually. The data suggest that tourism-related generation of solid wastes from all regional public campgrounds and use areas is about 5,500 tons per year (15 tons/day).

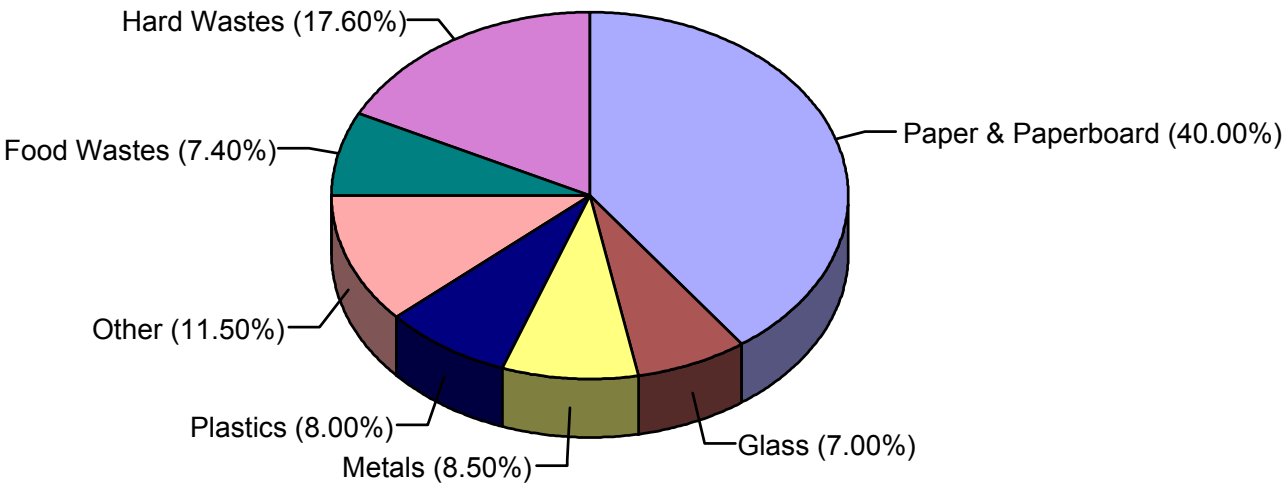
Waste composition

Understanding the types of solid wastes being produced in a given area is equally as important as knowing the quantity of wastes produced. For general description, the composition of solid wastes is described typically as consisting of seven categories of materials. These categories and their percentage contribution (by weight) to the total waste stream generated in the United States are illustrated in Figure 5.

Data compiled from regional studies have shown that the composition of MSW varies between communities. Several factors affect waste composition including the socio-economic characteristics of an area; the mix of commercial, manufacturing, institutional, and residential sectors; rural versus urban setting; and seasonal climatic changes.

Despite the variability to be expected in MSW composition, regional solid waste studies conducted in three states adjoining Oklahoma (Arkansas, Kansas, and Missouri) found percentages of MSW components that closely reflect the estimates derived from national data (Table 3). Review of county MSW estimates from northwest Arkansas show that more than any other category, the percentage of paper wastes can be expected to vary widely from county to county. In that study, the relative percentages of paper wastes ranged from 24% to 53% between counties (Franklin Associates, 1989a). Generally, those counties with larger commercial and manufacturing sectors contribute larger proportions of paper to the waste stream than do counties with smaller sectors.

COMPOSITION OF MUNICIPAL SOLID WASTE



Source: Franklin Associates (1988)

Figure 5. Estimated Composition of Municipal Solid Wastes in the United States.

Table 3. Waste Composition Estimates – Comparisons of Four Studies.

	Percent Composition by Weight				
MSW Category	National	Missouri	Kansas	NW Arkansas	MO, KS, AR Avg.
Paper & Paperboard	40.0	39.0	37.3	44.7	40.4
Glass	7.0	4.3	9.6	7.0	7.0
Metals	8.5	7.3	9.8	8.3	8.5
Plastics	8.0	8.0	7.0	6.7	7.2
Yard Waste	17.6	10.0	17.4	15.1	14.2
Food Waste	7.4	7.4a	8.7	7.5	7.7
Other Materials	11.5	24.0	10.2	10.7	15.0
TOTALS	100.0	100.0	100.0	100.0	100.0

Sources: National – U.S. Environmental Protection Agency (1990) Missouri – Environmental Improvement and Energy Resources Authority, 1898, (as reported by Deyle and James, 1991); Kansas – Franklin and Associates (1989b); NW Arkansas – Franklin and Associates (1989a).

a/ Estimate for Missouri food waste was not specified but was included in "Other Materials" category. In this table, the national average has been substituted for Missouri's food wastes and the percentage of "Other Materials" has been decreased proportionately.

Waste composition data is particularly important for assessing waste stream recycling potentials. Perhaps the most comprehensive data base of this nature from a region with similar characteristics to northeast Oklahoma is that obtained recently in Missouri. Surveys conducted at four community landfills in the state were used to establish waste composition profiles. Results of a separate analysis conducted on that data by Deyle and James (1991) are used in this report to generalize the findings to northeast Oklahoma.

Using these regional averages of MSW composition, a similar profile can be established for the study region. Based on the total quantity generated in the 14 counties, the quantity of each MSW component has been estimated and is shown in Table 4. The data do not necessarily reflect quantities of MSW components that are actually discarded at disposal facilities. As discussed later in this report, some recovery of materials for recycling is occurring in the region.

Table 4. Estimated Composition of Municipal Solid Wastes in the Northeast Oklahoma Study Region – 1990.

MSW Category	% of Discards (By Weight)	Tons Discarded
Paper and Paperboard		
-corrugated cardboard	15.4	53,384
-office paper	2.6	9,013
-newspaper	6.3	21,839
-other	16.1	55,809
	40.4	140,045
Glass	7	24,265
Metals		
-tin cans	2.4	8,319
-other ferrous	3.4	11,787
-aluminum cans	1.9	6,586
-other non-ferrous	0.8	2,773
	8.5	29,465
Plastics		
-HDPE & PET	0.7	2,426
-other plastics	6.5	22,531
	7.2	24,957
Yard Waste	14.2	49,224
Food Waste	7.7	26,692
Other Materials	15	51,997
TOTALS	100	346,645

SOLID WASTE COLLECTION AND DISPOSAL

Solid Waste Collection – Municipalities

The role of municipal governments in the collection and disposal of MSW generated in Oklahoma is relatively well-defined. Title 63, Section 2256 (a) (as amended) of the Oklahoma Statutes (1981) indicates that all incorporated cities and town in Oklahoma are required to provide for the collection and disposal of solid wastes generated within their boundaries. Considerable flexibility exists in the ways that regional municipalities may comply with this mandate; these decisions typically are influenced by each community's specific need and available resources.

All municipalities within the 14-county study area were surveyed during late 1990 to assess waste collection systems. The survey was facilitated by an associated municipal service study conducted by Grand Gateway Economic Development Association (GGEDA).

Survey results showed that 16 of the 100 regional municipalities maintained publicly owned/operated collection systems. These were:

Bartlesville	Henryetta	Picher	Tahlequah
Claremore	Miami	Ramona	Vian
Coweta	Muskogee	Sallisaw	Vinita
Dewey	Okmulgee	Stilwell	Westville

Of these communities, only four had populations less than 2,000 (Picher, Ramona, Vian, and Westville). At the time of the survey every community over 10,000 population maintained a publicly-owned collection system.

Municipalities using private collection contractors reportedly established such services both formally (by written agreements) and informally (verbal agreements). Only five of the communities using private contractors depended on individual residents to establish the service. Forty-seven (55%) of the communities using private haulers for municipal waste collection billed their residents for the waste collection service. Other municipalities depended on the private haulers to bill customers. Even in communities with public collection systems for residential wastes, many commercial waste collection accounts are handled by private companies. For instance, the City of Claremore in Rogers County has a municipal waste collection service for city residents; collection of commercial wastes are the responsibilities of more than 15 private waste collection business contractors (Jim Baker, GGEDA, pers. Commun., 1991).

Municipal waste collection is generally provided at curbside. Frequency of collection ranges from twice-per-week in most municipalities with publicly-owned collection systems, to once-per-week in smaller and privately-serviced communities.

Solid Waste Collection — Unincorporated Areas

Unlike their municipal counterparts, Oklahoma's county governments, presiding over the state's unincorporated rural areas, have no statutory mandate to provide solid waste management services to residents living in their jurisdictions. Yet, in the 14-county study region, two-thirds of the counties have 50% or more of their total populations residing in rural areas. Overall, about half of the residential wastes generated in the region originate from rural households.

Collection and disposal of rural residential solid waste occurs through a variety of practices. Some rural residents voluntarily elect to pay for private waste collection services. Others transport their household wastes to an area landfill or other solid waste management facility. An additional number choose to burn or bury their wastes on-site. Also, a presumably small, but significant quantity of regional residents contribute their household wastes to one or more of the many hundreds of illegal roadside dumps located throughout the region.

Although the need for understanding rural waste management practices is great, available information provides few answers to even the most simple of questions such as "How many rural residents ... dispose of their solid wastes on-site?; use private waste haulers?; burn and/or bury their household solid waste?" In addition, accurate information is difficult to obtain for several reasons including: the individual nature of waste management in rural areas; the large numbers of private waste haulers operating in the region; the proprietary interests of haulers in waste collection and disposal information; duplication of service areas; and frequent changes in service areas.

Data compiled during this study indicate that somewhat over 100 private waste hauling businesses are operating in the study region. Although private haulers are capable of providing service to virtually every rural home in the region, the extent of subscription to their services is believed to be relatively small. Information collected from an association of 15 independent solid waste haulers serving Cherokee County determined that about one-third of the county's 9,000 rural households are served by private haulers (Bob Patterson, Cherokee County Solid Waste Department, 1991). Information from other regional waste haulers suggests that service coverages range typically from about 15% to 35% of rural households. Costs for private collection services vary from about $8.00 to $12.00 per household per month. It is assumed that all significant commercial and industrial users in rural areas meet their off-site disposal needs by using private collection services.

Delaware County is currently the region's only county providing comprehensive waste collection service for rural residents. A greenbox collection system has been in operation since December 1989 (see also - Solid Waste Research Institute of NE Oklahoma, 1990). The system is funded by proceeds from a one-half cent county sales tax. In late 1990 and early 1991, two other counties (Cherokee and Adair, respectively) proposed the development of similar county-wide waste management systems. Both proposed systems failed to obtain popular support in elections concerning the establishment of operational funding.

Solid Waste Disposal Facilities

Throughout northeast Oklahoma, as in most other portions of the state, landfills meet the primary needs for disposal of solid wastes. Their capacity to provide for the disposal of wastes is an important indicator for regional solid waste management planning. As part of this study, an assessment of regional landfill operations was conducted to assess capacities and other operational aspects of the facilities.

A review of permit listings maintained by the OSDH and a follow-up survey of facility owners and operators were used for the assessments of regional solid waste disposal facilities. Facilities surveyed included all sanitary landfills and other disposal facilities classified by the following descriptions and types (detailed operational type definitions are provided in the OSDH Regulations Governing Solid Waste and Sludge Management, Bulletin 524, 1989): The facility types present in the region were:

* Sanitary Landfills: Types I, II, and III
* Construction/Demolition Waste Landfill: Type IV
* Solid Waste Processing Facility: Type VI

Type V facilities defined as "Other Industrial Waste Landfills" were not surveyed. These facilities typically serve as privately-operated sites for the disposal of residues from the manufacturing processes of specific industries. Fifteen such permitted sites are located in the study region; the majority are located near Pryor in Mayes County and are serving the disposal needs of manufacturing industries in the Mid-America Industrial Park.

Findings obtained from the survey showed that in November 1990, 14 landfills were operating within the study region (Note: results discussed herein are based on responses to 13 questionnaires. No information was provided by Talala landfill — closed (1991) following this survey). Four other landfills, in areas adjoining the study region, received some quantities of solid waste generated in the area; two were located in other counties (i.e., Osage and Haskell Counties); the other two facilities were located in other states (Cherryville, KS and Fort Smith, AR).

Other facilities used for solid waste disposal (or intermediate processing) that were operating in the region included:

* Mass-burn modular incinerator (Type VI) — City of Miami (1 permitted).

* Construction/demolition landfill (Type IV) — City of Miami (1 permitted).

* Transfer stations (Type VI) — City of Henryetta (1 permitted); City of Tahlequah (1 unpermitted — site of previous incinerator); Delaware County (2 unpermitted — permit application in process).

Names and approximate locations of the regional disposal facilities are shown in Figure 6. A summary of survey findings by disposal facility is provided in Table 5.

Nearly one-half of the regional landfills operating in 1990 were owned by local governments. The incinerator in Miami and the region's four transfer stations were also publicly-owned facilities. All permitted landfills of the largest operational class (Type I) were owned by private companies.

Collectively, the regions landfills represented 1,078 acres of disposal capacity at the time of their permitting (Table 5). Estimates provided by landfill owners indicated, however, that in 1990 an average of only 40% of this total capacity remained usable. The estimated years of useful life remaining before the regions landfills exhaust their capacity ranged from less than 1 year (i.e., just a few months) to a maximum of 30 years. The average of all estimates suggest the combined capacity of the region's landfills will be exhausted in only about eight years at current rates of disposal. About three-fifths of all landfill owners estimated useful life of their facilities at five or fewer years ... the majority of these owners believed their sites would be closed in less than one year.

Owner's estimates of average monthly rates of disposal at area landfills varied according to landfill size and service area. Most rates were reported in cubic yards. This data was converted to tons using an estimated 600 pounds per cubic yard based on compaction equipment specifications and estimates from landfill owners and regional waste collectors. Estimated rates of disposal ranged from a minimum of 240 tons per month to a maximum of nearly 10,000 tons per month. At these average rates, the total annual quantity of MSW disposed at area landfills for 1990 was estimated at approximately 400,000 tons. The MSW disposed at Miami's incinerator brings the total to over 415,000 tons.

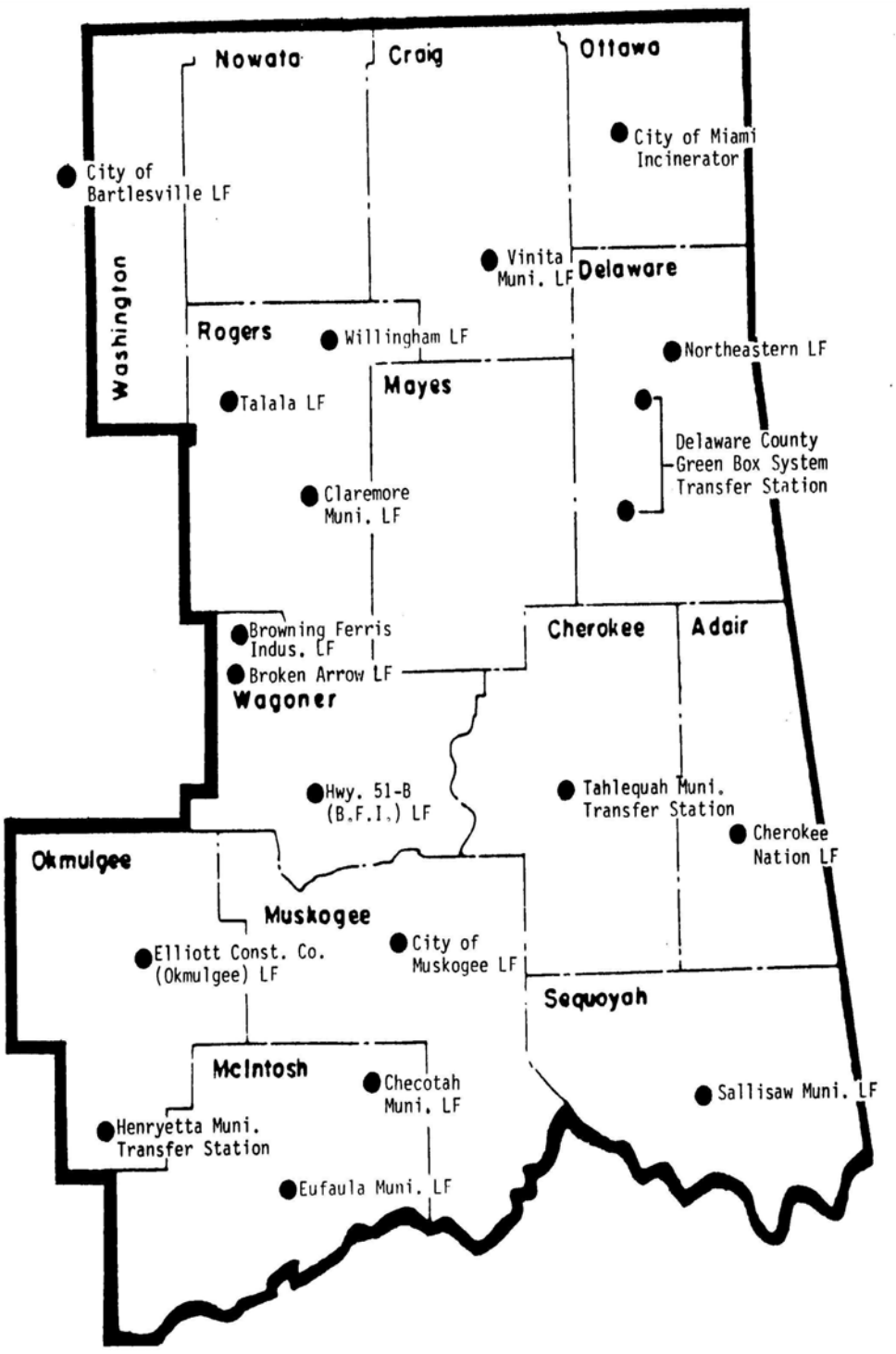


Figure 6. Names and Approximate Locations of Solid Waste Disposal Facilities in the 14-County Study Region.

Table 5. 1990 Operational Characteristics of Disposal Facilities in the Study Region.

Landfills	County	Type (a)	Size (Acres)	Avg. Disposal Tons/Month(b)	Tipping Fee ($) (c)	Remaining Service % Capacity	Years
Cherokee Nation	Adair	SL	160	3,600	12/ton	85	15-20
City of Vinita Muni	Craig	SL	40	900	3/cy	25	1-2
Northeastern	Delaware	SL	55	Unknown	3/cy	35	5-7
City of Eufaula Muni	McIntosh	SL	40	Unknown	5/cy	1	<1
City of Checotah	McIntosh	III-B	6	300	Unknown	1	<1
City of Muskogee	Muskogee	SL	240	7,200	2-3/cy	30	3-5
Elliott Construction Co.	Okmulgee	I-B	38	3,900	3-4/cy	90	16
City of Bartlesville	Osage	II	100	3,700	13-15	Unknown	10
City of Claremore Muni	Rogers	II	14	3,900	2.50+/cy	25	<1
Willingham	Rogers	III-B	5	240	2+/cy	80	18
Talala	Rogers	II	NR (e)	NR	NR	NR	NR
City of Sallisaw Muni	Sequoyah	SL	45	780	2.50/cy	1	<1
Quarry (Waste Mgt. Inc.)(d)	Tulsa	I-B	80	NR	4.55/cy	95	19
City of Broken Arrow Muni	Wagoner	I-B	40	Inactive	Inactive	50	15
Browning Ferris Indus (Hwy 51-B)	Wagoner	I-B	270	1,920	4/cy	95	30
Browning Ferris Indus (51st St.)	Wagoner	I-B	165	9,900	4.25/cy	5	<1
Incinerators							
City of Miami	Ottawa	VI	N/A	1,400	15-20/ton	N/A	N/A
Transfer Stations							
City of Tahlequah	Cherokee	VI	N/A	2,960	5/cy	N/A	N/A
Delaware County Solid Waste Dept.	Delaware	VI	N/A	Inactive	Inactive	N/A	N/A
City of Henryetta	Okmulgee	VI	N/A	685	4/cy	N/A	N/A

Source: 1990 Survey of regional disposal facility owners/operators.
(a) Facility types as designated by the Oklahoma State Dept. of Health (Bulletin 524).
(b) Disposal rates reported in cubic yards were converted to tons using a factor of 600 lbs./cu. yd.
(c) Tipping fees are shown on the basis reported (cy=cubic yard).
(d) Landfills located adjacent to, but not within study region; receive some quantities of regional wastes.
(e) NR = survey nonresponse.

From the regulatory perspective of the OSDH, several of the regional landfills were considered “substandard” facilities; six landfills (43%) had not yet upgraded their facility operations to the design and operation standards (for designated facility types) adopted by the State of Oklahoma in 1985 (OSDH, 1989). In addition, recent administrative and closure orders had affected several regional facilities; -- landfills at Eufaula, Miami (C&D), Tahlequah, Wagoner County, and the City of Vinita. Legal

actions, have also affected the establishment of additional disposal sites. Landfill sites permitted in Okmulgee, Rogers, and Wagoner Counties have not been developed due to legal impediments. At the beginning of 1991, only four additional landfill siting efforts were being considered; each by a municipality with landfills expected to close within months.

Considering such regulatory and legal issues, as well as the capacity limitations of existing facilities, it is very likely that overall disposal capacity within the 14-county region will be reduced significantly within the next few years. Survey responses by landfill owners indicated that applications were being considered for only about 50% of the existing landfills with less than five years of service life remaining.

The lack of landfill development in the study region (considered with at siting process that typically requires three to five years for successful landfill development) suggests that in the near future, numerous regional communities will face additional challenges for managing their solid wastes. The diminishing disposal capacity being experienced in the region will require a larger segment of the region's waste stream to be diverted to other facilities with adequate capacities. As a result, many regional communities may incur substantial increases in solid waste management costs due to long-distance transportation of wastes to adequate disposal sites.

Roadside Dumps — A Collection and Disposal Issue

Roadside dumps, also known as "wildcat" dumps are common throughout the 14-county region. Little attention has been given to the problem although the impacts of such dumps are widely recognized as negative. Their occurrence is believed to stem from a variety of influences including: social norms for rural waste management practices; economic considerations, and inadequate resources for enforcement of existing state litter laws.

Detailed roadside surveys conducted recently in Adair and Sequovah Counties may provide some indication to the extent of the roadside dumping problem; the number of roadside dumps documented in those counties was 99 and 33, respectively (Fan Robinson, Cherokee Nation of Oklahoma, pers. commun., 1990). The dumps ranged from a few hundred square feet to several acres in area. Information provided by county commissioners and county health personnel suggest that such numbers are not uncommon for other counties. The quantity of materials disposed annually in roadside dumps is virtually impossible to assess. It is safe to assume that many have accumulated multiple tons of materials over their many years of use.

Roadside dumps also carry several concerns related to public health issues. Some of these issues involve the potential impacts of dumps containing hazardous waste materials. The Cherokee Nation of Oklahoma is currently undertaking one such investigation under a federal program administered by the tribe. In three of the region's eastern-most counties, 17 roadside dumps on tribal lands are being tested for hazardous waste contents. (George Bearpaw, Cherokee Nation of Oklahoma, pers. Commun., 1990).

The establishment of comprehensive rural solid waste collection systems has demonstrated success in resolving roadside dumping problems. As noted previously, a county-wide green box collection system was established in Delaware County in 1989. During system implementation more than 60 roadside dumps were removed through site abatement efforts (Kenneth Crowder, Delaware County Commissioner, pers. commun., 1990). County officials have reported no significant recurrence of roadside dumping since the system became fully operational (Rebecca Sharp, Delaware County Solid Waste Dept., pers. commun., 1991).

MATERIALS RECOVERY AND RECYCLING

Some recovery of waste materials for recycling is occurring in the 14-county region. These recovery and recycling efforts, however, are not currently integrated in any comprehensive fashion into community solid waste management programs. Instead, and as it has for many years, recycling remains in the domain of private enterprise — a practice engaged largely by certain industries as well as other large and small private businesses (both profit and non-profit oriented).

Existing Recycling Programs

As part of this study, an inventory and survey of regional recycling programs was conducted during the fall of 1990. Survey results showed that no community within the study region had implemented a mandatory or other broad-scale municipal recycling program. Some of the larger communities, including Bartlesville, Henryetta, and Muskogee were considering (or had already implemented) limited, voluntary municipal recycling (i.e., curbside collection) programs targeting residential as well as some commercial MSW. Most of these efforts were being conducted on a trial basis in order to assess program feasibility.

Although municipally-operated recycling programs do not exist in the region, other opportunities for citizen involvement with recycling are relatively common. Based on a compilation of information from numerous sources (e.g., recycling directories, regional telephone and business directories, and personal/telephone interviews) 32 private recycling businesses operating in regional communities were identified. The enterprises identified reflect known multi-material recycling businesses available for public use; other private business recycling programs exist but were not identifiable from available sources of information.

Telephone interviews with the business operators indicated that most of the recycling businesses were based on the "buy-back" or purchase of recyclable materials delivered by persons to the recycling facility. Materials typically purchased and their prices reflected market demand for each commodity. Items purchased included aluminum cans and scrap, glass bottles and jars, ferrous metals, and some miscellaneous items such as used automobile batteries. Other recyclable commodities (e.g., most grades of waste paper) were collected by some businesses, but usually on a donation basis. Among the businesses identified, only eight (25) accepted waste paper (only three of these on a buy-back basis) and only two

facilities (6) accepted limited types of post-consumer plastics. A listing of the recycling businesses, their locations, and other operational information is provided in Appendix A.

Regional Recycling Options and Outlook

Contrary to much public opinion, the benefits of integrating a comprehensive recycling program into a community's waste management system are not clear cut. Community recycling programs and greater public involvement in recycling are currently constrained by several factors. Among the most prevalent impediments are the low costs of solid waste disposal, high collection costs, and uncertain and fluctuating markets for recyclable materials.

Recent research conducted by the University of Oklahoma's Science and Public Policy Program provided a comprehensive assessment of Oklahoma's community recycling options (Deyle and James, 1990). Detailed benefit/cost assessments were conducted for recycling systems based on three modes of materials collection: voluntary drop-off, buy-back, and curbside collection. Secondary materials markets for paper, glass, aluminum, and yard wastes were evaluated.

The findings of that research indicate that from a cost-effectiveness perspective, few northeast Oklahoma municipalities are likely to view recycling as a beneficial alternative to existing waste management practices. Because of the relatively low expense of disposal, avoiding such costs is not currently a major incentive for implementing municipal recycling systems. The economics of recycling in most Oklahoma communities are influenced more by factors such as anticipated rates of recycling, market values for recovered materials, and the costs of collecting and processing recovered materials.

Comparative results of the study showed that municipal buy-back systems or drop-off systems are typically more cost effective than curbside recycling systems. However, only small reductions in the total quantity of MSW can be achieved using such alternatives. Increased waste reduction is provided by curbside collection although costs are substantially greater.

Among the majority of Oklahoma's communities, achieving optimum cost efficiencies for recycling may depend on the development of regionalized systems (Deyle and Schade, 1990). With a system such as a regional materials recovery facility (MRF), municipalities may benefit from the economies of scale associated with more efficient processing of larger quantities of materials and the shared costs of system operations. Contractual arrangements with private recycling business hold still other possibilities for implementing recycling systems within smaller communities.

Communities considering development of recycling systems must carefully examine the trade-off between the costs of collection and processing recovered

materials and the revenue that can be expected from their sale to secondary materials markets. For most northeast Oklahoma communities, markets are relatively accessible for the primary materials included in recycling programs. While good market accessibility is beneficial for recycling systems it is, nevertheless, only one element in the cost/benefit equation that must be calculated for recycling programs. Brief descriptions and evaluations of the primary recyclable material commodity markets are provided below. This information is drawn largely from the findings reported by Deyle and James (1990).

Glass. Six glass container plants purchasing post-consumer glass cullet are located in the state; three of these are located in the 14-county study region – Anchor Container (Henryetta); Ball-Incon (Okmulgee); and Owens-Brockway (Muskogee). Although each plant currently operates near capacity, the majority of the glass cullet supplied to these markets is from out-of-state sources. The plants are capable of utilizing virtually all glass cullet from post-consumer glass containers generated in the state. Demand should remain strong.

Paper. Post-consumer wastepaper is used by five of Oklahoma's seven Daoer mills. Fort Howard Paper (Muskogee), Georgia-Pacific (Pryor), National Gypsum (Pryor) , and Robel Tissue (Pryor) are located within the study region. With the exception of Robel Tissue, all use post-consumer waste paper in their manufacturing activities. The market demand for wastepaper varies considerably by type. Current strong markets are expected to be maintained for the next several years for high grade paper (i.e., computer and office paper) and old corrugated cardboard. Mixed grades (used principally by Fort Howard for tissue paper production) are also projected to retain a moderate to strong demand. Demand for old newspaper (ONP), on the other hand, has been extremely weak in recent years. ONP market development in the southern United States and elsewhere may improve this situation in time (Hildebrand 1990). Over the next few years, however, the potential for stronger ONP markets does not appear promising.

Plastics. Large volumes of materials are typically required to make plastics recycling a cost-effective activity. The primary markets for post-consumer plastic wastes generated in Oklahoma are currently located in other states. Even though the demand for reclaimed plastic resins has been relatively strong, prices offered for plastic wastes seldom covered the costs of collecting, sorting, baling, and transportation necessary for delivery of the materials to market. In-state demand by manufacturing facilities using limited types of recovered plastic wastes (high and low density polyethylene) has been estimated at less than 5 of the discarded quantities of these materials. Phillips Petroleum Company has recently announced plans for development of a plastics recycling facility in Tulsa. Potential opportunities for increased community plastics recycling (within the 14-county study region) associated with the planned development are uncertain at this time.

Aluminum. With few exceptions, aluminum cans have been a mainstay of successful recycling programs. The demand for aluminum has been strong for several years; it is expected to remain strong. Although principal markets for recycled aluminum are located outside Oklahoma, and market prices have fluctuated, the

future for continued aluminum recycling is positive.

Other recyclables. Regional opportunities to recover and market other recyclable materials from the solid waste stream will likely continue to be developed in response to prevailing market conditions. As previously mentioned, recycling businesses in the study region currently collect an assortment of materials that include automotive lead-acid batteries, used appliances or "white goods," tin cans, ferrous metals, and other such miscellaneous items. Opportunities to continue diversion of these materials from the waste stream are expected to remain steady or increase. Where strong, local markets exist, collection of some of these materials (e.g., white goods) may become increasingly common for municipal recycling programs. Outlets for such miscellaneous materials will most likely remain available through private recycling businesses.

Because of its large contribution to a community's waste stream, special consideration should be given to recycling of yard wastes. The principal decision in planning a yard waste composting program is whether a community hopes to achieve waste reduction or revenue generation through a composting program. This decision affects the type of collection and processing that will be required. Revenue generation requires greater inputs at the collection and processing stages of the composting system. Even where maximum prices may be commanded for a compost product, system costs are likely to exceed revenues.

Communities with a large yard waste component of the waste stream and inadequate local disposal capacities may find composting more cost efficient than other communities. Demand for compost within the study region is unknown although potential demand sources include community residents, public works departments, regional landscaping and nursery industries, and the state highway department. Aggressive composting programs may be capable of reducing the composite waste stream by somewhat less than 10%.

Recycling and Waste Reduction Goals

Currently, national estimates indicate that only about 11% of the waste stream is diverted from disposal through materials recovery efforts (Franklin Associates, 1988). Within the 14-county study region, this rate may be somewhat lower. Possible MSW diversion rates to be expected among Oklahoma recycling programs have been estimated by Deyle and James (1990). The estimated rates associated with alternative recycling systems are shown below in Table 6.

Table 6. Potential MSW Diversion Rates by Alternative Recycling System.

Recycling System	Best Case (%)	Base Case (%)	Worst Case (%)
Drop-Off	1.2 - 3.6	0.5 - 1.6	0.1 - 0.2
Buy-Back	1.6 - 4.8	1.1 - 3.3	0.7 - 2.0
Curbside	4.1 - 8.1	1.4 - 4.1	0.5 - 1.3
Composting (leaves only)	4.0	2.0	1.2
Composting (leaves & grass)	14.9	9.0	4.4

Source: Deyle and James (1990)

Achieving state or federal waste reduction goals of 25% of the existing solid waste stream (a suggested national goal – U.S. Environmental Protection Agency, 1989) through recycling programs will require communities to adopt aggressive approaches based on multi-material collection and processing systems, including yard waste composting programs. Even then, experiences from existing municipal recycling programs suggest that attaining waste reduction levels exceeding 20% will require substantial recycling of commercial sector solid wastes (Deyle and James, 1990). Furthermore, pursuing such objectives will likely require increased monthly fees for community waste management services. Deyle and James suggest that for most municipal solid waste management systems, minimum recycling service fees are likely to be in the range of $1.50 to $3.00 per household per month ($18 to $36 annually).

Other alternatives are possible for achieving reductions of the regional solid waste stream. Solid waste incinerators and waste-to-energy (WTE) facilities have been used in this and other areas with some success. The only such facility currently operational in the study region is the mass-burn incinerator located in the City of Miami. Although once a generator of steam, this facility ceased production following the loss of the nearby industrial user of the steam. Ogden-Martin Systems, Inc. operates a large WTE plant just outside the study region, in the city of Tulsa. The facility processes approximately 1,000 tons of MSW per day generated within Tulsa (James Arnold, Ogden-Martin Systems, per. Commun., 1990). Steam is produced for use onsite and by local industrial facilities. Other industries, such as the region's coal-fired power generation plants (Oklahoma Gas and electric - Muskogee; Grand River Dam Authority - Pryor; and Public Service Company of Oklahoma - Oolagah) have potentials for use of refuse-derived fuels.

For the near future (and in the absence of local, state, or federal mandates), significant reductions of the waste stream generated in the study region appear unlikely. The cost efficiencies of waste reduction alternatives simply cannot compete with landfill disposal in the region. However, a continuing trend of diminishing landfill capacity, anticipated increases in landfill costs (associated with state and federal design, operation, and closure requirements), and a favorable public sentiment toward recycling as a waste management alternative may enhance the feasibilities of waste reduction practices.

REGIONAL SOLID WASTE MANAGEMENT ALTERNATIVES

During the last 20 years, the issues and problems of solid waste management have increased in both complexity and scope. Clearly, the same is occurring in the 14-county northeast Oklahoma region. Projections of increasing waste quantities, escalating collection and disposal costs, possible mandates for waste reduction, and diminishing regional disposal capacities all suggest that local governments within the study region should strive toward increasing efficiencies in solid waste management systems. Moreover, reduction of solid waste problems, such as roadside dumping, will require greater management control over the region's solid waste stream.

Local governments within the State of Oklahoma may exercise any of several options for the planning and establishment of regional management systems capable of addressing the solid waste needs that are shared among counties. The institutional arrangements allowable through Oklahoma law for establishing regional solid waste management systems are summarized below:

Regional Solid Waste Management District

Establishment of a Regional Solid Waste Management District is one alternative for achieving regional solid waste management in Oklahoma. As defined in Title 63 of the Oklahoma Statutes, such a regional district may encompass multiple municipalities and one or more counties (or any portions thereof). There are four stages in the creation of a regional district.

Stage I: Each governing body of a participating town, city, or county votes to create a Regional Solid Waste Planning Committee. Each governments committee consists of one to three individuals.

Stage II: Two or more of the regional solid waste planning committees may combine to form a Regional Solid Waste Planning Board. Thereafter, the board is required to study the need for establishing a regional management district including means of organizing, financing, and operating the district.

Stage III: If by a majority vote of the planning board members a district is determined to be feasible, an agreement is developed containing a legal description of the districts boundaries, provisions for sharing the construction and operational costs, the method of levying fees and charges, and other organizational and operational provisions.

Stage IV: The planning board reports its findings and recommendations to the governing bodies of each county, town, and city within the proposed district. If a district is recommended by the planning board, each board of county commissioners within the proposed district must call an election on the question of establishing the district. The district can be established and the agreement ratified upon approval by a majority of the voters in the proposed district.

A regional solid waste management district, and its process of implementation, has advantages and disadvantages. The district represents a flexible system, being adaptable to the needs of solid waste management on a regional level while incorporating local needs and interests. The district also refelects a unified effort by the participants, enhancing intergovernment cooperation for a common management problem. Furthermore, the process of establishing the district is one that obtains broad, public input. Economically, a regional district may enable communities to increase the cost efficiency of managing their waste stream thus, helping to maintain or even reduce their net management costs.

2 The summary descriptions of solid waste management structures are extracted in part from information compiled by Susan Young, The Metropolitan Environmental Trust, 1990.

On the other hand, with its multiple stages and tasks, the process of establishing a regional solid waste district is difficult and time consuming. Rapid implementation is virtually impossible during a time when immediate solutions are required. Intergovernment cooperation is often difficult to achieve and some local elected officials may be reluctant to relinquish control of their waste streams. Furthermore, a negative popular vote could stall or even terminate the delivery of an otherwise feasible system.

Affiliation of Subregional Solid Waste Management Systems

In lieu of forming a single solid waste management district, other alternatives are available for meeting regional waste management needs. These alternatives primarily deal with the affiliation of separate management systems within the region. In forming this affiliated subregional system, the boundaries for each district would encompass only the participating municipalities and/or counties. Districts would affiliate through one of the following methods:

Public trust. A regional public trust can be established to affiliate districts that cover distinct governmental jurisdictions (i.e., municipalities or counties). In doing so, counties and/or municipalities negotiate and draft a trust indenture. The indenture describes the organization, the trustees/ obligations, trust duration, etc. Beneficiary counties and municipalities must approve the indenture and accept the beneficial interests by a two-thirds vote of the respective governing bodies. The separate management districts represented by the beneficiaries may then contract with the trust for the management of their solid wastes.

Interagency agreement. Affiliation of separate systems also could be attained through interagency agreement. Contracts or interlocal agreements (under the Interlocal Cooperation Act) would be used to establish the affiliation. Interlocal agreements may be somewhat advantageous in that they allow the joint exercise of authority and enable the creation of a separate legal entity to conduct the cooperative undertaking.

The affiliation of subregional systems can occur fairly rapidly. Counties and/or municipalities that are interested in joining in a regional management system can do so without lengthy delays from other indecisive governments. Others may join the system at a later date if desired.

The greatest potential problem with subregional affiliations is the need to obtain separate approval for each of the regulatory needs of the affiliated body. This is particularly important with regard to obtaining the necessary control over each participants waste stream (i.e., "flow control").

Other Management System Options

Still other management structures may be used by regional governments to provide solid waste management services over broad areas. Although these are not typically thought of as "regional" systems they are, nevertheless, important considerations for regional decision makers considering their options for solid waste management. The following systems could, however, be readily adaptable to regional efforts if desired.

County solid waste management systems. There are two methods by which a board of county commissioners may provide a management system for solid wastes generated within counties. One method, as provided in Article 10 of the State Constitution, allows funding through a millage levy (not to exceed three mils) and requires a vote of the people. The other, enabled through the Oklahoma Solid Waste Management Act (Title 63, Oklahoma Statutes) requires only a resolution by the board of county commissioners and allows commissioners to levy and collect fees as required for establishing and operating the county waste management system. By agreement or contractual arrangements, commissioners may join with other counties, one or more towns or cities, or with any combination of these to provide the system. The management system may service an entire county or any portion thereof. Funds may be accepted and disbursed from federal or state grants, from private sources, or from monies that may be appropriated from the general fund for the installation and operation of the system.

Although the latter option in particular provides for rapid establishment, flexible funding, and comprehensive operation, it has not been exercised widely as a system development option in the state. As mentioned previously, only three counties in the study region have attempted to establish county waste management systems; Adair, Cherokee, and Delaware Counties. None of the proposed systems were established through resolution; popular votes were held in each case (considering a county sales tax as the proposed source of system funding). Only Delaware County succeeded in

establishing a system but only after holding two separate elections concerning sales tax funding for the system. The trend suggests that establishment of county solid waste management systems via resolution may be considered politically risky by elected officials.

Rural solid waste management district. The establishment of rural solid waste management districts (RSWMDs) is enabled through Title 82 of the Oklahoma Statutes. These districts are similar in form and function to rural water districts. RSWMDs are established as public nonprofit entities for the purpose of providing solid waste management services to rural residents; municipalities with populations of 10,000 or more cannot participate in this type of district. Establishment of the district is initiated by landowner (two or more) petition to the board of county commissioners.

RSWMDs do not have the authority to levy taxes or make assessments on property. The district may buy and sell property, contract indebtedness, and fix and collect fees for the facilities or services provided by the district. Landowner participation, however, is voluntary.

Although RSWMDs represent familiar management structures and are relatively easy to establish, they have not yet met a practical need. Indeed, none have been established within the northeast Oklahoma region. As discussed earlier in this report, virtually any household in the region can purchase waste collection service from a private waste hauler; establishment of districts have not been required to ensure delivery of this service. Furthermore, districts cannot ensure that waste management services are provided for all households located in the district; as with private waste haulers, participation remains voluntary. Nevertheless, it is possible that RSWMDs can be used to advantage for certain management needs. For instance, a collective of households represented by a district may (depending on the numbers) be better suited for negotiating cost issues for waste collection or other services than their independent counterparts.

SUMMARY AND CONCLUSIONS

This study has focused on an overview of the characteristics of solid wastes and their management within a 14-county region of northeast Oklahoma. The findings of the study clearly depict a region experiencing increasing quantities of solid wastes, decreasing disposal capacities, and few alternatives for dealing with the impending management problems. The ability of regional decision makers to confront these problems will play a major role in the future environmental, economic, and social well-being of the region.

It is estimated that at current rates of solid waste disposal, the capacities of the regions landfills to meet the needs for waste disposal will be consumed within less than 10 years. Few alternative methods of waste management, including comprehensive recycling and other waste recovery options, are being considered. Indeed, because of the current low costs of landfill disposal, few such alternatives can achieve comparable cost efficiencies.

This situation is likely to change, however, as greater numbers of communities seek more distant disposal sites for their solid wastes and incur the increased management costs of doing so. Already, several regional communities are facing this very situation; these numbers will continue to increase. Moreover, the costs of developing and operating landfills are expected to increase as more stringent state and federal regulatory requirements are placed on the facilities. Such costs will be passed on to facility users.

The advantages of regional approaches to waste management being experienced in other parts of the country recommends strongly that a comprehensive assessment be conducted for developing a similar approach for northeast Oklahoma communities. Such an assessment should include investigating the feasibilities of siting one or more regional landfills as well as a possible resource recovery facility.

Several alternatives for managing and coordinating a regional system have been outlined in this report. These, or other alternatives for more effective waste management must consider the needs of unincorporated, rural areas — areas that contribute somewhat over one-half of all the household solid wastes generated in the region while seldom receiving any form of comprehensive waste collection and disposal services.

Ultimately, the task of meeting the challenges of solid waste management in northeast Oklahoma will depend largely on the initiative and determination of local decision makers. We should now realize the management issues cannot be avoided. However, in dealing with the issues we do have choices. We can choose to simply react to crises as they occur or we can choose to avoid them by recognizing our needs and by planning management strategies that will provide for the responsible and efficient management of our solid waste stream(2).

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(2) Assistance with community solid waste planning is available from area agencies and organizations including:

- - Oklahoma State Department of Health, Solid Waste Division, Oklahoma City.
- - Oklahoma State University Cooperative Extension Service, Rural Development Program, Stillwater
- - Sub-State Planning Districts:
  - Eastern Oklahoma Development District, Muskogee
  - Grand Gateway Economic Development Association, Vinita
- - Solid Waste Research Institute of NE Oklahoma, Tahlequah

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APPENDIX A:

DIRECTORY OF NORTHEST OKLAHOMA RECYCLING BUSINESSES

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
Bartlesville	BARTLESVILLE RECYCLING	Santa Fe & Frank Phillips	None	Tu-Th 10-5 Sat 9-12	Aluminum	Cans & Scrap	None	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Bartlesville	ASSOCIATED RETARDED CITIZENS	501 SW Virgnina	336-6361	M-F 8-4	Aluminum	Cans Only	None	Yes
					Paper	Computer High Grade Corrugated	None Color separated No wax	No
					Glass	Bottles & Jars	No lids, color separated	Yes
					Misc.	Clothing		No
Checotah	OPTIONS, INC.	Lafayette & 2nd	473-5260	M-F 8:30 - 5 Sat. 9-12	Alumimum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	None	Yes
					Paper	Computer High Grade Corrugated	No Newspaper None None	Yes
Chouteau	CHOUTEAU	Hwy. 69 South	476-8533	M-Sat. 9-4	Aluminum	Cans & Scraps	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
					Paper	Newspaper Computer High Grade Corrugated	No slick paper No carbons Color separated No wax	No
					Glass	Bottles & Jars	Clean	Yes
					Metals	Non-ferrous	Separate by similar types	Yes
					Misc.	Auto Batteries	None	Yes
						Radiators	None	
						Catalytic convertors	None	
Coffeyville Kansas	DURA-THERM INC.	213 E. 8th	(316) 251-4800	M-F 8-4:30	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	No lids, color separated	Yes
					Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries Catalytic Convertors	None None	Yes
Coffeyville Kansas	HEYMAN IRON & METAL	1216 Beach St.	(316) 251-2140	M-F/8-5 Sa t/8-12	Aluminum	Cans & Scraps	None	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Dewey	OILFIELD PIPE & SUPPLY INC.	E. 9th St.	534-3760	M-F/8-5 Sat/8-12	Aluminum	Cans & Scraps	Yes	

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
	OILFIELD PIPE & SUPPLY INC., cont'd				Paper	Newspaper Corrugated	Bundles only None	No
					Glass	Bottles & Jars	No lids, clean Color separated	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
					Misc.	Catalytic convertors	None	Yes
Henryetta	ANCHOR GLASS	McLaughlin Rd.	652-9631	Tues 1:30-4:30	Glass	Bottles & Jars	No lids, color separated	Yes
Jay	DELAWARE CO. FRIENDSHIP RECYCLING	next to Horner's Grocery	253-4569	M-F/8-4	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	No lids, color separated	Yes
					Metals	Non-ferrous	Clean	Yes
Miami	MIAMI IRON & METAL	500 D. NE St	542-5144	M-F 8-4:30	Metals	Ferrous & Non Ferrous	Clean	Yes
					Misc.	Auto Batteries Catalytic Convertors	None None	Yes
Miami	GRISSOM DISTRIBUTING COMPANY	815 D. NE St.	542-1855	M-F 9-5	Aluminum	Cans only	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
Muskogee	C&S METALS	Main & Hancock	682-1937	M-F 8-5	Aluminum	Cans & Scraps	None	Yes
					Metals	Ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Muskogee	EASTERN SALES COMPANY	609 W. Peak	687-4421	M-F 9-2	Aluminum	Cans only	None	Yes
					Glass	Long-neck brown bottles only (cases)	None	Yes
Muskogee	MADEWELL METAL CORPORATION	301 E. Shawnee	682-7813	M-F/8-5	Aluminum	Cans & Scraps	None	Yes
					Metals	Steel only	None	Yes
					Misc.	Auto Batteries	None	Yes
Muskogee	QUICK SERVICE STEEL	1155 N. Peoria	587-5909	M-F 8-4:30	Aluminum	Cans & Scraps	None	Yes
				Sat. 8-11:30	Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Muskogee	SWAP/BIRP	514 Fondulac	683-8162	M-F 8:30-	Aluminum	Cans/Food Containers	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
					Glass	Bottles & Jars	Color separated, No lids	Yes
					Paper	Computer High Grade Corrugated	Color separated No carbons None	Yes Yes Yes
					Plastic	HOPE & PET	None	Yes
Muskogee	WHEELER METALS	54th & Border	682-1083	M-F/8-5	Aluminum	Scrap only	None	Yes
					Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries Radiators	None None	Yes Yes
Muskogee	YAFFEE IRON & METAL CO.	G & Lexington	800-759-2333	M-F/7-4	Aluminum	Cans & Scraps	None	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
					Misc.	Appliances	None	Yes
Okmulgee	BALL-INCON GLASS	800 S. Madison	756-2255	M-F/8-4	Glass	Bottles & Jars	Clear only	Yes
Okmulgee	BEELINE SCRAP METAL	Hwy. 75 North	756-6182	M-F/8-5 Sat/9-12	Aluminum	Cans & Scraps	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
					Glass	Bottles & Jars	Color separated No lids	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
						Tin cans	None	Yes
					Misc.	Radiators	None	Yes
						Appliances	None	Yes
						Cars	None	Yes
Okmulgee	HOLLEMAN IRON & METAL	708 W. 2nd	756-2630	M-F/8-4 Sat/9-12	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	Color separated No lids	Yes
					Metals	Ferrous & Non Ferrous	None	Yes
					Misc.	Radiators	None	Yes
						Auto Batteries	None	Yes
						Catalytic convertors	None	Yes
Pryor	D & M METALS	102 S. Mill	825-0687	M-F 8:30-5 Sat 9-1	Aluminum	Cans & Scraps	None	Yes
					Metals	Non-ferrous	None	Yes
					Misc.	Radiators	None	Yes
						Catalytic convertors	None	Yes
						Auto Batteries	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
Pryor	UNITED IRON & METAL CO./RYALS JUNK & SALVAGE (Same Owner)	215 S.Ella /Hwy.20	825-1777	M-F 8-5	Aluminum	Scrap only	None	Yes
					Metals	Copper	None	Yes
						Brass	None	Yes
Sallisaw	PEOPLE INC.	Hwy. 17 North	757-7787	M-F 7:30-4	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	None	Yes
					Paper	Newspaper	None	Yes
						Computer	None	Yes
						High Grade	None	Yes
						Corrugated	No wax	Yes
					Plastic	PET only	None	Yes
Sallisaw	WISE RECYCLING	1204 W. Redwood	775-9232		Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	None	Yes
					Paper			No
					Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Siloam Springs Arkansas	DIXON IRON	1004 E. Main	(501) 524-3611	M-F 8-12/1-5	Aluminum	Cans & Scraps	None	Yes

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
					Glass	Bottles & Jars	No lids	Yes
					Metals	Ferrous	Clean	Yes
						Tin cans		Yes
					Misc.	Appliances	None	No
						Catalytic convertors	None	No
Tahlequah	B & J AUTO SALVAGE	Hwy. 51 East	456-2481	M-Sat 8:30-5:30	Aluminum	Scrap only	None	Yes
					Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes
Tahlequah	DAY BATTERIES	901 W. Keetoowah	456-1558	M-F 8-5	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	Clean, color separated	Yes
					Metals	Non-ferrous	Clean	Yes
Tahlequah	OKLA. PRODUCTION CENTER RECYCLING	449 S. State St. & Hwy. 69 South (two sites)	456-1996	M-F 8:30-4 Sat 9-12	Aluminum	Cans	None	Yes
					Paper	Newspaper	None	No
						Computer	None	No
						High Grade	None	No
						Corrugated	None	No

City	Company	Address	Phone	Hours	Material	Types Accepted	Restrictions	Pay?
					Glass	Bottles & Jars	Clean, color separated	Yes
					Metals	Non-ferrous	None	Yes
Tahlequah	OTT'S ALUMINUM CAN RECYCLING	4th & College	456-0424	Sat 9-2	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	None	Yes
					Metals	Brass	None	Yes
						Copper	None	Yes
					Misc.	Auto Batteries	None	Yes
						Radiators	None	Yes
Vinita	ALCAN INC.	828 E. Tahlequah	236-3108	M-F 8-5 Sat 8-12	Aluminum	Cans & Scraps	None	Yes
					Glass	Bottles & Jars	No lids, color separated	Yes
					Metals	Non-ferrous	None	Yes
					Misc.	Auto Batteries	None	Yes