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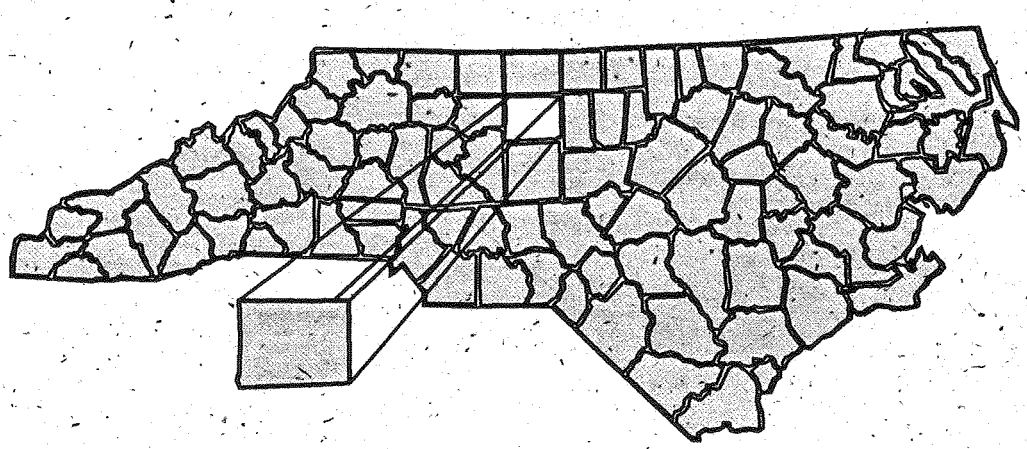
GUILFORD COUNTY, NORTH CAROLINA SOLID WASTE MANAGEMENT STUDY



- Guilford County
- City of Greensboro
- City of High Point

July 1996

HDR

HDR Engineering, Inc.
of North Carolina

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BACKGROUND

- According to North Carolina regulations, it is the responsibility of the local governments -- in this case, Guilford County -- to provide for the proper management of solid waste generated within their jurisdictions.

- State regulations also required that municipal solid waste (MSW) be disposed of in "lined" sanitary landfills starting in 1998.

- A solid waste disposal agreement that has been in effect since 1984 between Guilford County, the City of Greensboro, and the City of High Point, will expire in 1999; after that time, neither the City of Greensboro or the City of High Point will be obligated to provide the County with landfill space.

- In 1994, the U.S. Supreme Court ruled that local government flow control ordinances (ordinances used by local governments to direct solid waste generated in their jurisdictions to designated processing or disposal facilities) were invalid.

- In June 1995, Guilford County -- on behalf of itself, the City of Greensboro and the City of High Point -- issued a "request for proposals" for a solid waste study.

- The purpose of the solid waste study was to examine existing waste disposal capacity and to evaluate at least three future disposal options including: 1) waste-to-energy; 2) a multi-jurisdictional landfill; and 3) continued operation of the two municipal landfills operated by the cities of Greensboro and High Point.

- The study was to address disposal needs for the following three waste streams at least through the year 2015: municipal solid waste (MSW); land-clearing and inert debris (LCID) wastes; and construction and demolition (C&D) wastes. The actual planning period for the study is 1998-2017.

- The study was performed by HDR Engineering, Inc. of North Carolina, with the assistance of an Advisory Committee consisting of senior-level planners and managers from each of the three jurisdictions.

- This report presents the findings, conclusions, and recommendations made based on this study. This report is not subject to revision or change.

Solid Waste Quantities and Characteristics

- Municipal solid waste is non-hazardous solid waste generated by residences, businesses, industries, and institutions within a community. A review of records for Fiscal Year (FY) 1994-1995 indicates that a total of 486,000 tons of municipal solid waste was generated in Guilford County. Approximately 70,000 tons, or 15% of the MSW stream, was recycled or otherwise diverted from disposal through municipal and other recycling programs. As a consequence, 85% of the MSW generated, or 417,000 tons, were disposed of in MSW landfills in FY 1994-1995.

- Based on FY 1994-1995 data, MSW is generated at a rate equivalent to 7.35 pounds per person per day in Guilford County. In comparison, the generation rate for Mecklenburg County is reported to be 7.47 pounds per person per day (FY 1993-1994), while the state average is reported to be 7.9 pounds per person per day.

- Based on records for FY 1994-1995, 46% (193,310 tons per year) of the MSW generated in Guilford County and disposed of in MSW landfills was waste considered to be "publicly-controlled" waste (i.e., waste which is under the control of a public entity through the provision of collection services).

- It is estimated that 68% of the privately-controlled waste stream (283,295 tons per year) was disposed of in publicly-owned and operated MSW landfills in Guilford County during FY 1994-1995. This portion of the waste stream can potentially be controlled through collection franchise arrangements and is referred to as "franchise-controlled" waste.

- "Land-Clearing and Inert Debris", as the name implies, refers to solid waste generated by the clearing of land. The term "construction and demolition waste" is also self-explanatory, referring to solid wastes produced as a result of construction or demolition activities. The disposal requirements for these waste streams are less stringent than those for municipal solid wastes as long as any hazardous components are handled separately.

- LCID and C&D wastes are much more variable waste streams in terms of quantity than MSW, and disposal records for these waste streams are non-existent. LCID waste is estimated to be generated at a rate equivalent to 35% of the MSW generation rate, or 2.57 pounds per person per day, but is largely seasonal and dependent on weather conditions. C&D waste is estimated to be generated at a rate of 25% of the MSW rate, or 1.84 pounds per person per day, but is largely related to economic conditions, employment, and level of construction activity.

- In 1998, it is projected that about 500,000 tons of municipal solid waste will be generated in Guilford County, along with 175,000 tons of LCID wastes and 125,000 tons of C&D wastes.

- These waste streams are projected to grow due to projected population increases in the County. By the year 2017, it is projected that about 575,000 tons of MSW will be generated within the County, along with 200,000 tons of LCID wastes and 145,000 tons of C&D wastes.

Existing Disposal Services

- Currently, the majority of MSW generated within the County is disposed of at one of two publicly-owned landfills within the County. These landfills are the White Street Sanitary Landfill in Greensboro, which disposes of 245,000 tons per year, or 59% of the County's MSW stream, and the Kersey Valley Landfill in High Point, which disposes of 99,000 tons per year, or 24% of the County's MSW stream.

- The Piedmont Landfill, a private landfill in Kernersville, operated by Waste Management, Inc., disposes of approximately 71,000 tons of Guilford County MSW, or 17% of the MSW stream. A negligible additional amount of County MSW is disposed of outside of the County.

- The disposal of LCID waste is handled by private companies and individuals. There are currently 12 privately-owned permitted LCID landfill facilities in Guilford County.

- There are currently no landfills solely permitted for C&D in Guilford County. However, a small portion of the C&D wastes generated in the County is accepted at the White Street Sanitary Landfill. The remainder of the C&D waste is either taken to LCID facilities, disposed of outside of the County, or otherwise dumped illegally.

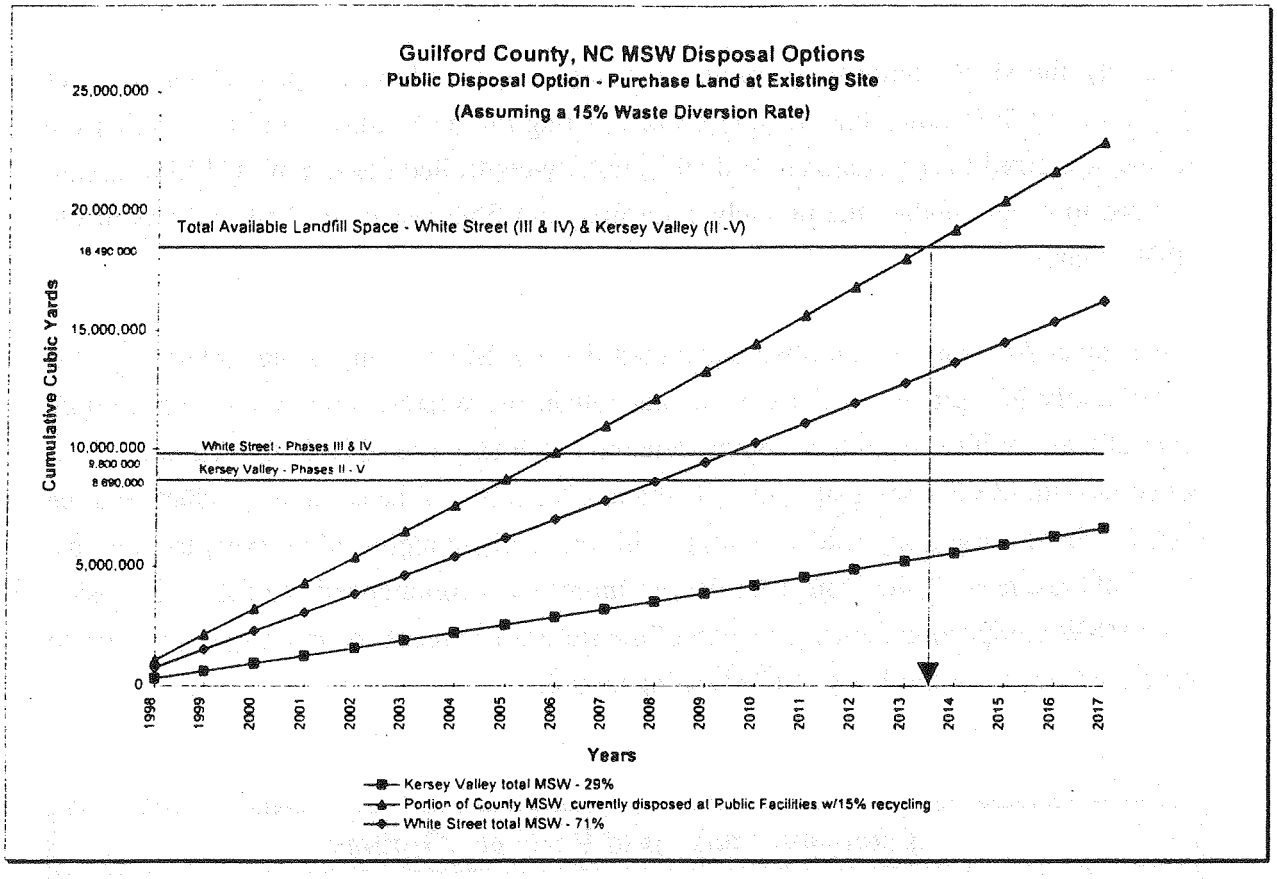
Future Landfill Disposal Needs

- Future landfill disposal needs for Guilford County will depend on the level of waste recycling and diversion achieved in the County. Currently, it is estimated that a waste recycling/diversion rate of at least 15% is being achieved in Guilford County for MSW.

- At the current 15% recycling/diversion rate, then it is estimated that 22.8 million cubic yards of municipal solid waste disposal capacity will be needed over the 20-year planning period (1998-2017).

Guilford County Future Disposal Requirements - 1998-2017		
Waste Stream	Future Disposal Needs	
	Tons of Waste	Cubic Yards of Landfill Space
Municipal Solid Wastes	9,100,000	22,800,000
Land-Clearing and Inert Debris	3,800,000	7,900,000
Construction and Demolition Wastes	2,700,000	6,000,000
TOTAL	**15,600,000**	**36,700,000**
Note: Assumes 15% recycling rate for MSW.		

- It is not known how much LCID or C&D wastes are being recycled or otherwise diverted from landfill disposal. However, assuming current recycling/diversion rates, it is estimated that approximately 7.9 million cubic yards of LCID disposal capacity will be needed over the period 1997-2016, while 6.0 million cubic yards of C&D disposal capacity will be needed.



- Because of the uncertainties surrounding the scheduled expansion of the local private landfill, the lack of long-term disposal guarantees for County waste at this landfill, and the expense of transporting to other private landfills in the region, the privatization option was determined to be risky as well as more costly (by $11 per ton) than the "Expansion of Existing Public Landfills" option.

- The waste-to-energy options evaluated were estimated to be on average $11 - $24 more costly than the "Expansion of Existing Public Landfills" option, regardless if the facility were sized to manage only the publicly-controlled portion of the MSW stream, or to manage both the publicly-controlled and franchise-controlled portions of the MSW stream.

  Although the waste-to-energy alternative was found to be proven from a technical standpoint, the Project Advisory Committee concluded that it should not be recommended for implementation at the present time, due to the higher costs, required capital investments, changing regulations, and negative public perception associated with this option. The Committee concluded that the waste-to-energy alternative should continue to be watched for future developments which may make this option more attractive in the future.

- Similarly, the MSW composting option on average was found to be approximately $11 per ton more expensive than the "Expansion of Existing Public Landfills" option whether the facility was sized to accommodate only the publicly-controlled portion of the MSW stream or sized to accommodate the publicly-controlled and franchise-controlled portions of the MSW stream.

- The Project Advisory Committee concluded that the MSW composting technology was significantly less proven in the United States than the waste-to-energy recovery option, especially for facilities sized to accommodate more that 600 tons of daily throughput. Other concerns with MSW composting include the marketability of the compost product, and the potential for increasing regulations to impact this relatively unregulated recovery technology. For all of these reasons, the Project Advisory Committee recommended against the inclusion of an MSW composting facility as a part of the solid waste recovery and disposal system to serve the County for the 1998-2017 planning period.

Economic Analysis of Recovery Options

Option	Average Cost/Ton (1995 Dollars)
Waste-to-Energy	
600 TPD Mass Burn Facility	$52
600 TPD RDF Facility	$39
900 TPD Mass Burn Facility	$51
900 TPD RDF Facility	$39
MSW Composting	
600 TPD Facility	$39
900 TPD Facility	$40

Notes: Costs represent average of waste transport and tip fees estimated for the recovery/disposal/ of MSW generated in Guilford County. Included in the composting and waste-to-energy options are design, financing, construction and operation costs.

- In total, HDR estimates that 36.7 million cubic yards of landfill space will be needed to dispose of the 15.6 million tons of County MSW, LCID, and C&D waste streams over the 20-year planning period. HDR estimates that a site of approximately 600 acres in size would be needed to dispose of these wastes.

Evaluation of Future Recovery and Disposal Alternatives

- Currently, municipal or County governments do not have responsibility for the recycling or disposal of LCID or C&D wastes. Therefore, it was assumed that the disposal of these waste streams will continue to be handled by private companies or individuals. The evaluation of future disposal alternatives focused on future MSW disposal requirements of 22.8 million cubic yards of disposal capacity.

- The following recovery and disposal options were evaluated to meet the future MSW disposal needs in Guilford County:

Options Evaluated	
Recovery	• Waste-to-Energy - Publicly-Controlled MSW - Publicly-Controlled and Franchise-Controllable MSW • MSW Composting - Publicly-Controlled MSW - Publicly-Controlled and Franchise-Controllable MSW
Disposal	• Expansion of Existing Public Landfills • Development of a New Public Landfill • Privatization of Disposal Services

- To fully utilize the existing and available disposal capacity at both the White Street Sanitary Landfill and the Kersey Valley Landfill, an additional 210 acres of Subtitle D landfill area will need to be developed. The capital costs associated with this type of landfill cell development (excluding equipment costs and costs associated with closure and post-closure activities) are typically estimated to be $150,000 - $200,000 per acre, depending on local conditions. Therefore, an overall capital expenditure of $31,500,000 to $42,000,000 (1995 dollars) will be needed to fully develop the existing and available disposal capacity at these landfills.

- Of the disposal options evaluated, the "Expansion of Existing Public Landfills" option was determined to be the most economical. The implementation of this option would cost an average of $28 per ton, in 1995 dollars, for transport and disposal of municipal solid waste over the 20 year planning period. Importantly, this option assumes the expansion and continued operation of both public landfills serving the County -- namely, the White Street Sanitary Landfill and the Kersey Valley Landfill. This option also assumes the utilization of some additional local public or private landfill capacity.

Economic Analysis of Disposal Options	
Option	Cost/Ton (1995 Dollars)
Public Disposal Option Expansion of Existing Public Landfills	$28
Multi-Jurisdictional Disposal Option Immediate Development of a New Public Landfill	$29
Private Disposal Option Privatization of Disposal Services	$35
Note: Costs included are pre-development, site development, equipment, cell construction, landfill operation, and post-closure costs. Costs represent average of waste transport and tip fees, reported in 1995 dollars, estimated to be incurred for the disposal of MSW generated in Guilford County over the 20 year planning period. Waste management includes use of both public and private waste management facilities.	

- It is estimated that the White Street Sanitary Landfill will have disposal capacity available for municipal solid waste from the City of Greensboro through the year 2008 if all available disposal capacity is developed. After that time, under the public disposal option, all County-generated municipal solid waste, including waste from the City of Greensboro, would be disposed of in the Kersey Valley Landfill facility. If all available disposal capacity at the Kersey Valley Landfill is fully developed, it is estimated that there will be adequate capacity to meet municipal solid waste disposal needs for all County-generated municipal solid waste until the year 2014.

RECOMMENDATIONS

Municipal Solid Waste Disposal

- Based on this study, the Project Advisory Committee recommends the expansion and full development of the White Street and Kersey Valley landfills. It is estimated that such development will provide the County with a total of 18,490,000 cubic yards of lined landfill capacity. The full development of the White Street Sanitary Landfill is estimated to provide the City of Greensboro with disposal capacity through the year 2008, after which time all County-generated municipal solid waste, including Greensboro's waste, would be disposed of at the Kersey Valley Landfill. It is projected that the combined usage of the fully developed White Street and Kersey Valley landfill facilities will meet the County's disposal needs until the year 2014.

- The Project Advisory Committee also recommends that the Guilford County government immediately begin the process of siting and developing a new multi-jurisdictional landfill facility to accommodate Guilford County-generated MSW estimated to require disposal starting in the year 2014.

- The Project Advisory Committee advises against the implementation of MSW recovery options (such as waste-to-energy or MSW composting) at the present time, regardless of whether or not franchising agreements are arranged with private waste haulers. Concerns pertaining to these technologies include high capital and operating costs, changing regulations, and negative public perception. Future developments in these recovery options should continue to be tracked over the planning period which may make their implementation more desirable.

LCID and C&D Wastes

- The management of LCID and C&D waste streams should continue to be handled through private commercial and residential disposal operations, as is presently being done. The County should implement programs which provide incentives for the increased recycling of materials from these waste streams.

Section 1.0
Solid Waste Quantities and Characteristics

1.1 INTRODUCTION

The purpose of this section is to present the quantities and characteristics of three solid waste streams currently being generated within Guilford County, North Carolina. These waste streams include municipal solid waste, land clearing and inert debris, and construction and demolition waste as defined by the State of North Carolina. This section will also provide a future profile of these waste streams as they are anticipated to be generated within Guilford County through the year 2017.

1.2 WASTE STREAM CHARACTERISTICS IN GUILFORD COUNTY

1.2.1 Municipal Solid Waste

Municipal solid waste, or MSW, is non-hazardous solid waste generated by the residential, commercial, industrial, and institutional sectors of a community. In North Carolina, MSW includes wastes from the following sources:

- Household, or residential waste
- Commercial solid waste
- Non-hazardous sludge
- Industrial non-hazardous waste
- Conditionally exempt small quantity generator waste.

Wastes which are prohibited from disposal in MSW landfill facilities in North Carolina include hazardous waste, lead acid batteries, liquid waste (including used oil), regulated medical waste, white goods, waste tires, yard trash, and any other wastes that may pose a threat to the environment or the public health, as determined by the Division of Solid Waste Management. These banned materials are managed through recycling (including composting) and reclamation efforts, and other disposal means (such as incineration of medical waste).

Table 1-1 and Figures 1-1 and 1-2 present an overview of the management of municipal solid waste generated within Guilford County during the fiscal year July 1, 1994 -- June 30, 1995 (FY 1994-1995). According to data provided by Guilford County, waste classified as MSW was generated by three sectors. These

Table 1-1

Municipal Solid Waste Generated in Guilford County, July 1, 1994 - June 30, 1995

Material Disposed of in an MSW Landfill Facility

Facility Name	Location	Tonnage	% of Total Co. Waste
White Street Sanitary Landfill	City of Greensboro, Guilford County, NC -- MSW	244,490	50%
Kersey Valley Landfill	City of High Point, Guilford County, NC -- MSW	98,795	20%
Piedmont Landfill *(Waste Management, Inc.)*	City of Kernersville, Forsyth County, NC -- MSW	70,772	14%
Charlotte Motor Speedway Landfill *(BFI)*	Town of Harrisburg, Cabarrus County -- Ash	2,607	1%
Uwharrie Landfill *(Addington Environmental)*	Town of Mount Gilead, Montgomery County -- Asbestos	20	<1%
Holt Corporation	City of Winston-Salem, Forsyth County -- Industrial/Special	121	<1%
	Total MSW Landfilled Materials:	**416,805**	**85%**

Materials Diverted from Landfill Disposal

Service Provider	Materials Diverted	Tonnage	% of Total Co. Waste
Guilford County	Waste Tires	5,503	1%
Guilford County	White Goods	728	<1%
Guilford County	Household Hazardous Wastes	91	<1%
City of Gibsonville *(BFI)*	Glass, Metal, Paper, Plastic	275	<1%
City of Greensboro (*City & Waste Industries*)	Glass, Metal, Paper, Plastic, Other Materials	22,001	5%
City of Greensboro	Mixed Yard Wastes	15,376	3%
City of High Point	Glass, Metal, Paper, Plastic, Wood, Other Materials	15,104	3%
City of High Point	Yard Waste	7,547	2%
Town of Jamestown (*Waste Industries & BFI)*	Glass, Metal, Paper, Plastic	325	<1%
Modern Garbage Service	Glass, Metal, Paper, Plastic	2,618	<1%
	Total Diverted Materials:	**69,568**	**15%**
	TOTAL COUNTY MUNICIPAL SOLID WASTE:	**486,374 Tons**	**100%**

Source: Guilford County Solid Waste Management Annual Report, for the period July 1, 1994 - June 30, 1995, and White Street Sanitary Landfill Scalehouse records.
Total County MSW does not include C&D waste received at the White Street Sanitary Landfill during FY 1994-1995 (33,453 tons), or C&D waste processed at the City of High Point's Materials Recovery Facility (4,230 tons). Percentages rounded up to the nearest positive integer.

Figure 1-1

Municipal Solid Waste Management in Guilford County (FY 94-95)
Total Tonnage = 486,374 tons

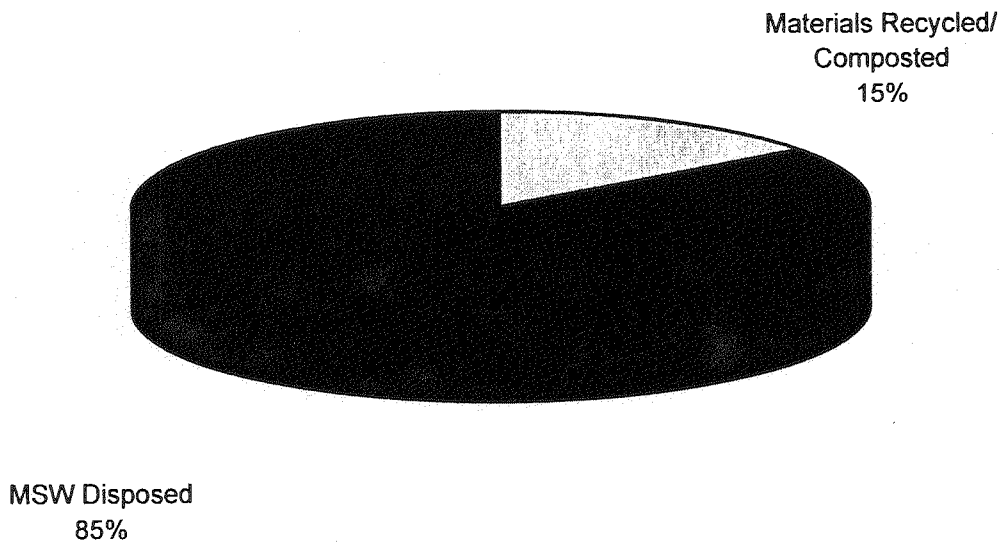
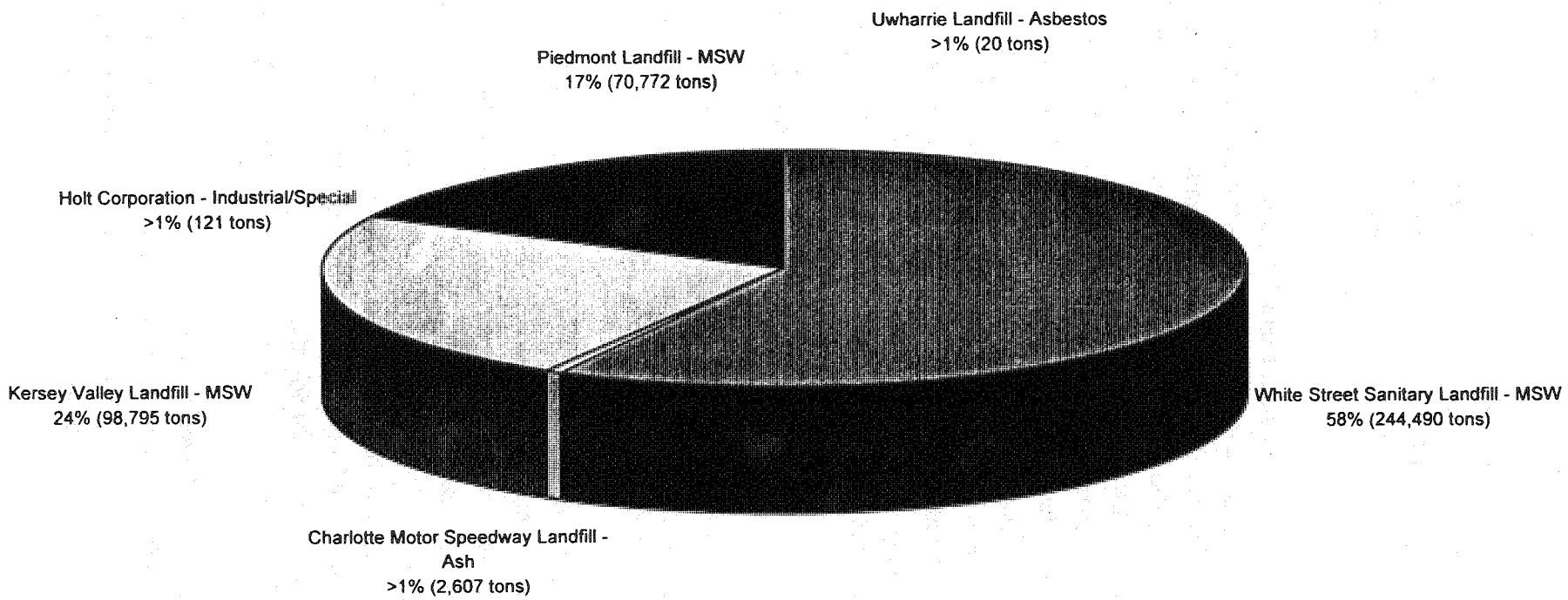


Figure 1-2

Material Disposed of in a MSW facility (FY 94-95)
Total Tonnage = 416,805 tons



waste stream generated in Guilford County, HDR contacted the North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR) regional office in Winston-Salem that oversees solid waste facilities in Guilford County. The NC DEHNR regional office confirmed data characterizing the LCID waste streams from both a quantitative and qualitative perspective is not currently available.

The NC DEHNR regional office estimates that the tonnage of LCID waste generated in the County during FY 1994-1995 would be equivalent to 50% of the municipal solid waste generated in Guilford County during the same period. Based on this estimate, up to 243,000 tons of LCID waste could have been generated in Guilford County in FY 1994-1995.

At present there are 12 permitted LCID facilities in Guilford County which are listed by NC DEHNR as being active. These are all privately operated, unlined landfill facilities which are not required to maintain detailed records of the LCID materials accepted for disposal. In addition to these permitted facilities, there are other LCID operations which, due to their size or fill activity, are not subject to LCID permitting requirements. Section 2 of this report provides additional information regarding LCID disposal facilities in Guilford County.

1.2.3 Construction & Demolition

Construction and demolition (C&D) waste is defined by the State of North Carolina as "any waste resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures, but does not include inert debris, land-clearing debris, or yard debris."

Management of C&D waste via landfill disposal is considered by the State to be the least desirable method of dealing with this portion of the waste stream. The potential exists for recycling and reusing a portion of the C&D waste which is produced in the construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures. Scrap lumber and other salvageable building materials can sometimes be reused in other building projects. Materials such as aluminum, steel, and copper are often recyclable.

In accordance with §130A-309B(1), construction and demolition waste which is not suitable for reuse or recycling can be separated from the municipal solid waste stream and disposed of in a landfill permitted as a C&D facility, or a LCID

facility if the C&D debris qualifies as LCID waste. If neither of these options are available, then the C&D waste can be managed at an MSW landfill facility.

According to the NC DEHNR, Winston-Salem Regional Office, there are no facilities currently permitted solely as C&D landfills in Guilford County. However, NC DEHNR officials report that C&D waste is accepted at both the City of Greensboro's White Street Sanitary Landfill and a privately owned facility known as the Wiley Davis Road Landfill, which is located near the Town of Jamestown in Guilford County.

At the White Street Sanitary Landfill, C&D waste is handled separately from MSW. During the period July 1, 1994 - June 30, 1995, scalehouse records indicate that approximately 33,450 tons of C&D waste was accepted at the White Street Sanitary Landfill.

There are no scale facilities at the Wiley Davis Road Landfill; therefore, it is difficult to estimate the amount of C&D waste which is accepted at this facility. It is known, however, that on a monthly basis approximately 350 tons (4,230 tons per year) of demolition and roofing material is processed at the City of High Point's Material Recovery Facility (MRF), and that these materials are directed to the Wiley Davis Road Landfill for disposal. The Wiley Davis Road Landfill is operating under an old permit which allows for the disposal of C&D waste; however, it appears that this facility may have less than a year of remaining operational capacity.

The combined total tonnage of C&D waste processed at both the City of High Point's MRF and the City of Greensboro's landfill (37,680 TPY) is considered by public works officials of both Cities, as well as representatives of NC DEHNR, to be a low estimate of the actual C&D waste which is generated in Guilford County. It is known that a portion of the C&D waste generated in Guilford County is disposed of in LCID facilities (LCID facilities can accept asphalt, bricks, and concrete), and that another portion of the C&D waste generated in Guilford County is illegally dumped.

Based on published data and accepted "rules of thumb", C&D waste is typically believed to comprise up to 10% of the MSW stream. The actual amount of C&D waste in a community will vary from year to year based on local construction activity.

In researching the characteristics of the C&D waste stream generated in Guilford County, the NC DEHNR regional office in Winston-Salem that oversees solid waste facilities in Guilford County was contacted regarding the quantities of the C&D waste stream currently generated in Guilford County. As was the case with LCID waste, the NC DEHNR regional office indicated that sufficient data does not exist to quantify the C&D waste stream generated in Guilford County.

When asked about C&D generation, the NC DEHNR office estimated that the total tonnage of C&D waste generated in the County during FY 1994-1995 was roughly equivalent to 30% of the municipal solid waste generated in Guilford County during FY 1994-1995 (486,370 tons). Using this estimate, up to 146,000 tons of C&D waste could have been generated in Guilford County during FY 1994-1995.

1.3 PER CAPITA WASTE GENERATION RATE FOR GUILFORD COUNTY

The methodology used in this study for developing a per capita solid waste generation rate for Guilford County is the same which has been used by the State of North Carolina for planning projection purposes. The North Carolina Recycling and Solid Waste Management Plan concluded that:

> "Based on the amount recycled and disposed according to surveys (and rules of thumb for special waste), it is estimated that in 1990, approximately 9,507,775 tons of solid waste were generated in North Carolina. With a total population of 6,628,637, an average of 7.9 pounds per day of municipal solid waste was generated per capita in 1990. This includes residential, commercial, and industrial waste."

Population estimates for the County for the years 1990, 2000, 2010, and 2020, which were obtained from the Guilford County Planning and Development Department, were used to arrive at a per capita municipal solid waste generation rate for Guilford County. The population estimate for 1995 (362,710) was based on the straight line interpolation of data provided for 1990 and 2000; likewise, the population projections for the entire 20-year planning period included under this study (1998-2017) were derived based on straight line interpolation of the population estimates provided by the Guilford County Planning and Development Department.

Solid waste generation data was obtained from Guilford County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, and from White Street Sanitary Landfill scalehouse records (see Appendix A). From this information it was determined that approximately 486,370 tons of municipal solid waste was generated in Guilford County during FY 1994-1995. This total MSW tonnage estimate includes materials reported as either landfilled or diverted from landfilling (via recycling, composting, and/or other reclamation efforts), and reflects waste generated by the residential, commercial, and industrial sectors. This total MSW tonnage estimate does not include the C&D waste accepted at the White Street Sanitary Landfill during FY 1994-1995, or the C&D waste processed at the City of High Point's MRF.

Using the 1995 calendar year population estimate, and the MSW tonnage reported to the state as having been generated within Guilford County during FY 1994-1995, a "base year" per capita municipal solid waste generation rate of 7.35 lbs/person/day for Guilford County was calculated (see Table 1-2.)

Table 1-2
Calculation of Base Year
Per Capita MSW Generation Rate for Guilford County

Total MSW Generated (FY 1994-1995)	x	pounds/ton	÷	days/year	÷	Population (1995)	=	Base Year Per Capita MSW Generation Rate
[(486,370 TPY	x	2000 lbs./ton)	÷	365 days/yr)]	÷	362,710	=	7.35 lbs/person/day

The 1995 "base year" per capita municipal solid waste generation rate of 7.35 pounds per person per day which was calculated for Guilford County is slightly lower than the 7.9 pounds per person per day reported as the State average in 1990. In any case, the per capita generation rate used for projecting the generation of municipal solid waste within Guilford County over the planning period appears justifiable when compared with State estimates.

Section 2.0
Existing Disposal Services

2.1 INTRODUCTION

The purpose of this section is to present and analyze the existing disposal services and infrastructures which are currently used to manage three solid waste streams currently being generated in Guilford County. These waste streams include municipal solid waste, land clearing and inert debris, and construction and demolition waste.

2.2 MUNICIPAL SOLID WASTE DISPOSAL

At present, municipal solid waste (MSW) which is generated in Guilford County is managed either via landfill disposal or is diverted from landfill disposal via recycling, composting, or other reclamation efforts. A description of the infrastructure and services associated with both landfilling and diversion programs utilized for managing MSW generated in Guilford County is provided below and summarized in Table 2-1. Additional information is provided in Appendix B.

2.2.1 In-County Public MSW Disposal Sites

2.2.1.1 White Street Sanitary Landfill

Municipal Solid Waste -- The City of Greensboro, North Carolina, owns and operates the White Street Sanitary Landfill which is located in the northeast quadrant of the City. The landfill is used for the disposal of MSW and C&D waste generated within the City of Greensboro and Guilford County. The unlined landfill, which is currently operating under Solid Waste Permit No. 41-03, is permitted to receive solid waste as defined in 15A NCAC 13 B .0101 (36). This permit will expire on March 4, 1997.

At present, the landfill property covers an area of approximately 767 acres. As constructed, the White Street Sanitary Landfill is divided into two phases. Phase I is an 85-acre site that stopped receiving waste prior to 1978. Phase II consists of approximately 120 acres, of which 30 acres stopped receiving waste prior to 1991 and is closed. The current active area of Phase II encompasses approximately 90 acres.

Guilford County — Projections of Publicly Controlled Municipal Solid Waste

Year	Population[2]	Total MSW Generated[3] TPY	Materials Expected to be Diverted from LF Disposal (TPY)		Publicly-Controlled MSW Projected to be Landfilled 46% of (Total MSW Generated - Diverted Materials) 15% Diversion Rate			Publicly-Controlled MSW Projected to be Landfilled 46% of (Total MSW Generated - Diverted Materials) 40%[4] Diversion Rate		
			15% Diversion Rate	40% Diversion Rate[4]	TPY	Annual CY[5]	Cumulative CY[5]	TPY	Annual CY[5]	Cumulative CY[5]
1998	371,884	498,670	74,800	137,130	194,980	487,450	487,450	166,308	415,770	415,770
1999	374,942	502,770	75,420	159,210	196,581	491,450	978,900	158,038	395,090	810,860
2000	378,000	506,870	76,030	181,630	198,186	495,470	1,474,370	149,610	374,030	1,184,890
2001	381,050	510,960	76,640	204,380	199,787	499,470	1,973,840	141,027	352,570	1,537,460
2002	384,100	515,050	77,260	206,020	201,383	503,460	2,477,300	142,154	355,380	1,892,840
2003	387,150	519,140	77,870	207,660	202,984	507,460	2,984,760	143,281	358,200	2,251,040
2004	390,200	523,230	78,480	209,290	204,585	511,460	3,496,220	144,412	361,030	2,612,070
2005	393,250	527,320	79,100	210,930	206,181	515,450	4,011,670	145,539	363,850	2,975,920
2006	396,300	531,410	79,710	212,560	207,782	519,460	4,531,130	146,671	366,680	3,342,600
2007	399,350	535,500	80,330	214,200	209,378	523,450	5,054,580	147,798	369,500	3,712,100
2008	402,400	539,590	80,940	215,840	210,979	527,450	5,582,030	148,925	372,310	4,084,410
2009	405,450	543,680	81,550	217,470	212,580	531,450	6,113,480	150,057	375,140	4,459,550
2010	408,500	547,770	82,170	219,110	214,176	535,440	6,648,920	151,184	377,960	4,837,510
2011	411,450	551,730	82,760	220,690	215,726	539,320	7,188,240	152,278	380,700	5,218,210
2012	414,400	555,680	83,350	222,270	217,272	543,180	7,731,420	153,369	383,420	5,601,630
2013	417,350	559,640	83,950	223,860	218,817	547,040	8,278,460	154,459	386,150	5,987,780
2014	420,300	563,590	84,540	225,440	202,363	550,910	8,829,370	155,549	388,870	6,376,650
2015	423,250	567,550	85,130	227,020	221,913	554,780	9,384,150	156,644	391,610	6,768,260
2016	426,200	571,510	85,730	228,600	223,459	558,650	9,942,800	157,739	394,350	7,162,610
2017	429,150	575,460	86,320	230,180	225,004	562,510	10,505,310	158,829	397,070	7,559,680
	Totals:	**10,747,120 tons**	**1,612,080 tons**	**4,173,490 tons**	**4,202,118 tons**	**10,505,310 CY**		**3,023,870 tons**	**7,559,680 CY**	

Notes:

1. Publicly-controlled waste landfilled at White Street Sanitary Landfill during FY 1994-1995 = 152,813 tons and publicly-controlled waste landfilled at Kersey Valley Landfill during FY 1994-1995 = 40,497; for a total of 193,310 tons of MSW. This publicly-controlled tonnage represents 46% of the MSW generated by Guilford County that was managed via landfill disposal during FY 1994-1995 (416,805 tons). Data reported by Mr. Dale James (City of Greensboro) and Mr. Perry Kairis (City of High Point).
2. Population estimates based on data provided by the Guilford County Planning and Development Department and straight line interpolation of data.
3. Total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of 7.35%, and annual population estimates for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during fiscal year 1994-1995. Tonnages rounded to the nearest tenth.
4. Landfill diversion rate in 1998 based on FY 1994-1995 diversion rate of 15%. This rate was then increased yearly as follows to achieve a 40% diversion rate by the year 2001 and beyond: 1996, 19%; 1997, 23%; 1998, 28%; 1999, 32%; 2000, 36%; 2001, 40%. Landfill diversion rate of 15% based on County data for the FY 1994-1995 period which indicates that approximately 15% of County generated waste is diverted from landfilling.
5. Cubic yard estimates based on a 4:1 waste-to-cover ratio (excluding final cover) and the conversion factor of 1,000 pounds per cubic yard.

The current fill rate at the White Street Sanitary Landfill is estimated to be 20,800 tons per month (TPM), or 800 tons per day (TPD). The remaining capacity of Phase II, as of November 1994, was estimated to be 7,370,000 cubic yards, which would provide 11.8 years of disposal life at current filling rates. This capacity is not anticipated to be used in its entirety due to the fact that unlined disposal is not permitted after January 1, 1998.

The City of Greensboro is planning to construct a new Subtitle D facility (Phase III) that is anticipated to provide a total of 52 acres of lined fill area. This area can provide disposal capacity for 4,700,000 cubic yards of waste, which, at a projected filling rate of 22,300 TPM (850 TPD), should allow for a total of 7 years of disposal capacity.

Through acquisition of adjacent property, there is potential for developing additional lined landfill capacity at the site. Preliminary estimates indicate that this additional area, designated as Phase IV, could provide 5,100,000 cubic yards of airspace, which would allow for an additional 7 years of disposal capacity.

C&D Wastes -- The terms of Solid Waste Permit No. 41-03 specify that C&D waste generated in Guilford County may be accepted at the White Street Landfill. A select portion of this waste stream is handled separately from the MSW at the facility, in accordance with current regulations.

LCID Wastes -- Currently, only yard waste is accepted at the White Street Sanitary Landfill for composting. No other LCID waste is accepted at the landfill facility.

2.2.1.2 Kersey Valley Landfill

Municipal Solid Waste -- The City of High Point, North Carolina, owns and operates the Kersey Valley Landfill located in the eastern quadrant of the City. The landfill is used for the disposal of municipal solid waste (MSW) generated within the City of High Point and adjacent communities in Davidson, Forsyth, Randolph (including Archdale), and Guilford Counties (including Jamestown). The Kersey Valley Landfill, which became operational in October 1993, is situated on a 120-acre tract of land owned by the City of High Point.

The landfill is currently operating under Solid Waste Permit No. 41-04. At present, the fill rate at the Kersey Valley Landfill is estimated to be 8,770 TPM (350 TPD). It is anticipated that Phase I will reach capacity by April 1, 1997.

The City of High Point is considering developing future phases of the Kersey Valley Landfill. Adjoining undeveloped tracts lie within the permitted area to the south and west of the current landfill footprint, which are under consideration for development as Kersey "Phase II." Phase II would provide an additional 9.2 acres of fill area which, at current fill rates, represents an additional fill life of 2.2 years. There is also adjacent property that might be suitable for landfill development. Were the City to acquire and permit this area, there is potentially enough capacity to accommodate the City of High Point's lined landfill capacity needs until the year 2037.

C&D Wastes -- Currently, C&D wastes are not accepted at the Kersey Valley Landfill. C&D is taken to the privately-owned Wiley Davis Road Landfill, located on Groomtown Road near Jamestown, about 6 miles away from the Kersey Valley Landfill. There does not appear to be any expansion potential for this facility, and it is questionable at present how much longer this facility will be available for disposal of High Point's or other Guilford County C&D waste.

LCID Wastes -- Currently, LCID wastes are not being accepted at the Kersey Valley Landfill. The City of High Point does own and operate a yard waste facility which only handles that part of the LCID waste stream.

2.2.2 Out-of-County Public MSW Disposal Sites

2.2.2.1 Hanes Mill Road Sanitary Landfill

Municipal Solid Waste -- The City of Winston-Salem owns and operates the Hanes Mill Road Sanitary Landfill located in the north-central quadrant of Forsyth County. The service area of this landfill includes Forsyth, Davie, Stokes, Surry, and Yadkin Counties. Currently, waste is only received from Forsyth, Davie, and Stokes Counties. The Hanes Mill Road Sanitary Landfill is currently operating under Solid Waste Permit No. 34-02. This permit will expire on October 9, 1996.

At present, the City is filling in an unlined area encompassing approximately 140 acres at a rate which is estimated to be 24,000 TPM (920 TPD). The City of Winston-Salem is in the process of developing a new Subtitle D facility adjacent to the existing Hanes Mill Road Sanitary Landfill facility. Once completed, the Subtitle D expansion area will provide the City with a total of 37 acres of lined fill area. This area is estimated to be capable of holding 3,350,000 cubic yards of waste, which, at the current filling rate, should provide a total of 5 years of disposal capacity.

In an effort to conserve lined landfill space, it is unlikely that the service area of the Hanes Mill Road Sanitary Landfill would be expanded to include waste generated by other municipalities. Current tip fees for use of the unlined facility are set at $23.00/ton; tip fees for use of the new Subtitle D facility have not yet been determined.

The City owns 350 acres adjacent to the Hanes Mill Road Sanitary Landfill, and development of this site is anticipated to serve the City for 30 to 40 years beyond the life of the Subtitle D "piggy-back" cell described above.

C&D Wastes -- Currently, C&D wastes are not accepted at the Hanes Mill Road Landfill facility. The City of Winston-Salem has purchased property for a C&D Landfill facility. A permit for construction has been received, and the facility is expected to be opened in the spring of 1996. The estimated life of this new facility is expected to be 20-30 years, but at present this new facility is anticipated to only serve areas within Forsyth County.

LCID Wastes -- Currently LCID wastes are not accepted at the Winston-Salem Hanes Mill Road Sanitary Landfill facility. However, yard wastes are accepted for mulching at a separate site.

2.2.2.2 Davidson County Landfill

Municipal Solid Waste -- The Davidson County Landfill is a lined facility that began operation in October 1994. The service area of this landfill is limited to Davidson County. The Davidson County Landfill is currently operating under Solid Waste Permit No. 29-06. This permit will expire in October 1999.

At present, the County is filling an 8-acre lined area at a rate which is estimated to be 7,800 TPM (300 TPD), based on fiscal year 1994 - 1995 tonnage data.

Through October 1995, approximately 20% of the incoming waste was hauled by WMI vehicles, 10% was hauled by BFI vehicles, and the remaining 70% was hauled by municipalities. WMI ceased using the Davidson County Landfill facility for disposal of waste as of mid-November 1995. Should BFI open a new transfer station in the area and begin hauling waste to its own facility, there could be another reduction in the Davidson County Landfill's incoming waste stream.

The County has received approval of a site plan for the development of an additional 19 acres for lined landfill usage. Once completed, this Subtitle D expansion area will provide the County an estimated 12-15 years of waste disposal capacity.

C&D Wastes -- Currently C&D waste is accepted at the Davidson County Landfill facility and disposed of in the current lined fill area. The County is in the process of trying to site a separate C&D landfill facility.

LCID Wastes -- Currently LCID wastes are not accepted at the Davidson County Landfill. However, the County has an agreement with a private yard waste facility to manage this portion of the County-generated waste stream.

2.2.3 Private MSW Disposal Sites

2.2.3.1 BFI Charlotte Motor Speedway

The Charlotte Motor Speedway Landfill is owned and operated by BFI. During FY 1994-1995, this facility, which is located in the City of Concord in Cabarrus County, was the disposal site for 2,607 tons of incinerator ash that was derived from the combustion of medical waste produced in Guilford County.

2.2.3.2 Piedmont Landfill

The Piedmont Landfill and Recycling Center, which is owned and operated by Waste Management, Inc., is located in Kernersville, on the border of Forsyth and Guilford Counties. This is a private, lined landfill facility which was first permitted in 1989. The landfill entrance is located in Guilford County, and the filling areas of the facility are located in Forsyth County. During the period July 1, 1994 - June 30, 1995, approximately 70,770 tons of municipal solid waste generated within Guilford County was hauled to this facility by private haulers.

At present, 43 acres of this facility are lined; the first two cells were constructed with a composite liner system which includes a double geomembrane liner. The remainder of the facility will be lined with a Subtitle D composite liner, using sand and a geonet leachate collection system. It is estimated that there are 5½ years remaining capacity left in the permitted area of the Landfill, at current filling rates, and officials have indicated that potential exists for additional expansion.

2.2.3.3 Uwharrie Landfill

The Uwharrie Landfill is owned and operated by Addington Environmental. During FY 1994-1995, this facility, which is located near the Town of Mount Gilead in Montgomery County, was the disposal site for 20 tons of asbestos waste that was generated in Guilford County.

2.2.3.4 Holt Corporation

The Holt Corporation owns and operates a private landfill, which in FY 1994-1995, was the disposal site for 121 tons of industrial/special waste that was generated in Guilford County. This facility is located in the City of Winston-Salem in Forsyth County.

2.2.4 Waste Diversion

Not all municipal solid waste that is generated within Guilford County is landfilled. A portion of the municipal solid waste stream is diverted by means of recycling and composting activities. The City of Greensboro operates a comprehensive recycling and composting program for residential, commercial, and industrial sectors, as does the City of High Point. The smaller municipalities of Gibsonville and Jamestown sponsored their programs through private haulers, while Stokesdale was served by Guilford County. The Town of Whitsett currently has no recycling programs for its citizens. Table 2-2 presents an overview of programs in Guilford County that serve to divert municipal solid waste from MSW landfills.

Table 2-2
Overview of Programs in Guilford County Which Divert Materials from Landfill Disposal

Reported By	Description	Materials Managed
Guilford County	All private haulers of residential waste are required to offer biweekly curbside collection of recyclables (commingled). County co-sponsors program for collection of household hazardous waste with City of Greensboro.	Glass, Plastic, Metal, Paper, Wood, Household Hazardous Waste, White Goods, Waste Tires
Town of Gibsonville	The Town contracts with a private hauler to provide residential and commercial customers with biweekly curbside collection of recyclables (commingled)	Glass, Plastic, Metal, Paper, Wood, Yard Waste, White Goods, Used Oil/Antifreeze
City of Greensboro	The City operates a weekly curbside recycling collection program (commingled). The program is offered to residential, commercial, and industrial customers. In addition, the City sponsors drop-off recycling activities at 14 drop-off sites.	Glass, Plastic, Metal, Paper, Wood, Yard Waste, White Goods, Used Oil/Antifreeze, Household Hazardous Waste
City of High Point	The City operates a weekly mixed waste /recyclables "co-collection" system (recyclables are "blue bagged"). The recyclables and wastes are processed through a "mixed waste" Materials Recovery Facility. In addition, the City sponsors drop-off recycling activities at 11 drop-off sites and operates a yard waste composting facility.	Glass, Plastic, Metal, Paper, Wood, Yard Waste, White Goods, Household Hazardous Waste
Town of Jamestown	The Town provides residential and commercial customers with mixed waste collection services (recyclables are "blue bagged) two times a week. In addition, the Town sponsors drop-off recycling activities at 11 drop-off sites.	Glass, Plastic, Metal, Paper, Wood, Yard Waste, White Goods
Town of Stokesdale	Town residents are responsible for making their own arrangements for solid waste disposal. Those that contract with private haulers are offered curbside collection of recyclables (commingled).	Glass, Plastic, Metal, Paper, Wood
Town of Whitsett	The Town contracts with a private hauler to provide residents with weekly garbage collections service. This service does not include separate collection or management of recyclables.	N/A

Source: Solid Waste Management Annual Reports for the period July 1, 1994 - June 30, 1995 compiled by Guilford County and the Cities of Gibsonville, Greensboro, High Point and Towns of Jamestown, Stokesdale and Whitsett

2.3 LCID AND C&D WASTE MANAGEMENT

At present, land clearing and inert debris (LCID) and/or construction and demolition (C&D) waste which is generated in Guilford County is managed either via landfill disposal or is diverted from landfill disposal through recycling or other reclamation efforts. A description of the infrastructure and services associated with both landfilling and diversion programs utilized for managing both the LCID and C&D waste streams generated in Guilford County is provided below.

2.3.1 LCID Waste Disposal

Table 2-3 presents a list compiled by the NC DEHNR, Winston-Salem Regional Office, of the LCID facilities currently listed as being active in Guilford County. This list does not reflect all LCID operations, many of which, due to their size or fill activity, are not subject to LCID landfill permitting requirements, nor does it reflect the final destination of LCID waste generated in Guilford County. LCID waste is disposed of in what are considered official sites by NC DEHNR, but it is also apparent that some LCID waste is dumped illegally.

Table 2-3
Active LCID Facilities in Guilford County, NC

Facility Name	Location	Contact
Coble Demo Landfill	Ruralview Rd., Gibsonville	Briton Coble
David H. Griffin	Wiley Davis Rd., Greensboro	David H. Griffin
Ed Montgomery Demo Landfill	Wades Store Rd., Greensboro	Edward Montgomery
Groome Demo Landfill	Montview St., Greensboro	Fred Groome
Joyce Demo Landfill	Commercial Rd., Greensboro	H.F. Joyce
L. Baynes Demo Landfill	Montview St., Greensboro	Walter Baynes
R.K. Simmons Demo Landfill	Trosper Rd., Greensboro	R.K. Simmons
Strickland Groome Demo Landfill	Montview St., Greensboro	John Groome
Wiley David Landfill	Wiley Davis Rd., Greensboro	David H. Griffin, Sr.
Cosie Doggett Demo Landfill	Scalesville Rd., Summerfield	Truman Doggett
Hazel Sizemore Demo Landfill	Stanley Huff Rd., Summerfield	Hazel Sizemore
Fitzgerald Demo Landfill	Flemming Street, Stokesdale	Robert Yates

Source: N.C. Solid Waste Section, "List of Solid Waste Facility Contacts", dated 9/95

2.3.2 C&D Waste Disposal

According to the NC DEHNR, Winston-Salem Regional Office, there are no landfill facilities solely permitted for C&D currently listed as being active in Guilford County. A small portion of the C&D waste generated in Guilford County is accepted at the White Street Sanitary Landfill, where it is handled separately from the MSW. The remainder of the C&D waste generated in Guilford County is either taken to LCID facilities, taken out of the County to other facilities, or is otherwise dumped illegally.

2.3.3 LCID and C&D Waste Diversion

Within Guilford County not all LCID and C&D waste that is generated is landfilled. A small portion of these waste streams are diverted by means of recycling and composting activities. Since no public reporting process for private operations is in place, data on quantities recycled are not available.

Section 3.0
Future Disposal System Needs

3.1 INTRODUCTION

According to the North Carolina state regulations, it is the responsibility of the designated local government to provide for the operation of solid waste facilities to meet the needs of the area (see Appendix C). These needs include disposal systems for municipal solid wastes, construction and demolition wastes, and land clearing and inert debris. This section also reviews state regulations covering the management of these waste streams.

The purpose of this section is to present the future solid waste disposal system needs and requirements for Guilford County over the project planning period (1998-2017).

3.2 METHODOLOGIES AND PROJECTIONS

The three waste streams analyzed in this report are municipal solid wastes, land clearing and inert debris, and construction and demolition wastes. According to North Carolina regulations, these three waste streams will require different future disposal facilities.

3.2.1 Methodologies and Assumptions

To estimate future quantities of MSW that will be generated within Guilford County, HDR utilized population projections provided by the County Planning Department. These were multiplied by the per capita waste generation rate to obtain the total MSW generation projected for each year of the planning period.

According to the U.S. Environmental Protection Agency's 1994 report on municipal solid waste generation in the U.S., waste generation rates are beginning to decline as a result of backyard composting and other waste reduction efforts (see Characterization of Municipal Solid Waste in the United States: 1994 Update). Based on this finding, the per capita municipal waste generation rate of 7.35 pounds per person per day was assumed to be constant for the planning period. Future quantities of LCID and C&D wastes were estimated as percentages of the future quantities of MSW projected for each year of the planning period.

During the past five years there has been a surge in economic growth in Guilford County, and an associated increase in building projects which require the clearing of land debris. It is thought that building trends in Guilford County will begin to slow in the near future, and that composting, recycling, and reuse of land clearing and inert debris will increase. Therefore, it was assumed that LCID waste generation during the planning period (1998-2017) will be equivalent to 35% of the total yearly MSW generation estimates.

Similar to LCID generation trends, C&D waste generation in Guilford County during the past 5 years is expected to change in the future. It is expected that there will be a decline in the generation of C&D waste as fewer construction, renovation, and demolition projects are undertaken, and the recycling and reuse of materials generated in such projects increases. Therefore, for the purposes of this study, it was assumed that C&D waste generation during the planning period (1998-2017) will be equivalent to 25% of the total yearly MSW generation estimates.

Table 3-1 presents the quantities of MSW, LCID, and C&D waste which HDR estimates will be generated within Guilford County during the period 1998-2017. The total MSW projections presented in Table 3-1 have been calculated based on anticipated growth in Guilford County's population and the constant per capita solid waste generation rate of 7.35 pounds per person per day; the projected LCID waste quantities are equivalent to 35% of the total yearly MSW generation estimates; and the projected C&D waste quantities are equivalent to 25% of the total yearly MSW generation estimates.

Based on these assumptions, approximately 499,000 tons of MSW, 175,000 tons of LCID waste, and 125,000 tons of C&D waste are projected to be generated in Guilford County in the year 1998. These waste streams are projected to grow to approximately 575,000 tons of MSW, 201,000 tons of LCID waste, and 144,000 tons of C&D waste by the year 2017.

3.2.2 MSW Disposal Requirements

3.2.2.1 Entire MSW Stream

Table 3-2 presents future MSW landfilling estimates for Guilford County based on two waste diversion scenarios. The first scenario assumes that waste disposal and recycling rates reported for fiscal year 1994-1995 in Guilford County will continue throughout the planning period; namely, that approximately 85% of the

Table 3-1
Guilford County Waste Stream Projections

Year	Population	Municipal Solid Waste		Land Clearing & Inert Debris		Construction & Demolition Waste	
		TPY	TPD (6)	(TPY)	TPD (6)	(TPY)	TPD (6)
1998	371,884	498,670	1,600	174,535	559	124,668	400
1999	374,942	502,770	1,610	175,970	564	125,693	403
2000	378,000	506,870	1,620	177,405	569	126,718	406
2001	381,050	510,960	1,640	178,836	573	127,740	409
2002	384,100	515,050	1,650	180,268	578	128,763	413
2003	387,150	519,140	1,660	181,699	582	129,785	416
2004	390,200	523,230	1,680	183,131	587	130,808	419
2005	393,250	527,320	1,690	184,562	592	131,830	423
2006	396,300	531,410	1,700	185,994	596	132,853	426
2007	399,350	535,500	1,720	187,425	601	133,875	429
2008	402,400	539,590	1,730	188,857	605	134,898	432
2009	405,450	543,680	1,740	190,288	610	135,920	436
2010	408,500	547,770	1,760	191,720	614	136,943	439
2011	411,450	551,730	1,770	193,106	619	137,933	442
2012	414,400	555,680	1,780	194,488	623	138,920	445
2013	417,350	559,640	1,790	195,874	628	139,910	448
2014	420,300	563,590	1,810	197,257	632	140,898	452
2015	423,250	567,550	1,820	198,643	637	141,888	455
2016	426,200	571,510	1,830	200,029	641	142,878	458
2017	429,150	575,460	1,840	201,411	646	143,865	461

Notes:

1. Constant per capita MSW generation rate of 7.35% assumed in projecting the total MSW tonnage throughout the planning period. TPD (6) indicates a 6-day week.
2. 1998 total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of 7.35%, and 1995 population estimate for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during FY 1994-1995. Tonnages rounded to the nearest tenth.
3. The LCID waste is estimated to represent 35% of the projected total MSW waste stream.
4. The C&D waste is estimated to represent 25% of the projected total MSW waste stream.
5. These estimates for C&D and LCID wastes are somewhat lower than those that are estimated by the NC DEHNR regional representative.

Table 3-2

Guilford County Municipal Solid Waste Disposal Projections

Year	Population[1]	Total MSW Generated[2]	Materials Expected to be Diverted from LF Disposal (TPY)		MSW Landfill Disposal Projections 15% Diversion Rate			MSW Landfill Disposal Projections 40%[3] Diversion Rate		
		TPY	15% Diversion Rate	40% Diversion Rate[3]	TPY	Annual CY[4]	Cumulative CY[4]	TPY	Annual CY[4]	Cumulative CY[4]
1998	371,884	498,670	74,800	137,130	423,870	1,059,680	1,059,680	361,540	903,850	903,850
1999	374,942	502,770	75,420	159,210	427,350	1,068,380	2,128,060	343,560	858,900	1,762,750
2000	378,000	506,870	76,030	181,630	430,840	1,077,100	3,205,160	325,240	813,100	2,575,850
2001	381,050	510,960	76,640	204,380	434,320	1,085,800	4,290,960	306,580	766,450	3,342,300
2002	384,100	515,050	77,260	206,020	437,790	1,094,480	5,385,440	309,030	772,580	4,114,880
2003	387,150	519,140	77,870	207,660	441,270	1,103,180	6,488,620	311,480	778,700	4,893,580
2004	390,200	523,230	78,480	209,290	444,750	1,111,880	7,600,500	313,940	784,850	5,678,430
2005	393,250	527,320	79,100	210,930	448,220	1,120,550	8,721,050	316,390	790,980	6,469,410
2006	396,300	531,410	79,710	212,560	451,700	1,129,250	9,850,300	318,850	797,130	7,266,540
2007	399,350	535,500	80,330	214,200	455,170	1,137,930	10,988,230	321,300	803,250	8,069,790
2008	402,400	539,590	80,940	215,840	458,650	1,146,630	12,134,860	323,750	809,380	8,879,170
2009	405,450	543,680	81,550	217,470	462,130	1,155,330	13,290,190	326,210	815,530	9,694,700
2010	408,500	547,770	82,170	219,110	465,600	1,164,000	14,454,190	328,660	821,650	10,516,350
2011	411,450	551,730	82,760	220,690	468,970	1,172,430	15,626,620	331,040	827,600	11,343,950
2012	414,400	555,680	83,350	222,270	472,330	1,180,830	16,807,450	333,410	833,530	12,177,480
2013	417,350	559,640	83,950	223,860	475,690	1,189,230	17,996,680	335,780	839,450	13,016,930
2014	420,300	563,590	84,540	225,440	479,050	1,197,630	19,194,310	338,150	845,380	13,862,310
2015	423,250	567,550	85,130	227,020	482,420	1,206,050	20,400,360	340,530	851,330	14,713,640
2016	426,200	571,510	85,730	228,600	485,780	1,214,450	21,614,810	342,910	857,280	15,570,920
2017	429,150	575,460	86,320	230,180	489,140	1,222,850	22,837,660	345,280	863,200	16,434,120
	Totals:	**10,747,120 tons**	**1,612,080 tons**	**4,173,490 tons**	**9,135,040 tons**	**22,837,660 CY**		**6,573,630 tons**	**16,434,120 CY**	

Notes:

1. Population estimates based on data provided by the Guilford County Planning and Development Department and straight line interpolation of data.
2. Total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of lbs/per day, and annual population estimates for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during fiscal year 1994-1995. Tonnages rounded to the nearest tenth.
3. Landfill diversion rate in 1998 based on FY 1994-1995 diversion rate of 15%. This rate was then increased yearly as follows to achieve a 40% diversion rate by the year 2001 and beyond: 1996, 19%; 1997, 23%; 1998, 28%; 1999, 32%; 2000, 36%; 2001, 40%. Landfill diversion rate of 15% based on County data for the FY 1994-1995 period which indicates that approximately 15% of County generated waste is diverted from landfilling.
4. Cubic yard estimates based on a 4:1 waste-to-cover ratio (excluding final cover) and the conversion factor of 1,000 pounds per cubic yard.

MSW generated within Guilford County will be managed by means of landfill disposal, and the remaining 15% of the MSW generated within Guilford County will be diverted from landfill disposal via recycling, composting, or other reclamation programs.

The second scenario assumes that waste diversion rates in Guilford County will be in keeping with the current State goal of a 40% reduction by weight of solid waste disposed at municipal solid waste disposal facilities by the year 2001 (through source reduction, reuse, recycling, and composting programs). For this scenario, the 15% landfill diversion rate reported by Guilford County during FY 1994-1995 has been used as the starting point for achieving the 40% reduction goal in 2001. In order to achieve this goal, it has been assumed that, starting with a 15% diversion rate in 1995, the Guilford County diversion rate will increase by approximately 4% annually until the 40% reduction goal is achieved in 2001. Beyond the year 2001, the 40% diversion rate will remain constant throughout the remainder of the planning period.

In both of these scenarios it has been assumed that the per capita waste generation rate of 7.35 pound per person per day will remain constant throughout the planning period. The resulting tonnage projections presented in Table 3-2 reflect the entire waste stream anticipated to be generated within Guilford County and which will require management during the period 1998-2017.

In order to convert tonnage projection into landfill airspace requirement, a review of landfill regulation is necessary. State regulations require that municipal solid waste be covered after each day of operation, with a compacted layer of at least 6 inches of suitable cover material (15A NCAC 13B .1626 (2)(b)). Regulations also require that 1 foot of intermediate cover be used in areas which will not have additional wastes placed on them for 12 months or more (15A NCAC 13B .1626 (2)(c)). In addition, State regulations require that, after final termination of disposal operations at the site, the area shall be covered with at least 18 inches of suitable compacted earth (15A NCAC 13B .1627 (c)(1)(B)) that will serve as a low-permeability barrier, and 6 inches of an erosion layer that is capable of sustaining plant growth (15A NCAC 13B .1627 (c)(1)(C)). (See Appendix C.)

3.2.2.2 Publicly-Controlled MSW

The term "flow control" refers to the ability of a local government to control the "flow" of municipal solid waste by directing haulers to take the wastes to designated facilities for processing or disposal. In recent years, the U.S. Supreme Court has ruled that local governments do not have the flow control over MSW generated within their boundaries, and that wastes collected by private haulers may be taken by the haulers to facilities of their own choice. A possible exception to this case, as is presented and discussed in Appendix J, is if the haulers collect the waste under a local government franchise arrangement.

The Supreme Court ruling has forced local government to differentiate between the entire MSW stream -- for which they have planning responsibilities -- and the "publicly-controlled MSW" stream. The publicly-controlled MSW stream refers to the portion of the MSW stream over which local governments have direct control. This control generally takes one of two forms. The first form is that the waste is collected directly by the local government. The second form is that the waste is collected by a private hauler under contract with the local government. MSW collected under either of these arrangements is referred to as "publicly-controlled MSW" in this report.

A third form which is being currently being tested by local governments, is when the private hauler collects the MSW under authorization by a local government through a franchise. This third form is called "franchised-controlled MSW" and is discussed in Appendix J.

According to tonnage data provided by the Cities of Greensboro and High Point for FY 1994-1995, only 46% of the total MSW expected to be landfilled (whether a 15% diversion rate or 40% diversion rate is achieved) is waste which is publicly-controlled; the remaining 54% of the total Guilford County generated MSW stream is managed privately.

Table 3-3 presents future publicly-controlled MSW landfilling estimates for Guilford County during the period 1998-2017. The estimates are based on the theory that 46% of the total MSW generated within Guilford County will be publicly-controlled throughout the planning period.

Table 3-3
Guilford County Solid Waste Management Study
Municipal Solid Waste Disposal Analysis
FY 1994-1995

Jurisdiction	Tons Disposed (FY 94-95)	% of Total	
White Street Sanitary Landfill			
Publicly-Controlled	152,813	37%	
Private Collection	91,677	22%	
Subtotal	244,490		59%
Kersey Valley Landfill			
Publicly-Controlled	40,497	10%	
Private Collection	58,298	14%	
Subtotal	98,795		24%
Subtotal - Publicly-Controlled MSW	193,310	46%	
Other County MSW	73,520		17%
Totals:	**416,805**		**100%**

Note: MSW tonnage data derived from Guilford County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, and information provided by Mr. Dale James (City of Greensboro) and Mr. Perry Kairis (City of High Point).

When considering only publicly-controlled MSW (see Table 3-5), it is estimated that a working volume of about 10.5 million cubic yards of landfill airspace will be required to meet Guilford County MSW disposal requirements through the year 2017 if a 15% recycling rate is considered, and 7.6 million cubic yards of landfill airspace will be needed for disposing of publicly-controlled MSW if a 40% reduction rate is considered.

Based on these requirements, a bulk density conversion factor of 1,000 pounds per cubic yard and a "waste-to-soil cover" ratio of 4:1 (on a volume basis) was used to calculate the annual and cumulative cubic yards of landfill airspace that will be needed to handle the MSW that will be generated in the County. These volume estimates do not include the final cover.

As is indicated in Table 3-2, it is estimated that a working volume of about 22.8 million cubic yards of landfill airspace will be required to meet Guilford County's MSW disposal requirements through the year 2017 if a 15% recycling rate is considered, and 16.4 million cubic yards of landfill airspace will be needed if a 40% reduction rate is considered.

3.2.3 LCID and C&D Waste Capacity Requirements

Land clearing and inert debris, or LCID waste, is defined by NC DEHNR as any waste material that is produced in the clearing off of property, such as limbs, stumps, branches, uncontaminated dirt, rocks, untreated wood, and gravel. Like C&D waste, the least desirable method for disposal of LCID waste is landfilling since the potential exists for recycling and reusing much of this part of the waste stream. There are currently 12 privately-owned permitted LCID landfill facilities in Guilford County.

According to state regulations, operational requirements for the LCID landfill require that adequate soil cover shall be applied monthly, or when the active area reaches one acre in size (15A NCAC 13B .0566 (4)). A density conversion factor of 1,000 pounds per cubic yard has been assumed for converting projected LCID tonnages to volumes. A "waste-to-soil cover" ratio of 20:1, as well as this density factor, was used to calculate the required cubic yardage of landfill airspace that will be required to handle the waste (see Table 3-5).

Table 3-4
Guilford County -- Projections of Publicly-Controlled[1] Municipal Solid Waste

Year	Population[2]	Total MSW Generated[3] TPY	Materials Expected to be Diverted from LF Disposal (TPY)		Publicly-Controlled MSW Projected to be Landfilled 46% of (Total MSW Generated - Diverted Materials) 15% Diversion Rate			Publicly-Controlled MSW Projected to be Landfilled 46% of (Total MSW Generated - Diverted Materials) 40%[4] Diversion Rate		
			15% Diversion Rate	40% Diversion Rate[4]	TPY	Annual CY[5]	Cumulative CY[5]	TPY	Annual CY[5]	Cumulative CY[5]
1998	371,884	498,670	74,800	137,130	194,980	487,450	487,450	166,308	415,770	415,770
1999	374,942	502,770	75,420	159,210	196,581	491,450	978,900	158,038	395,090	810,860
2000	378,000	506,870	76,030	181,630	198,186	495,470	1,474,370	149,610	374,030	1,184,890
2001	381,050	510,960	76,640	204,380	199,787	499,470	1,973,840	141,027	352,570	1,537,460
2002	384,100	515,050	77,260	206,020	201,383	503,460	2,477,300	142,154	355,380	1,892,840
2003	387,150	519,140	77,870	207,660	202,984	507,460	2,984,760	143,281	358,200	2,251,040
2004	390,200	523,230	78,480	209,290	204,585	511,460	3,496,220	144,412	361,030	2,612,070
2005	393,250	527,320	79,100	210,930	206,181	515,450	4,011,670	145,539	363,850	2,975,920
2006	396,300	531,410	79,710	212,560	207,782	519,460	4,531,130	146,671	366,680	3,342,600
2007	399,350	535,500	80,330	214,200	209,378	523,450	5,054,580	147,798	369,500	3,712,100
2008	402,400	539,590	80,940	215,840	210,979	527,450	5,582,030	148,925	372,310	4,084,410
2009	405,450	543,680	81,550	217,470	212,580	531,450	6,113,480	150,057	375,140	4,459,550
2010	408,500	547,770	82,170	219,110	214,176	535,440	6,648,920	151,184	377,960	4,837,510
2011	411,450	551,730	82,760	220,690	215,726	539,320	7,188,240	152,278	380,700	5,218,210
2012	414,400	555,680	83,350	222,270	217,272	543,180	7,731,420	153,369	383,420	5,601,630
2013	417,350	559,640	83,950	223,860	218,817	547,040	8,278,460	154,459	386,150	5,987,780
2014	420,300	563,590	84,540	225,440	202,363	550,910	8,829,370	155,549	388,870	6,376,650
2015	423,250	567,550	85,130	227,020	221,913	554,780	9,384,150	156,644	391,610	6,768,260
2016	426,200	571,510	85,730	228,600	223,459	558,650	9,942,800	157,739	394,350	7,162,610
2017	429,150	575,460	86,320	230,180	225,004	562,510	10,505,310	158,829	397,070	7,559,680
	Totals:	**10,747,120 tons**	**1,612,080 tons**	**4,173,490 tons**	**4,202,118 tons**	**10,505,310 CY**		**3,023,870 tons**	**7,559,680 CY**	

Notes:
1. Publicly-controlled waste landfilled at White Street Sanitary Landfill during FY 1994-1995 = 152,813 tons and publicly-controlled waste landfilled at Kersey Valley Landfill during FY 1994-1995 = 40,497; for a total of 193,310 tons of MSW. This publicly-controlled tonnage represents 46% of the MSW generated by Guilford County that was managed via landfill disposal during FY 1994-1995 (416,805 tons). Data reported by Mr. Dale James (City of Greensboro) and Mr. Perry Kairis (City of High Point).
2. Population estimates based on data provided by the Guilford County Planning and Development Department and straight line interpolation of data.
3. Total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of 7.35%, and annual population estimates for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during fiscal year 1994-1995. Tonnages rounded to the nearest tenth.
4. Landfill diversion rate in 1998 based on FY 1994-1995 diversion rate of 15%. This rate was then increased yearly as follows to achieve a 40% diversion rate by the year 2001 and beyond: 1996, 19%; 1997, 23%; 1998, 28%; 1999, 32%; 2000, 36%; 2001, 40%. Landfill diversion rate of 15% based on County data for the FY 1994-1995 period which indicates that approximately 15% of County generated waste is diverted from landfilling.
5. Cubic yard estimates based on a 4:1 waste-to-cover ratio (excluding final cover) and the conversion factor of 1,000 pounds per cubic yard.

Construction and Demolition , or C&D waste is defined by NC DEHNR as waste resulting from the construction or demolition of any structures, such as insulation, bricks, concrete, concrete block, and shingles. C&D wastes, by definition, do not include any inert or yard debris. The landfilling of C&D wastes is considered the least desirable method of disposing of these wastes, since the potential exists for the recycling and reuse of these C&D wastes. C&D wastes which are not suitable for reuse or recycling require disposal in a permitted facility. Such a facility can be a permitted C&D landfill facility or possibly an LCID facility if the C&D wastes qualify as LCID wastes. If neither option is available, the waste must be disposed of in a permitted MSW landfill facility. At present, there are no landfills solely permitted for C&D in Guilford County.

State regulations for C&D waste landfills require that adequate soil cover be applied on a weekly basis (see Appendix A). A density conversion factor for mixed C&D wastes of 1,000 pounds per cubic yard was assumed for this study. A "waste-to-soil" cover ratio of 10:1 (on a volume basis) was also assumed and used for calculating the required cubic yardage (see Table 3-5).

The quantities of LCID and C&D waste estimated to be generated within Guilford County over the next 20-year period (1998-2017), as well as the landfill air space that will be required to dispose of this waste, are presented in Table 3-5.

As is stated in the North Carolina Recycling and Solid Waste Management Plan, waste which is considered either LCID or C&D waste is difficult to quantify with any degree of confidence for a variety of reasons. First of all, only a few facilities which manage these waste streams (whether activities are geared towards disposal or recycling/reuse) keep records which quantify or characterize the materials received. Unlike MSW facilities, neither LCID or C&D facilities are required to record quantities of waste received during any given period of time.

Secondly, levels of LCID and C&D waste generation vary widely depending on economic activity, government funding of public works projects, changes in population density, and the influences of climatic changes. Thirdly, it is known that a portion of the LCID and C&D waste which is generated in the state of North Carolina is disposed of via means of illegal dumping.

Table 3-5
Guilford County LCID and Construction and Demolition Waste Projections

Year	Population[1]	Total MSW Generated[2] TPY	Projected LCID Waste[3]			Projected C&D Waste[4]		
			TPY	Annual CY	Cumulative CY	TPY	Annual CY	Cumulative CY
1998	371,884	498,670	174,535	367,440	367,440	124,668	277,040	277,040
1999	374,942	502,770	175,970	370,460	737,900	125,693	279,320	556,360
2000	378,000	506,870	177,405	373,480	1,111,380	126,718	281,590	837,950
2001	381,050	510,960	178,836	376,500	1,487,880	127,740	283,870	1,121,820
2002	384,100	515,050	180,268	379,510	1,867,390	128,763	286,140	1,407,960
2003	387,150	519,140	181,699	382,520	2,249,910	129,785	288,410	1,696,370
2004	390,200	523,230	183,131	385,540	2,635,450	130,808	290,680	1,987,050
2005	393,250	527,320	184,562	388,550	3,024,000	131,830	292,960	2,280,010
2006	396,300	531,410	185,994	391,570	3,415,570	132,853	295,230	2,575,240
2007	399,350	535,500	187,425	394,580	3,810,150	133,875	297,500	2,872,740
2008	402,400	539,590	188,857	397,590	4,207,740	134,898	299,770	3,172,510
2009	405,450	543,680	190,288	400,610	4,608,350	135,920	302,040	3,474,550
2010	408,500	547,770	191,720	403,620	5,011,970	136,943	304,320	3,778,870
2011	411,450	551,730	193,106	406,540	5,418,510	137,933	306,520	4,085,390
2012	414,400	555,680	194,488	409,450	5,827,960	138,920	308,710	4,394,100
2013	417,350	559,640	195,874	412,370	6,240,330	139,910	310,910	4,705,010
2014	420,300	563,590	197,257	415,280	6,655,610	140,898	313,110	5,018,120
2015	423,250	567,550	198,643	418,190	7,073,800	141,888	315,310	5,333,430
2016	426,200	571,510	200,029	421,110	7,494,910	142,878	317,510	5,650,940
2017	429,150	575,460	201,411	424,020	7,918,930	143,865	319,700	5,970,640
	Totals:	**10,747,120 Tons**	**3,761,492 Tons**	**7,918,930 CY**		**2,686,780 Tons**	**5,970,640 CY**	

Notes:
1. Population estimates based on data provided by the Guilford County Planning and Development Department and straight line interpolation of data.
2. Total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of 7.35%, and annual population estimates for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during fiscal year 1994-1995. Tonnages rounded to the nearest tenth.
3. The LCID waste is estimated to represent 35% of the projected total MSW waste stream. This estimate is somewhat lower than those that are estimated by the NC DEHNR regional representative. Cubic yard estimates based on a 20:1 waste-to-cover ratio (excluding final cover) and the conversion factor of 1,000 pounds per cubic yard.
4. The C&D waste is estimated to represent 25% of the projected total MSW waste stream. somewhat lower than those that are estimated by the NC DEHNR regional representative. Cubic yard estimates based on a 10:1 waste-to-cover ratio (excluding final cover) and the conversion factor of 1,000 pounds per cubic yard.

Table 5-1
Guilford County, North Carolina
Subtitle D Landfill Siting Criteria

Category	Requirements
Airport Safety	• Greater than 5,000 FT from runway used by piston aircraft. • Greater than 10,000 FT from runway used by turbo-jet aircraft. • Five-Mile Notification Zone.
Floodplains	• Must not restrict flow of 100-year flood.
Wetlands	• New landfills are prohibited in wetlands.
Fault Areas	• Greater than 200 FT from fault displaced in Holocene time.
Seismic Zone	• Must be designed to withstand maximum horizontal acceleration expected from the seismic impact zone.
Unstable Areas	• Measures required to ensure structural integrity of the landfill components.
Cultural Resources	• Cannot damage or destroy an archaeological or historical property.
State Nature and Historic Preserve	• New MSWLF units may not have an adverse impact on any lands included in the State Nature and Historic Preserve.
Water Supply Watersheds	• New MSWLF units are prohibited in the critical area of a water supply watershed or in the watershed for a stream classified as WS-1, in accordance with the rules codified at I5A NCAC 2B .0200- "Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina." • New MSWLF units that will discharge leachate to surface waters at the facility and must obtain a NPDES permit shall not be located within watersheds classified as WS-II or WS-III, in accordance with the above mentioned rules.
Endangered and Threatened Species	• New MSWLF units shall not jeopardize the existence of endangered or threatened species or result in the destructions or adverse modification of a critical habitat.
Vertical Separation Requirements	• New MSWLF units shall be constructed so that the post settlement bottom elevation of the base liner system is a minimum of four FT above seasonal high groundwater table and/or bedrock.
Horizontal Separation Requirements	• More than 300 FT from property line. • More than 500 FT from private residences and wells. • More than 50 FT from any stream, river, or lake.

Section 4.0
Evaluation of Existing Disposal Options

4.1 INTRODUCTION

According to current North Carolina state regulations, only lined MSW landfill units will be permitted to receive waste as of January 1, 1998. This section has been prepared in response to the pending closure of unlined landfill units which are currently used for the disposal of MSW generated within Guilford County, and to provide the County with an evaluation of options that can meet the County's projected lined landfill capacity needs for the 20-year period of 1998 - 2017. This section is limited to reviewing the capacities and projected capacities of disposal facilities which currently receive Guilford County waste.

4.2 MSW DISPOSAL OPTIONS

At present, landfill disposal services include the use of both public and private landfill facilities for managing MSW generated within Guilford County. The City of Greensboro is proceeding with plans to develop Phase III of the White Street Sanitary Landfill, while the City of High Point is proceeding with plans to develop Phases II and IV of the Kersey Valley Landfill facility. The completion of each of these development activities will provide an additional 8,380,000 cubic yards of lined landfill capacity within Guilford County. Private landfill facilities are less specific in regard to their expansion plans, but an additional 2,700,000 cubic yards of lined landfill capacity is estimated to be available from these sources at the present time.

Future MSW disposal requirements projected for Guilford County during the planning period (1998 - 2017), as indicated in Section 3.0, are 22,837,660 CY of disposal capacity at a 15% diversion rate, and 16,434,120 CY of disposal capacity at a 40% diversion rate. In light of these future disposal projections, it is evident that maintaining the status quo associated with public landfilling activities will not suffice in meeting the future landfill disposal requirements in Guilford County. Three scenarios which could provide for the future MSW disposal needs of the County are described below.

4.2.1 Public Disposal Option

An alternative to maintaining the present status quo for landfill disposal services in which both public and private landfill facilities are used for managing MSW

generated within Guilford County would be to switch to using only public disposal facilities for managing MSW generated within Guilford County. Under this scenario, which for the purpose of this study will be referred to as the "public disposal option", it is assumed that all currently-owned and adjacent land being considered for development by existing public landfill facility owners/ operators will be developed as Subtitle D landfill area.

In the case of the White Street Sanitary Landfill, the public disposal option assumes development of Phases III and IV. In the case of the City of High Point, the public disposal option assumes development of Phases II, III, IV, and V of the Kersey Valley Landfill facility. As shown in Table 4-1, the completion of all of these development activities would provide an estimated 18,490,000 cubic yards of lined landfill capacity within Guilford County. Under the public disposal option, the City of High Point would dispose of waste at the Kersey Valley Landfill, while the City of Greensboro and Guilford County would continue to dispose of waste at the White Street Sanitary Landfill until the completion of Phase IV; after such time, all County-generated waste requiring landfill disposal would be hauled to the Kersey Valley Landfill.

4.2.2 Private Disposal Option

A second scenario for providing for the future disposal needs of Guilford County would be to switch to using only private disposal facilities for managing MSW generated within Guilford County. Under this scenario, which for the purposes of this study will be referred to as the "private disposal option", it is assumed that all public MSW landfilling operations in Guilford County will cease in 1997, after which time all County-generated waste requiring landfill disposal would be hauled to a private landfill facility. For comparative purposes only, it has been assumed in this study that a facility economically equivalent to the Piedmont Landfill which is located in Kernersville, NC, would be the facility used to dispose of all Guilford County-generated waste starting in 1998. From a logistics standpoint, this facility is the most conveniently located private landfill to Guilford County. As is shown in Table 4-1, under present permit conditions it is estimated that there will be a total of 2,705,000 cubic yards of landfill capacity remaining at the Piedmont Landfill as of January 1998. It would be expected that additional private capacity would be made available to make this a viable option.

Table 4-1
Guilford County Solid Waste Management Study
MSW Disposal Options and Associated Landfill Capacities

MSW Disposal Option	Available Landfill Space (Cubic Yards)									
	Kersey Valley Landfill					White Street Sanitary Landfill			Piedmont Landfill	Total Capacity (Cubic Yards)
	Phase II	Phase III	Phase IV	Phase V	Sub-Total	Phase III	Phase IV	Sub-Total		
Status Quo	*590,000*		*3,090,000*		*3,680,000*	*4,700,000*		*4,700,000*		*8,380,000*
1. Public Disposal Option	590,000	950,000	3,090,000	4,060,000	**8,690,000**	4,700,000	5,100,000	**9,800,000**		**18,490,000**
2. Private Disposal Option									**2,705,000**	**2,705,000**
3. Combined Option (Public to Public, Private to Private)	590,000		3,090,000		**3,680,000**	4,700,000	5,100,000	**9,800,000**	**2,705,000**	**16,185,000**

4.2.3 Combined MSW Disposal Option

The third scenario included involves a combination of both developing public disposal facilities for Guilford County's publicly-controlled waste disposal needs and using private landfill facilities for managing privately-controlled MSW generated within Guilford County. Under this scenario, which for the purposes of this study will be referred to as the "combined disposal option", it is assumed that, starting in 1998 only publicly-controlled waste generated in Guilford County (which represents 47% of the total County-generated MSW landfilled) will be disposed of in public landfill facilities. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities. For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County. It is also assumed that the entire 2,705,000 cubic yards of landfill capacity estimated to be remaining at the Piedmont Landfill facility as of January 1998 will be available for the disposal of Guilford County-generated waste.

To provide adequate disposal capacity for the publicly-controlled waste stream over the planning period of 1998-2017 involves development of both the White Street Sanitary Landfill and the Kersey Valley Landfill. Under this option, the City of Greensboro would develop the areas which have been earmarked for containing Phases III and IV of the White Street Sanitary Landfill to accommodate its future publicly-controlled MSW disposal needs; whereas, the City of High Point would proceed with the status quo development of Phases II and IV of the Kersey Valley Landfill facility to accommodate its future publicly-controlled MSW disposal needs. The completion of all of these development activities would provide an estimated 13,480,000 cubic yards of lined landfill capacity within Guilford County available for the disposal of publicly-controlled waste.

4.3 C&D AND LCID WASTE DISPOSAL OPTIONS

As was discussed in Section 1.0, analyzing the C&D and LCID waste streams that are generated and disposed of is difficult due to the fact that neither Guilford County nor the municipalities within Guilford County have control over the collection or management of these waste streams. For this reason, it has been assumed for the purposes of this study that current C&D and LCID waste disposal practices in Guilford County will continue throughout the period 1998-2017. It is assumed that public facilities within the County that currently accept either/or C&D and LCID waste (for the most part LCID

waste is limited to yard trimmings) will continue to do so throughout the planning period, and the remainder of the County-generated C&D and LCID waste will be disposed of at other facilities.

4.4 EVALUATION OF FUTURE DISPOSAL CONCEPTS

4.4.1 Status Quo Option

In order to provide Guilford County with future public landfill disposal services, the City of Greensboro is working towards the development of Phase III of the White Street Sanitary Landfill, and the City of High Point is proceeding with plans to develop Phases II and IV of the Kersey Valley Landfill facility (i.e., the "status quo" option). These additional phases of landfill development, if completed by 1998, will provide the County with an estimated 8,380,000 cubic yards of disposal capacity. As is shown in Table 4-2 and Figures 4-1 and 4-2, however, such a strategy will only meet a portion of the County's disposal needs for the 20-year planning period (1998-2017).

Table 4-2
Guilford County Solid Waste Management Study
Status Quo Disposal Capacity

Landfill Diversion Rate	MSW Disposal Requirements (1998-2017)		Status Quo Option Lined Landfill Capacity (1998-2017 -- CY)
	Total County-Generated MSW (CY)	Publicly-controlled MSW (CY)	
15%	22,837,660	10,733,700	8,380,000
40%	16,434,120	7,724,036	8,380,000

Note: Assumes development of currently-owned and adjacent land (White Street Sanitary Landfill, Phase III, and Kersey Valley Landfill , Phases II and IV), and disposal of 83% of all County-generated waste in public facilities throughout the planning period.

At a 15% diversion rate, the status quo option should provide for the County's disposal needs for the period 1998 through early-2006 if current waste disposal practices continue; namely, that 83% of County-generated waste is disposed of at public facilities. At a 40% diversion rate, the status quo option should provide for the County's disposal needs for the period 1998 through mid-2009 if current disposal practices continue (see Figure 4-2).

Figure 4-1

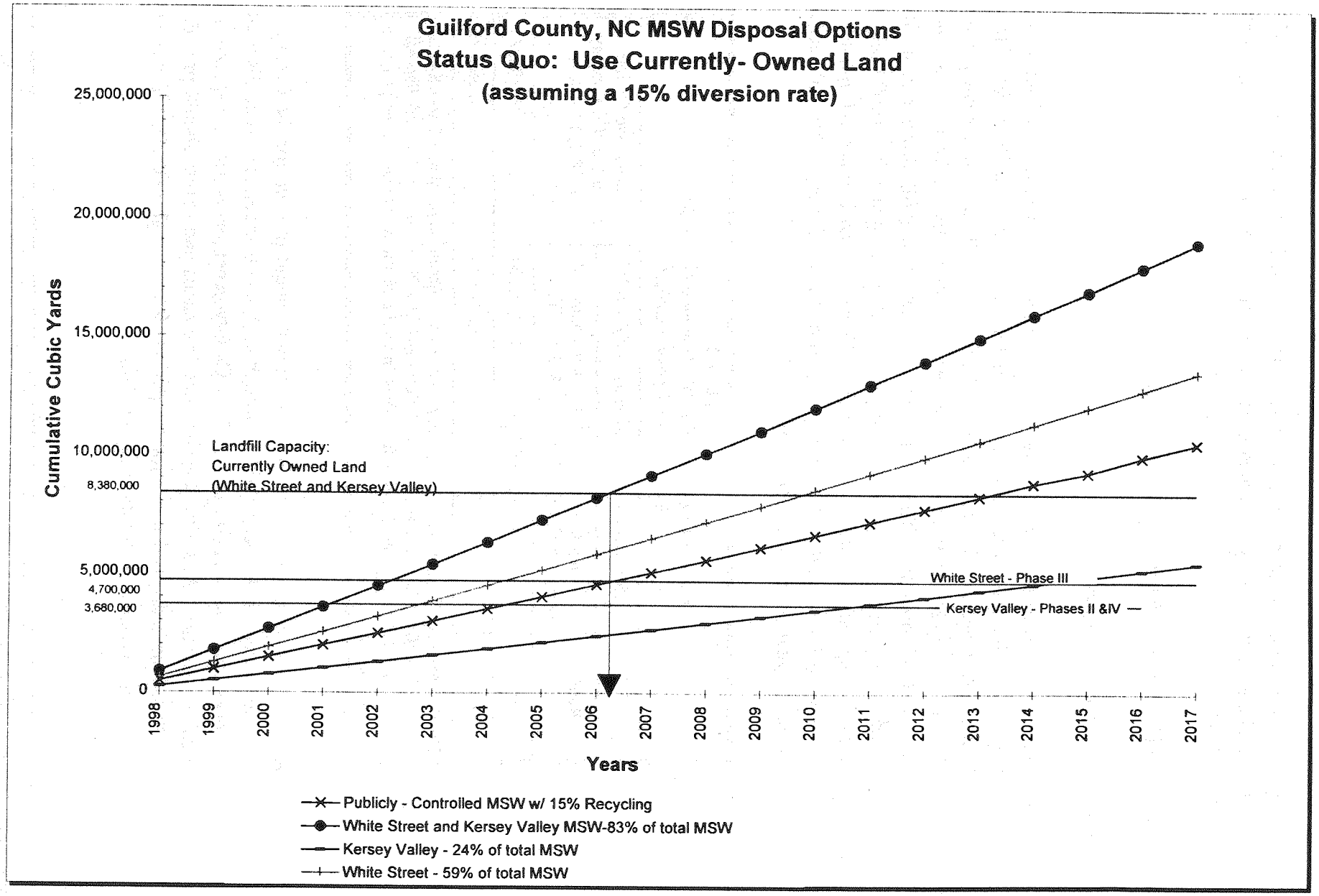


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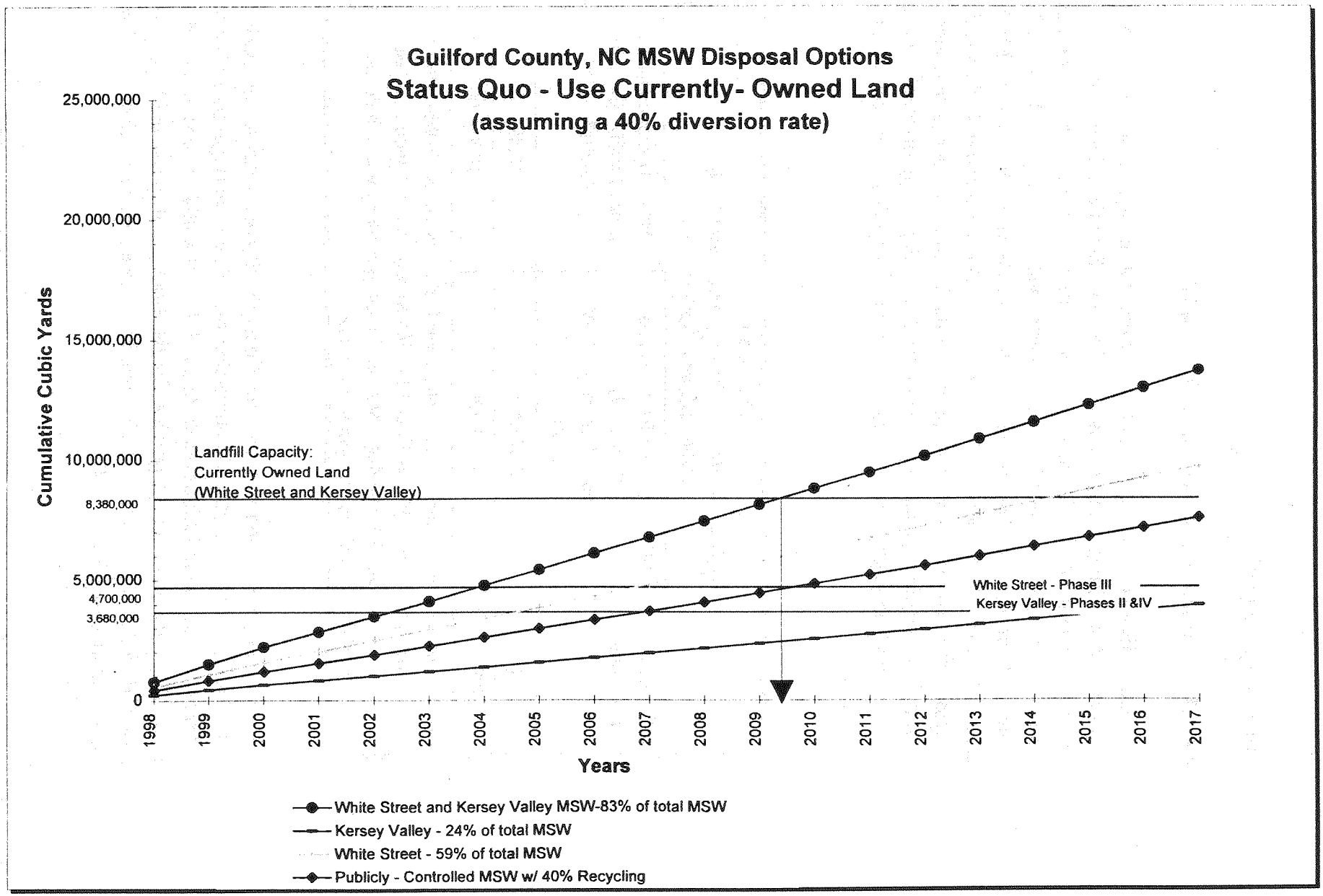
Figure 4-2


Guilford County, NC MSW Disposal Options
Status Quo - Use Currently- Owned Land
(assuming a 40% diversion rate)
Cumulative Cubic Yards
25,000,000
20,000,000
15,000,000
10,000,000
8,380,000
5,000,000
4,700,000
3,680,000
0
Landfill Capacity:
Currently Owned Land
(White Street and Kersey Valley)
White Street - Phase III
Kersey Valley - Phases II &IV
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Years
White Street and Kersey Valley MSW-83% of total MSW
Kersey Valley - 24% of total MSW
White Street - 59% of total MSW
Publicly - Controlled MSW w/ 40% Recycling

4.4.2 Public Disposal Option

4.4.2.1 Capacities and Development Potential

The public disposal option involves the development of all currently-owned and adjacent land at existing public disposal facilities into Subtitle D landfill capacity, and the disposal of all County-generated wastes in these public facilities throughout the planning period. This option provides an estimated 18,490,000 cubic yards of disposal capacity available for meeting Guilford County's MSW disposal needs. As is shown in Table 4-3 and Figures 4-3 and 4-4, the public disposal option has the potential for providing the County with adequate disposal capacity for the entire planning period (1998-2017), depending on the diversion rate achieved through source reduction, reuse, recycling, and composting programs.

Table 4-3
Guilford County Solid Waste Management Study
Public Disposal Option

Landfill Diversion Rate	MSW Disposal Requirements (1998-2017) Total County-Generated MSW (CY)	Public Disposal Option Lined Landfill Capacity (1998-2017 -- CY)
15%	22,837,660	18,490,000
40%	16,434,120	18,490,000

Note: Assumes development of currently-owned and adjacent land (White Street Sanitary Landfill, Phases III and IV, and Kersey Valley Landfill , Phases II, III, IV and V), and disposal of all County-generated waste in public facilities throughout the planning period.

The public disposal option will meet the County's disposal needs for the period 1998 through early 2013 at a 15% diversion rate if all County-generated waste is disposed of at public facilities (see Figure 4-3). At a 40% diversion rate, the public disposal option should provide for the County's disposal needs for the period 1998-2017 and beyond if all County-generated waste is disposed of at public facilities (see Figure 4-4).

Figure 4-3

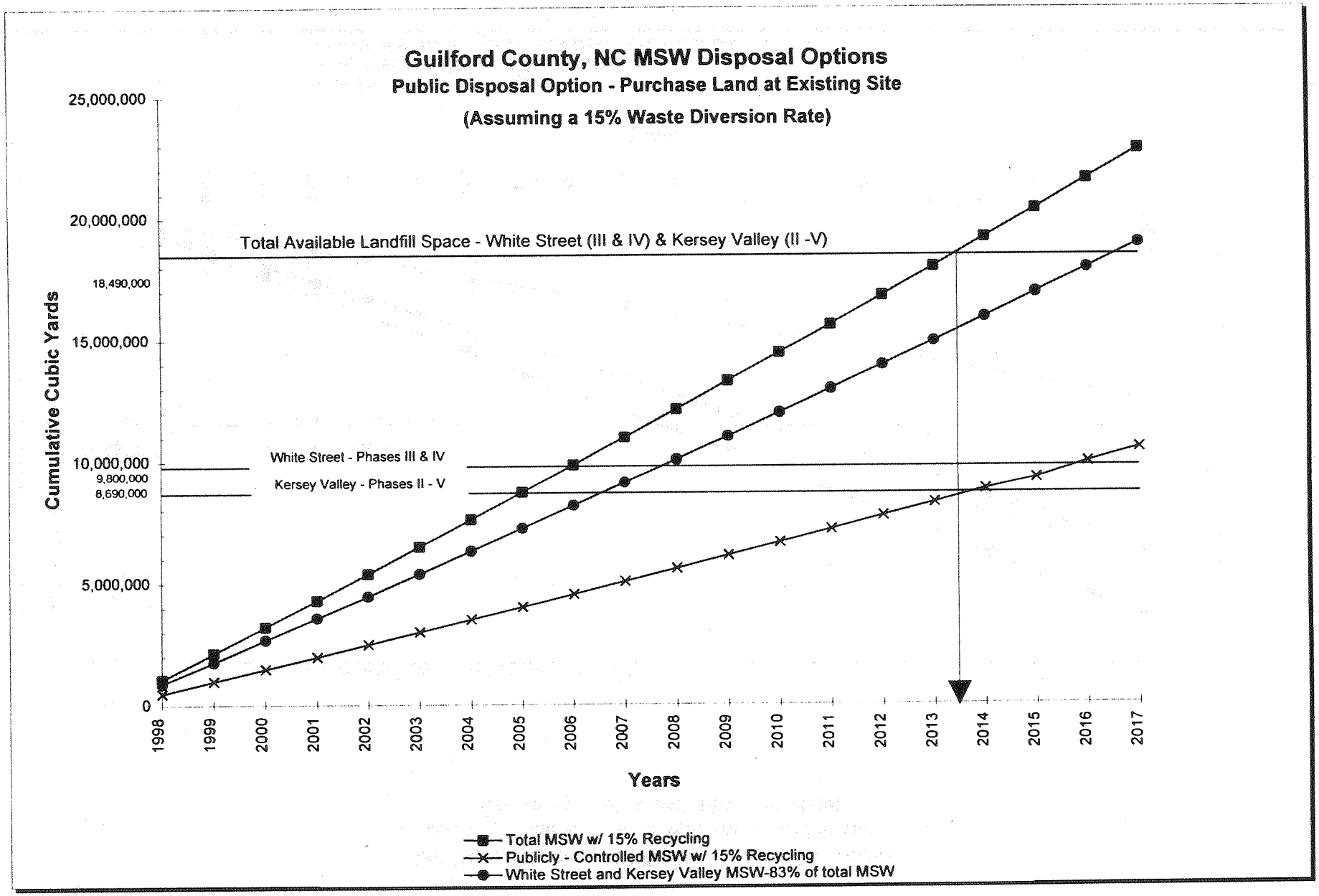


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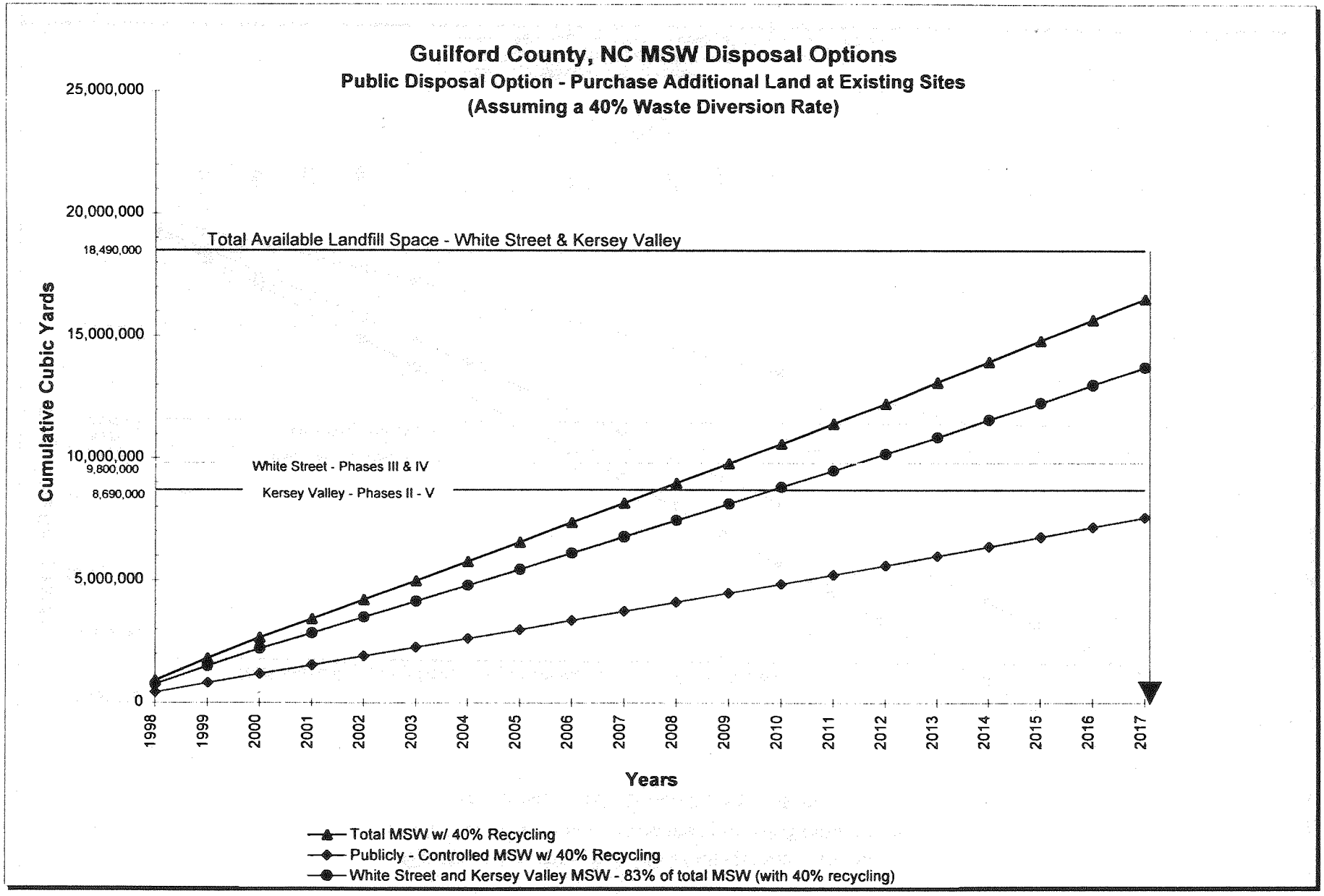
Figure 4-4



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4.4.2.2 Unit Costs and Economics

The unit costs and economics associated with the implementation of the public disposal option are presented in Table 4-4 and Appendix D of this report. The costs associated with the public disposal option are based on an assumed transport cost of $2.00 per travel mile, an 8-ton payload per packer truck, haul distances indicated in Table 4-5, and the assumption that all County-generated wastes will be disposed of in a public facility.

It is estimated that the average disposal costs for a 500 ton per day Subtitle D landfill (similar in daily disposal rates to the Kersey Valley Landfill) would be $26 per ton (1995 dollars), and that the average disposal costs for an 800 ton per day Subtitle D landfill (similar in daily disposal rates to the White Street Sanitary Landfill) would be $23 per ton (1995 dollars). Once existing public disposal facilities are filled (estimated to occur by the end of the year 2013) and a new public landfill facility is constructed, it is estimated that the average disposal costs for a 1,300 ton per day Subtitle D landfill (New Public Landfill) would be $19 per ton (1995 dollars). The new public landfill facility, once implemented, would most likely increase the hauling distance and costs for both the City of Greensboro and the City of High Point.

As is shown in Table 4-4, once transportation and disposal costs are considered, the average cost for the public disposal option is $28/ton (in 1996 dollars), with a range of $27-$32 per ton.

4.4.2.3 Environmental Considerations

Both the City of Greensboro and the City of High Point are in the process of obtaining permit approval from the NC DEHNR for the development of Subtitle D lined landfill facilities on sites which are adjacent to existing fill areas (White Street Sanitary Landfill, Phase III, and Kersey Valley Landfill, Phases II and V). It appears that the pursuit of these status quo landfill development activities should be considered acceptable under current environmental regulations pertaining to MSW landfill development.

Table 4-4
Guilford County Solid Waste Management Study
Summary of Economic Analyses:
Existing Disposal Facilities and Privatization

Jurisdiction Waste Description		Public Disposal Option		Private Disposal Option		Combined Option (Public to Public, Private to Private)	
		Total Costs	Cost/Ton	Total Costs	Cost/Ton	Total Costs	Cost/Ton
White Street Sanitary Landfill							
Publicly-Controlled Waste	37%	$92,172,382	$27	$118,298,768	$35	$96,328,997	$29
Privately-Controlled Waste	22%	$54,805,200	$27	$70,339,808	$35	$70,339,808	$35
Subtotal	**59%**	**$146,977,582**		**$188,638,576**		**$166,668,805**	
Kersey Valley Landfill							
Publicly-Controlled Waste	10%	$25,938,045	$28	$32,429,392	$36	$54,353,488	$60
Privately-Controlled Waste	14%	$36,313,262	$28	$45,401,149	$36	$45,401,149	$36
Subtotal	**24%**	**$62,251,307**		**$77,830,541**		**$99,754,637**	
Other County MSW	**17%**	**$49,905,698**	$32	**$55,906,000**	$36	**$55,906,000**	$36
TOTAL	**100%**	**$259,134,587**	**$28**	**$322,375,117**	**$35**	**$322,329,442**	**$35**

Note: All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

Table 4-5
Assessment of Public and Private MSW Disposal Options for Guilford County

CONSIDERATION	PUBLIC DISPOSAL OPTIONS				PRIVATE DISPOSAL OPTIONS		
	White Street Sanitary Landfill	Kersey Valley Landfill	Hanes Mill Road Sanitary Landfill	Davidson County Landfill	BFI Charlotte Motor Speedway Landfill	Piedmont Landfill (WMI)	Uwharrie Landfill (Addington)
1. Distance from Guilford County(1)	4 miles	11 miles	29 miles	32 miles	75 miles	17 miles	58 miles
2. Distance from City or Greensboro(1)	5 miles	10 miles	24 miles	30 miles	75 miles	15 miles	56 miles
3. Distance from City of High Point(1)	18 miles	5 miles	20 miles	17 miles	60 miles	16 miles	48 miles

(1) Mileage reflects the distance "as the crow flies" from the geographic center of Guilford County, the City of Greensboro, and the City of High Point.

4.4.3 Private MSW Disposal Option

4.4.3.1 Capacities and Development Potential

At present, the Piedmont Landfill has a permitted capacity of 5,240,000 cubic yards. Based on the FY 1994-1995 fill rate of 507,123 tons, it is estimated that by January 1, 1998, there will be 2,705,000 cubic yards of remaining capacity at the Piedmont Landfill. The owner of the landfill, Waste Management Inc., is currently seeking to expand this facility; however, it is uncertain as to whether or not such efforts will be successful. Should additional acreage not be permitted for Subtitle D landfill development, the Piedmont Landfill facility is estimated to reach capacity in June 2000; a situation which would preclude the facility's ability to accommodate Guilford County's waste throughout the planning period (1998-2017). Therefore, the only conditions under which it would be feasible for Guilford County to use the Piedmont Landfill under the "private disposal option" would be for additional land to be permitted for landfill development, and for a contract to be signed between Guilford County and WMI guaranteeing that WMI will provide adequate capacity to meet the County's disposal needs throughout the planning period.

The uncertainty regarding the additional landfilling capacity and the ultimate cost of the Piedmont Landfill facility are risks that should be considered in the reliance on this facility for disposal of all of the MSW anticipated to be generated within Guilford County during the period 1998-2017. As is shown in Table 4-6 and Figure 4-5, it is clear that, under current permit conditions, the use of the Piedmont Landfill alone will not meet Guilford County's future disposal needs under either a 15% or the 40% landfill diversion rate. Additional lined landfill acreage would need to be permitted and constructed to supplement the permitted capacity anticipated to remain after January 1, 1998.

Figure 4-5

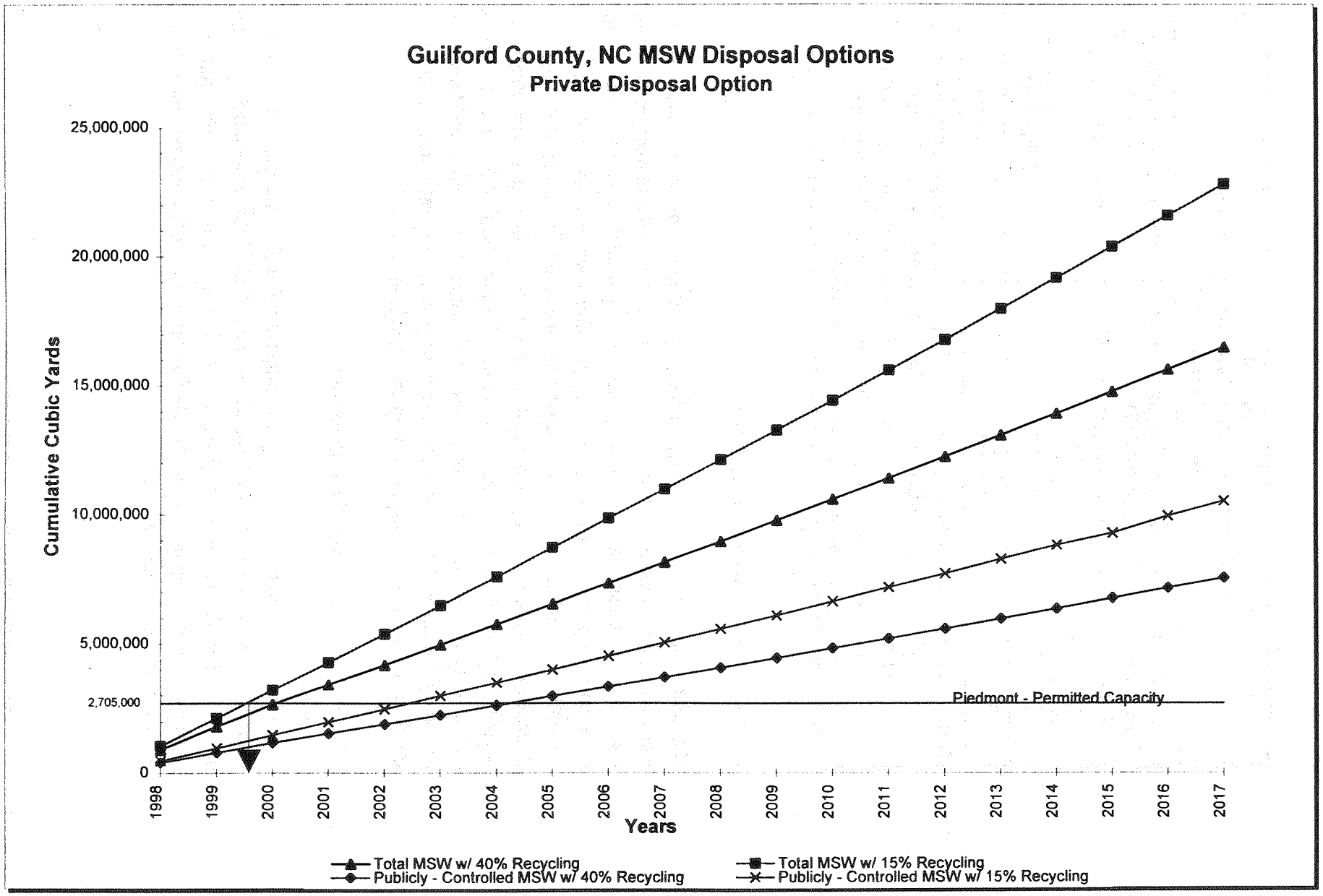

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Table 4-6 *Guilford County Solid Waste Management Study* *Private Disposal Option*		
Landfill Diversion Rate	MSW Disposal Requirements (1998-2017) Total County-Generated MSW (CY)	Private Disposal Option Lined Landfill Capacity (1998-2017 -- CY)
15%	22,837,660	2,705,000
40%	16,434,120	2,705,000
Note: Assumes use of the Piedmont Landfill as the private landfill to which County-generated MSW will be hauled throughout the planning period. Assumes that the entire 2,705,000 cubic yards of landfill capacity estimated to be remaining as of January 1998 will be available to Guilford County starting in 1998.		

4.4.3.2 Unit Costs and Economics

The unit costs and economics associated with adoption of the private disposal alternative are presented in Appendix E of this report, and summarized in Table 4-4. The costs associated with the private disposal alternative are based on an assumed transport cost of $2.00 per travel mile (two-way distance), an 8-ton payload per packer truck, haul distances indicated in Table 4-4, and the assumption that all County-generated wastes will be hauled to the Piedmont Landfill for disposal at a tipping fee of $27.50 per ton (1995 dollars). As is shown in Table 4-5, once transport costs and disposal costs are considered, the average cost estimated to be incurred under the private disposal option is $35.00 - $36.00 per ton of waste disposed of at the Piedmont Landfill.

4.4.3.3 Environmental Considerations

The adoption of the private disposal alternative would increase the hauling distance for both the Cities of Greensboro and High Point associated with the disposal of MSW. The greater distances traveled would have a more significant impact on the environment from the standpoint of air pollutants associated with by MSW transport vehicles emissions.

4.4.3.4 Market Considerations

The other issue to be considered under the private disposal option is the fact that, at present, it is uncertain as to whether or not the Piedmont Landfill will accommodate Guilford County's future MSW disposal needs. If additional acreage is not developed for landfill disposal, an alternate private disposal facility would have to be sought to accommodate Guilford County's MSW. It is likely that use of any other private landfill facilities would still result in greater hauling distances than those incurred with existing public disposal facilities, and that tip fees combined with transport and disposal costs would result in minimum costs of $35.00 per ton of waste disposed to be incurred under the private disposal option.

4.4.4 Combined MSW Disposal Option

4.4.4.1 Capacities and Development Potential

The third option involving the use of public disposal facilities is the "combined" disposal option. Under this option, only publicly-controlled waste would be disposed of in public facilities, while privately-controlled MSW would be disposed of in private facilities. With the combined disposal option, there would be an estimated 13,480,000 cubic yards of disposal capacity available for meeting Guilford County's publicly-controlled MSW disposal needs, and 2,705,000 cubic yards of disposal capacity available for privately-controlled MSW disposal needs, or a total of 16,185,000 cubic yards of disposal capacity available for the period 1998-2017 (see Table 4-7).

As is shown in Figures 4-6 and 4-7, the combined disposal option would meet the County's waste disposal needs, at either a 15% or 40% diversion rate, for the period 1998 - 2017 for publicly-controlled waste. As for the privately-controlled waste, use of the Piedmont Landfill facility, given the permitted capacity anticipated to be remaining as of January 1, 1998, will only serve as an interim solution unless WMI is successful in permitting additional acreage for lined landfill development.

Table 4-7
Guilford County Solid Waste Management Study
Combined Disposal Option

Landfill Diversion Rate	Publicly-controlled MSW Disposal Requirements (1998-2017) (CY)	Public Landfill Lined Landfill Capacity (1998-2017 -- CY)
15%	10,733,700	13,480,000
40%	7,724,036	13,480,000

Note: Assumes development of currently-owned and adjacent land (White Street Sanitary Landfill-- Phases III and IV, and Kersey Valley Landfill -- Phases II and IV), and disposal of all publicly-controlled County-generated waste in public facilities throughout the planning period.

Landfill Diversion Rate	Privately-Controlled MSW Disposal Requirements (1998-2017) (CY)	Private Lined Landfill Capacity (1998-2017 -- CY)
15%	12,332,350	2,705,000
40%	8,874,440	2,705,000

Note: Assumes use of the Piedmont Landfill as the private landfill to which County-generated MSW will be hauled throughout the planning period. Assumes that the entire 2,705,000 cubic yards of landfill capacity estimated to be remaining as of January 1998 will be available to Guilford County starting in 1998.

Figure 4-6

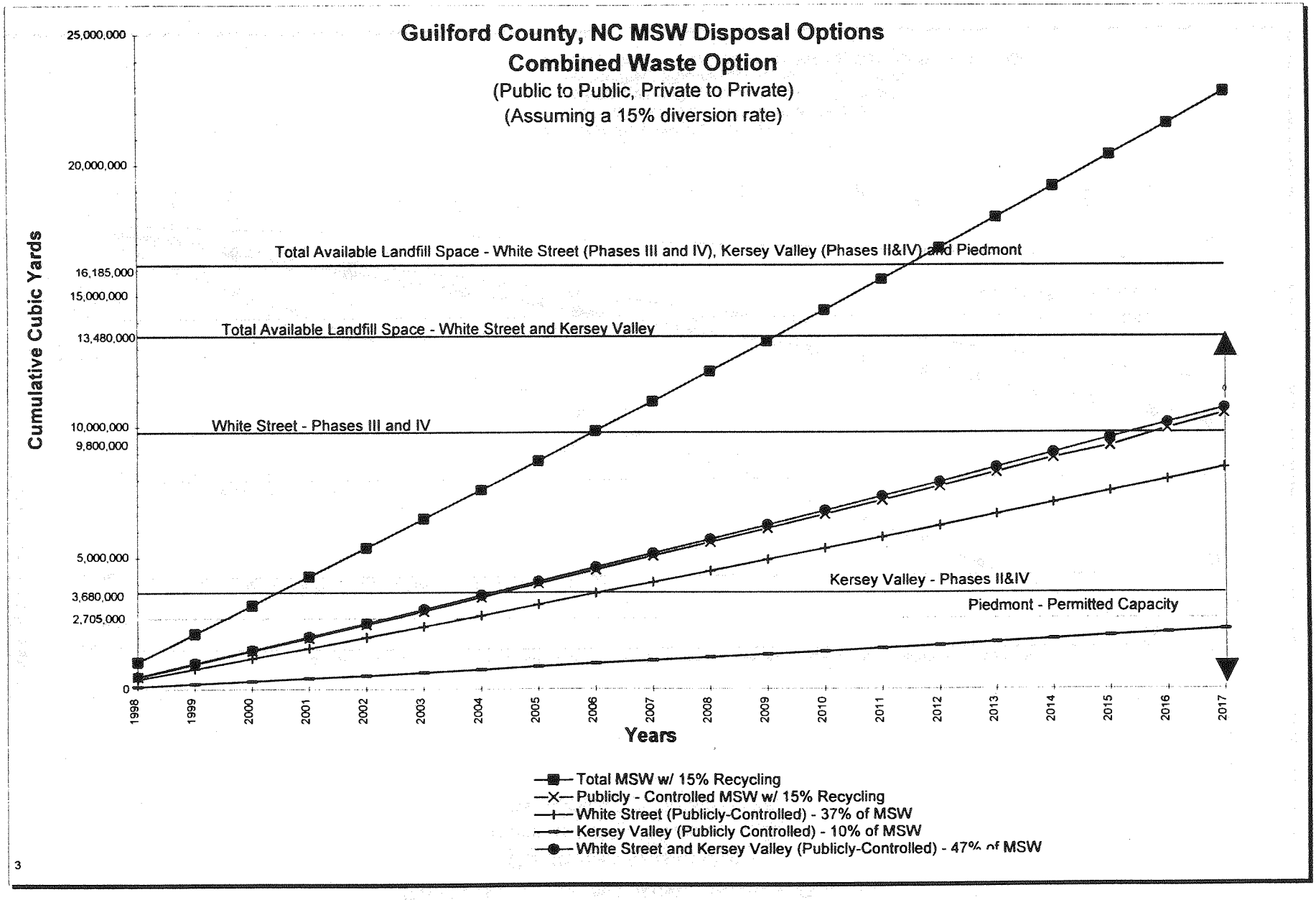

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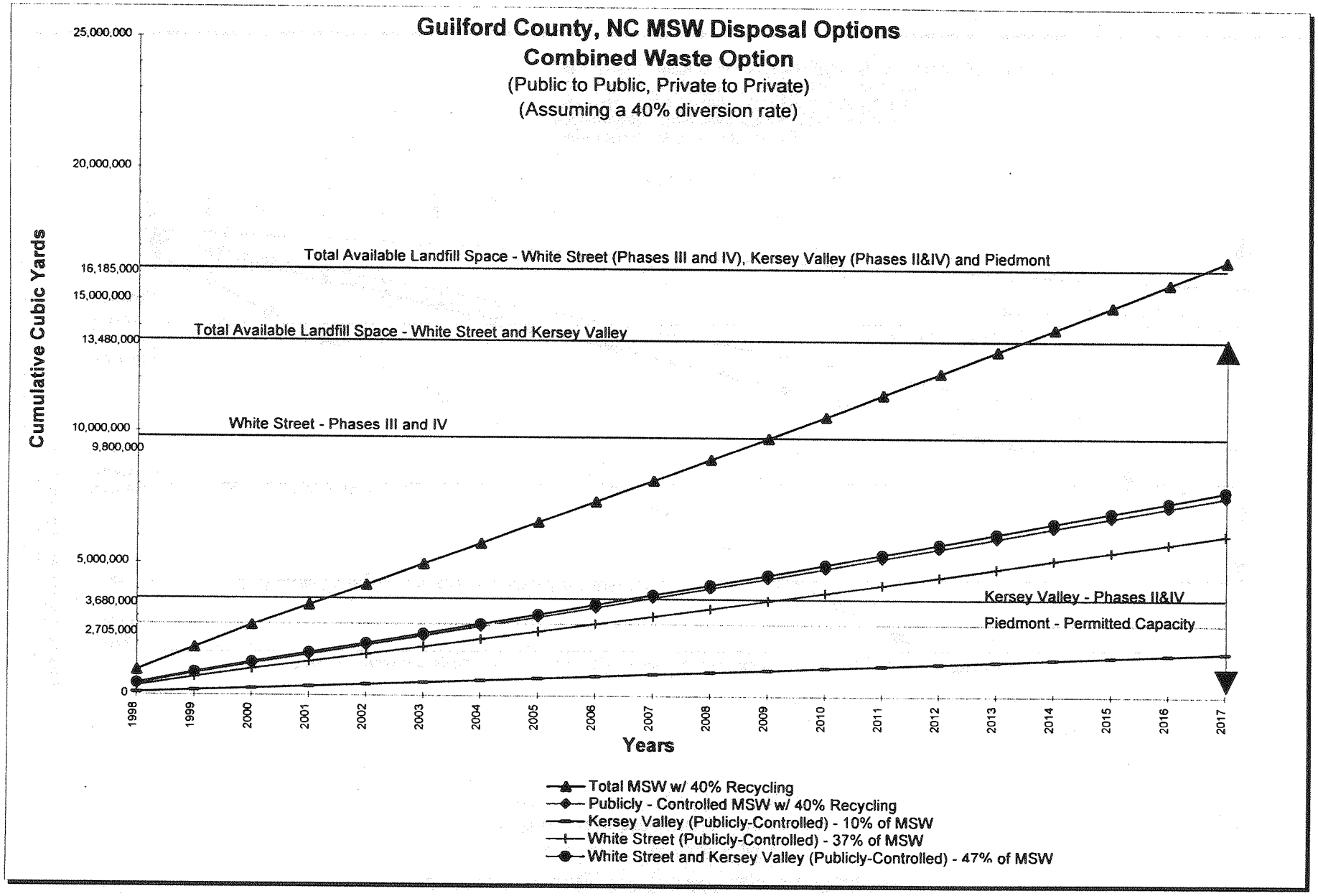
Figure 4-7



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4.4.4.2 Unit Costs and Economics

The unit costs and economics associated with the implementation of the combined disposal option, are presented in Table 4-8 and Appendix F of this report.

The costs associated with the combined disposal option are based on an assumed transport cost of $2.00 per travel mile, an 8-ton payload per packer truck, haul distances indicated in Table 4-5, and the assumption that all publicly-controlled County-generated wastes will be disposed of in public facilities. It is estimated that, for publicly-controlled waste, the average disposal costs for a 100-ton per day Subtitle D landfill (Kersey Valley Landfill) would be $57 per ton (1995 dollars), and that the average disposal costs for an 500-ton per day Subtitle D landfill (White Street Sanitary Landfill) would be $26 per ton (1995 dollars). These higher disposal costs are due to the lower daily throughput of waste anticipated to be disposed of at the White Street Sanitary Landfill and the Kersey Valley landfill, should the decision be made to develop these facilities to only accept publicly-controlled MSW in the future. In considering privately-controlled waste, it is assumed that the Piedmont Landfill would be the facility to be used for disposal, at a tipping fee of $27.50 per ton (1995 dollars).

As is shown in Table 4-8, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled waste is $29.00 - $60.00 per ton (1995 dollars), and the average costs estimated to be incurred for the disposal of privately-controlled waste at the Piedmont Landfill is $35.00 - $36.00 per ton (1995 dollars).

4.4.4.3 Environmental Considerations

In terms of the development and use of public landfill facilities, future expansion of both the White Street Sanitary Landfill and the Kersey Valley Landfill appears to be acceptable from a comparative standpoint with regard to current environmental regulations pertaining to MSW landfill development.

4.5 CONCLUSIONS

4.5.1 Future MSW Disposal Strategy

It appears that from the analysis of existing MSW disposal options, and from discussions with the Guilford County Project Advisory Team, work should continue towards the development of additional landfill phases at both the White

Street Sanitary Landfill and Kersey Valley Landfill. From both an economic and logistical standpoint, as well as the perspective of future landfill capacity, the extent of such development should include Phases III and IV of the White Street Sanitary Landfill and Phases II through V at the Kersey Valley Landfill, or what has been described in this section as the public disposal option.

The private disposal option, as presented and evaluated in this section, may be a costlier solution to Guilford County's future landfill disposal needs than the public disposal option. In addition, there are uncertainties regarding the availability of future private MSW landfill capacity in or near Guilford County.

The County could obtain more accurate information regarding the long-term availability of private disposal capacity, as well as the tipping fees that would be charged, through the development and issuance of an RFP.

Given these factors, it can be concluded that the Public Disposal Option presented in this section would provide Guilford County with the greatest assurance of adequate disposal capacity, as well as the most economical MSW disposal option for Guilford County, even if only publicly-controlled MSW were to be managed under this option. Should the County decide to adopt such a strategy, and all County-generated waste is disposed of at public facilities, there will be a need to develop new public landfill capacity by the year 2014. The County has adequate opportunity to plan ahead for such a facility, and should now begin to give thought to the development schedule, the location, and size of such a facility.

4.5.2 Future C&D and LCID Disposal Strategy

From the observations presented in Section 4.3.4 of this report, it appears that reliance on current status quo C&D and LCID waste disposal practices in Guilford County, should be considered as the long-term solution for the management of these two waste streams during the planning period 1998-2017 for which this study has been prepared.

This conclusion is based on the understanding that some existing C&D and LCID facilities may expand and/or new private facilities shall be developed.

Section 5.0
Evaluation of Multi-Jurisdictional Landfill Options

5.1 INTRODUCTION

The purpose of this section is to present findings regarding the potential for the development of a new, multi-jurisdictional landfill within Guilford County.

The new landfill would provide for the disposal of three waste streams: municipal solid waste (MSW), construction and demolition (C&D) wastes, and land clearing and inert debris (LCID) wastes. The landfill would provide disposal services for these waste streams for the period 1998 - 2017.

As stated in the project scope, the purpose of this task is to examine "the feasibility of consolidating existing services so as to pursue the development of a multi-jurisdictional landfill facility to handle all three waste streams. In exploring this option, the costs, benefits, and potential risks of constructing and operating a multi-jurisdictional landfill will be identified."

Accordingly, this section includes sections on multi-jurisdictional landfill benefits, costs, and potential risks. In addition, a section has been included which identifies broad land areas within the County borders which may have potential for the establishment of future landfill sites.

5.2 FACILITY SIZING

5.2.1 Planning Horizon

The County indicated that potential future sites should have the capacity of serving the disposal needs of the Cooperative members for a period of 20 years. According to State regulations, municipal solid waste must be disposed of in a "lined" Subtitle D landfill starting in January 1998. Therefore, the planning horizon for the project was determined to be the period 1998 - 2017.

5.2.2 Waste Stream Assumptions

The waste stream projections for the years 1998 through 2017 are presented in Section 3.0, Future Landfill Disposal Needs. The estimated tonnages requiring disposal and the associated landfill volume requirements are provided in Table 3-1.

Assuming a 15% waste recycling/diversion rate, it is projected that a total of 9.135 million tons of municipal solid waste will require disposal over this timeframe. This tonnage would require approximately 22.8 million cubic yards of landfill airspace, and the operation of a 1,300 TPD MSW landfill facility (6 days/week) in 1998.

HDR projects that during the 20-year planning period (1998-2017) approximately 3.8 million tons of LCID waste would require an additional 7.9 million cubic yards of landfill airspace, while disposal of an estimated 2.7 million tons of C&D wastes would require an additional 6 million cubic yards of airspace during this period. In total, 36.7 million cubic yards of landfill airspace would be required to dispose of a total of 15.6 million tons of MSW, LCID, and C&D wastes.

HDR projects that 4.2 million tons of "publicly-controlled" MSW would require disposal over the 1998-2017 timeframe. This tonnage equates to about 10.7 million cubic yards of landfill space and would require the operation of a 600 TPD MSW landfill (6 days/week) in 1998.

5.2.3 Facility Concept and Sizing

To determine the amount of land required to provide 36.7 million cubic yards of landfill "airspace", the following assumptions were made:

- It was assumed that the landfill will be developed in a series of cells; four for MSW and two each for C&D and LCID wastes (see Figure 5-1).
- Each cell would have a square shape at ground level.
- Each cell would be constructed as truncated pyramids on level ground with no excavation. The flat peak would be 2 acres in size.

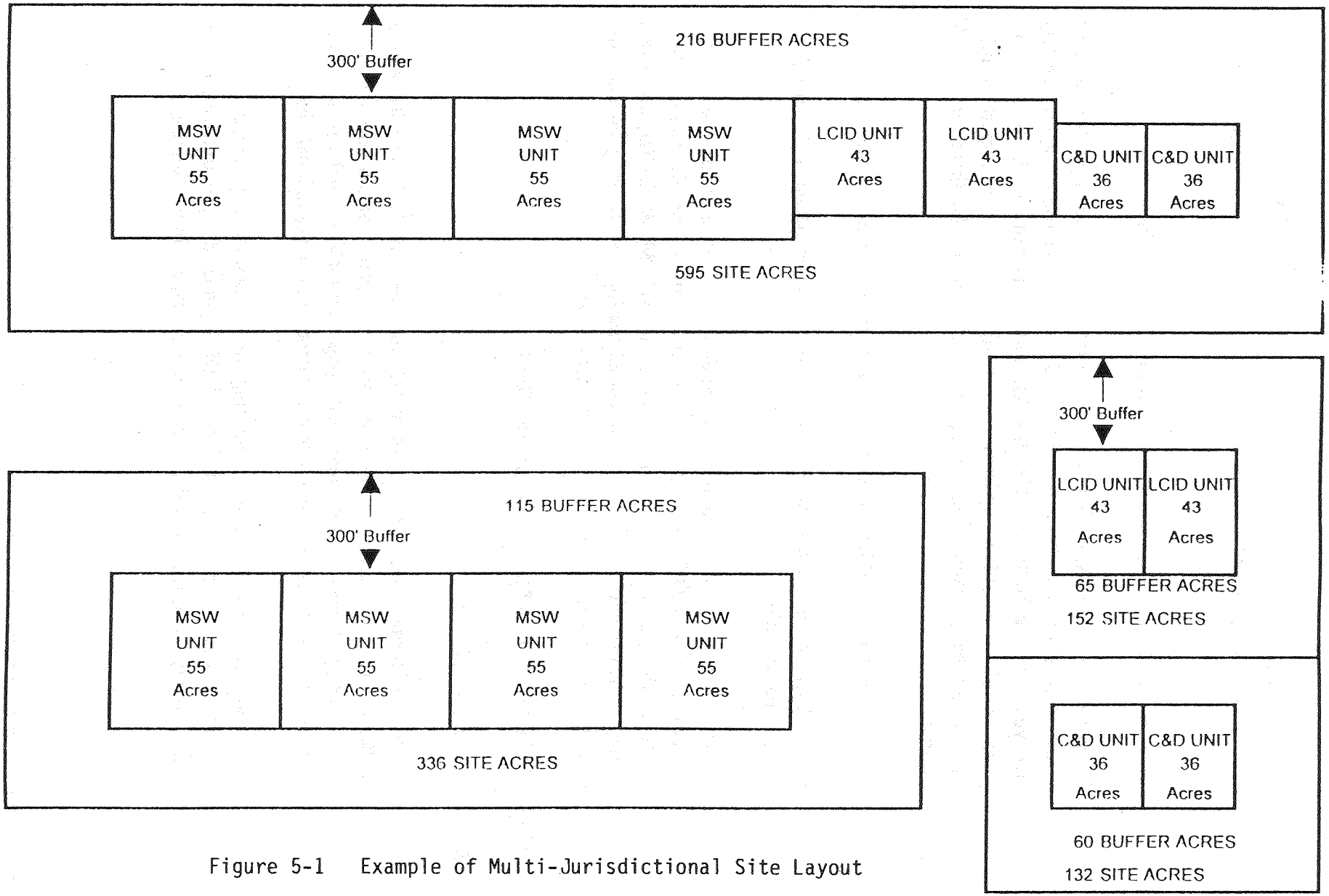

Figure 5-1 Example of Multi-Jurisdictional Site Layout

- The sideslopes of each cell would be 4 horizontal to 1 vertical above ground (4:1).

Final cover airspace requirements were neglected (2-ft. thickness).

Using these assumptions, HDR calculated that the total land required for the units would be approximately 380 acres. Each MSW cell would average approximately five years of landfill life, and each C&D and LCID cell would last about 10 years. To allow for buffer requirements and miscellaneous site support facilities such as leachate treatment impoundments, maintenance facilities, etc., HDR assumed:

- The cells would be oriented in a line with no separation between them.

- There would be a minimum of a 300-foot buffer between property lines and the cells.

These assumptions indicated that an additional 220 acres would be needed. Therefore, a total of 600 acres would be needed to provide the 36.7 million cubic yards of airspace needed to dispose of the County's MSW, LCID, and C&D waste for the planning period. This concept allows for slightly irregular sites and other unknowns while providing for the desired capacity.

5.3 PRELIMINARY POTENTIAL SITE SCREENING

5.3.1 Screening Criteria

When considering the potential for developing new landfill capacity within Guilford County, a basic question which arises is whether or not potential areas exist which could meet landfill zoning and siting requirements, and which contain land parcels having the required acreage for the multi-jurisdictional landfill.

To provide a preliminary answer regarding the availability of potential "Subtitle D" landfill space within Guilford County, HDR conducted a preliminary analysis of the County using the landfill siting criteria contained in the Subtitle D

- The sideslopes of each cell would be 4 horizontal to 1 vertical above ground (4:1).

Final cover airspace requirements were neglected (2-ft. thickness).

Using these assumptions, HDR calculated that the total land required for the units would be approximately 380 acres. Each MSW cell would average approximately five years of landfill life, and each C&D and LCID cell would last about 10 years. To allow for buffer requirements and miscellaneous site support facilities such as leachate treatment impoundments, maintenance facilities, etc., HDR assumed:

- The cells would be oriented in a line with no separation between them.

- There would be a minimum of a 300-foot buffer between property lines and the cells.

These assumptions indicated that an additional 220 acres would be needed. Therefore, a total of 600 acres would be needed to provide the 36.7 million cubic yards of airspace needed to dispose of the County's MSW, LCID, and C&D waste for the planning period. This concept allows for slightly irregular sites and other unknowns while providing for the desired capacity.

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To provide a preliminary answer regarding the availability of potential "Subtitle D" landfill space within Guilford County, HDR conducted a preliminary analysis of the County using the landfill siting criteria contained in the Subtitle D regulations. At this stage of planning, not all of the criteria could be applied due

to the site-specific nature of certain criteria and the lack of available information regarding other criteria.

The application of each criterion to the County land area is discussed below.

In 1991, under the Federal "Resource Conservation and Recovery Act" (RCRA), the U.S. Environmental Protection Agency (EPA) promulgated regulations governing the design and operation of municipal solid waste landfills. As these regulations pertained to "Subtitle D" of RCRA, which deals with municipal solid waste, they have been referred to since that time as "Subtitle D" regulations.

On October 9, 1993, the State of North Carolina adopted 15A NCAC 13B, the North Carolina Solid Waste Management Rules. This state regulation incorporated the requirements of the Federal "Subtitle D" regulations, as well as added a number of state-specific requirements.

As with the federal regulations, the North Carolina "Subtitle D" regulations include restrictions regarding the location of new municipal solid waste landfills. These restrictions are summarized in Table 5-1 and described in the following paragraphs.

5.3.2 Proximity to Airports

There are six public airports within Guilford County: the Piedmont/Triad International Airport, the Southeast Greensboro Airport, Seller's Landing Strip, the Air Harbor Airport, the May Airport, and the Causey Airport. All of these airports can accommodate turbojet aircraft, and therefore all will require a 10,000-foot buffer zone from the runway ends.

This criterion states that, for landfills located within these buffer zones, the owner or operator must demonstrate that the landfill is designed so that it "does not pose a bird hazard to aircraft." That is, a landfill can be located within the buffer zone if this demonstration is made successfully. Any new landfill facility within a 5-mile radius of an airport must notify the FAA of its location.

Table 5-1 Guilford County, North Carolina Subtitle D Landfill Siting Criteria	
Category	**Requirements**
Airport Safety	• Greater than 5,000 FT from runway used by piston aircraft. • Greater than 10,000 FT from runway used by turbo-jet aircraft. • Five-Mile Notification Zone.
Floodplains	• Must not restrict flow of 100-year flood.
Wetlands	• New landfills are prohibited in wetlands.
Fault Areas	• Greater than 200 FT from fault displaced in Holocene time.
Seismic Zone	• Must be designed to withstand maximum horizontal acceleration expected from the seismic impact zone.
Unstable Areas	• Measures required to ensure structural integrity of the landfill components.
Cultural Resources	• Cannot damage or destroy an archaeological or historical property.
State Nature and Historic Preserve	• New MSWLF units may not have an adverse impact on any lands included in the State Nature and Historic Preserve.
Water Supply Watersheds	• New MSWLF units are prohibited in the critical area of a water supply watershed or in the watershed for a stream classified as WS-1, in accordance with the rules codified at I5A NCAC 2B .0200- "Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina." • New MSWLF units that will discharge leachate to surface waters at the facility and must obtain a NPDES permit shall not be located within watersheds classified as WS-II or WS-III, in accordance with the above mentioned rules.
Endangered and Threatened Species	• New MSWLF units shall not jeopardize the existence of endangered or threatened species or result in the destructions or adverse modification of a critical habitat.
Vertical Separation Requirements	• New MSWLF units shall be constructed so that the post settlement bottom elevation of the base liner system is a minimum of four FT above seasonal high groundwater table and/or bedrock.
Horizontal Separation Requirements	• More than 300 FT from property line. • More than 500 FT from private residences and wells. • More than 50 FT from any stream, river, or lake.

5.3.3 Floodplains

The "Floodplains" criterion requires that new MSWLF must not restrict the flow of the 100-year flood (Rule .1622 (2)). HDR acquired GIS maps from the County showing the 500-year flood zone. Additionally, the Flood Insurance Rate Map from the Federal Emergency Management Agency (FEMA) can be used to analyze the impact of this criterion. These maps show the approximate areas expected to be within the 100-year floodplain. Based on this analysis, HDR determined that this criteria's impact was minimal, and could be dealt with, on a case-by-case basis, during the design process.

5.3.4 Wetlands

The determination of the existence of wetlands on a potential area can be made only through a site visit onto the property and the visual observation of plant species, soil types, and water. As permission to access the potential areas was beyond the scope of this study, field recognizance work was not performed. With a large portion of its terrain being hilly, Guilford County does not have large areas which could be considered "wetlands" or swamps. For this reason, it would be unreasonable to exclude region based solely on the wetlands criterion.

5.3.5 Seismic Impact Zones

To determine the seismic impact zone for the County and selected areas, the USGS Miscellaneous Field Studies Map (MF-2120C) was consulted. This map is part of the Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico, and shows that portions of the County are greater than the 0.10 g criteria for a seismic impact zone as defined by the North Carolina regulations (Rule .1622 (5)). The expected level (95% confidence level) of earthquake activity in this zone would result in a maximum horizontal acceleration of approximately 0.09g - 0.12g (g = the acceleration of gravity). Landfills have been designed and built in other areas of similar activity, and it is HDR's opinion that the landfill structures can be designed to withstand this level of acceleration.

Therefore, the application of the seismic impact zone criteria was not used to exclude any areas from further consideration.

5.3.6 Fault Areas

Fault offsets in Holocene strata have not been recognized in the Carolinas (Prowell, D.C. and Obermeier, S.F., 1991, The Geology of the Carolinas: Carolina Geological Society Fiftieth Anniversary Volume: Knoxville, The University of Tennessee Press, pp.309-318. Therefore, the application of this criterion would not result in the exclusion of any areas, and requirements set forth in Rule .1622 (4) would be complied with.

5.3.7 Unstable Areas

Knowledge of the geology and geomorphology of the surrounding area indicate that potential landfill areas in Guilford County are not generally unstable areas. The county is situated in typical North Carolina terrain, with stable slopes and no areas of landslides, avalanches, debris slides or flows, soil fluction, block sliding, or rock falls. The soils that are present are sandy silts to silty sands that provide excellent foundation stability throughout the region. As generally the case throughout the Piedmont, no limestones or marbles are present in the area, thus Karst terrain cannot be present. Site specific field surveys would be required to confirm that there are no local soil conditions that may result in significant differential settling, no local geologic or geomorphological features that are conducive to unstable conditions, or no local human-made features or events should not contribute to unstable conditions. However, there are no known areas of significant instability that would rule out any areas at this phase of the study.

5.3.8 Cultural Resources

In order to identify potentially significant archaeological or historical resources within Guilford County, an informational search must be performed by the North Carolina Department of Cultural Resources, Division of Archives and History. In order to comply with Rule .1622 (7), no new MSWLF unit may be placed where an area of cultural or historical significance may be damaged or destroyed.

5.3.9 State Nature and Historic Preserves

In order to determine whether or not a proposed area encompasses or surrounds any lands in the State Nature and Historic Preserve, an informational search must be performed by the North Carolina Department of Cultural Resources. Compliance with Rule .1622 (8) requires that no new MSWLF unit have an adverse impact on any lands included in the State Nature and Historic Preserve.

5.3.10 Water Supply Watersheds

According to Rule .1622 (9), no new MSWLF units are permitted in the critical area of a water supply watershed or in the watershed for a stream classified as WS-1, in accordance with the rules codified at 15A NCAC 2B .0200 - "Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina."

In addition, any new MSWLF units that will discharge leachate to surface waters at the facility and that are required to obtain an NPDES permit shall not be located within watersheds classified as WS-II or WS-III, in accordance with the same above mentioned rules.

5.3.11 Endangered and Threatened Species

In order to identify the potential for destruction or modification of a critical habitat or endangered or threatened species, an informational search must be performed by the NC DEHNR. Previous studies indicate that Guilford County has three (3) state-ranked special concern areas and one (1) federally listed endangered species. The special concern species consist of *Ambystoma talpoideum* (mole salamander), *Etheostoma collis* (Carolina darter), and *Lanius ludovicianus* (loggerhead shrike). The federally endangered species is the *Haliaeetus leucocephalus* (bald eagle). Once identified, individual areas would be surveyed to confirm the applicability of this restriction.

In order to be in compliance with Rule .1622 (10), any new proposed MSWLF facilities must not jeopardize the continued existence of these endangered or

threatened species or result in the destruction or adverse modification of a critical habitat.

5.3.12 Vertical Separation Requirements

In accordance with Rule .1624 (4), new MSWLF units must be constructed so that the post settlement bottom elevation of the base liner system is a minimum of four feet above the seasonal high groundwater table and/or bedrock. This criteria is typically of address in the preliminary design stage of site selection.

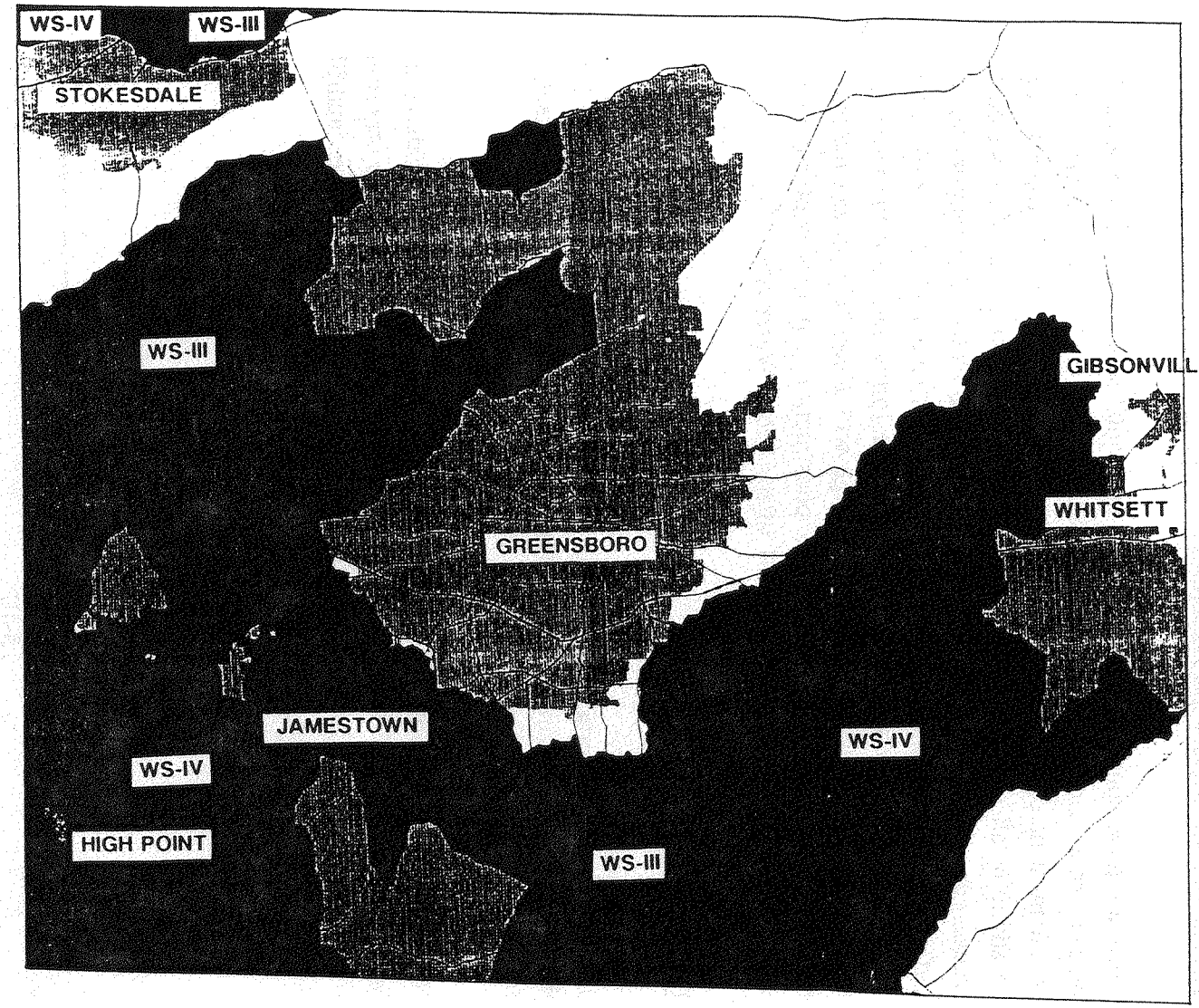
5.3.13 Horizontal Separation Requirements

There are three considerations relating to horizontal separation requirements that must be met in order to comply with Rule .1624 (3). A minimum 300-foot buffer must be established between a new MSWLF unit and all property lines. In addition, all new MSWLF units must establish a minimum 500-foot buffer between the unit and existing private residences and wells. A minimum 50-foot buffer must be established between new MSWLF units and any stream, river, or lake, unless the owner can demonstrate the following: that the alternative management of the water and any discharge will adequately protect the public health and environment; and that the construction activities conform to the requirements of Sections 404 and 401 of the Clean Water Act.

5.3.14 Initial Screening Results

The application of certain "Subtitle D" criteria at this preliminary stage led to the elimination of certain areas from further consideration as areas for potential future landfill sites. These areas are indicated in Figure 5-2.

In addition to the Subtitle D criteria, HDR also eliminated from consideration land in "Watershed IV" (WS-IV) designated areas. The addition of this criterion further reduced the amount of potential land available for future landfill development, as shown in Figure 5-3.



N

LEGEND

HIGHWAYS

POTENTIAL AREAS

NON-OPTIMAL AREAS

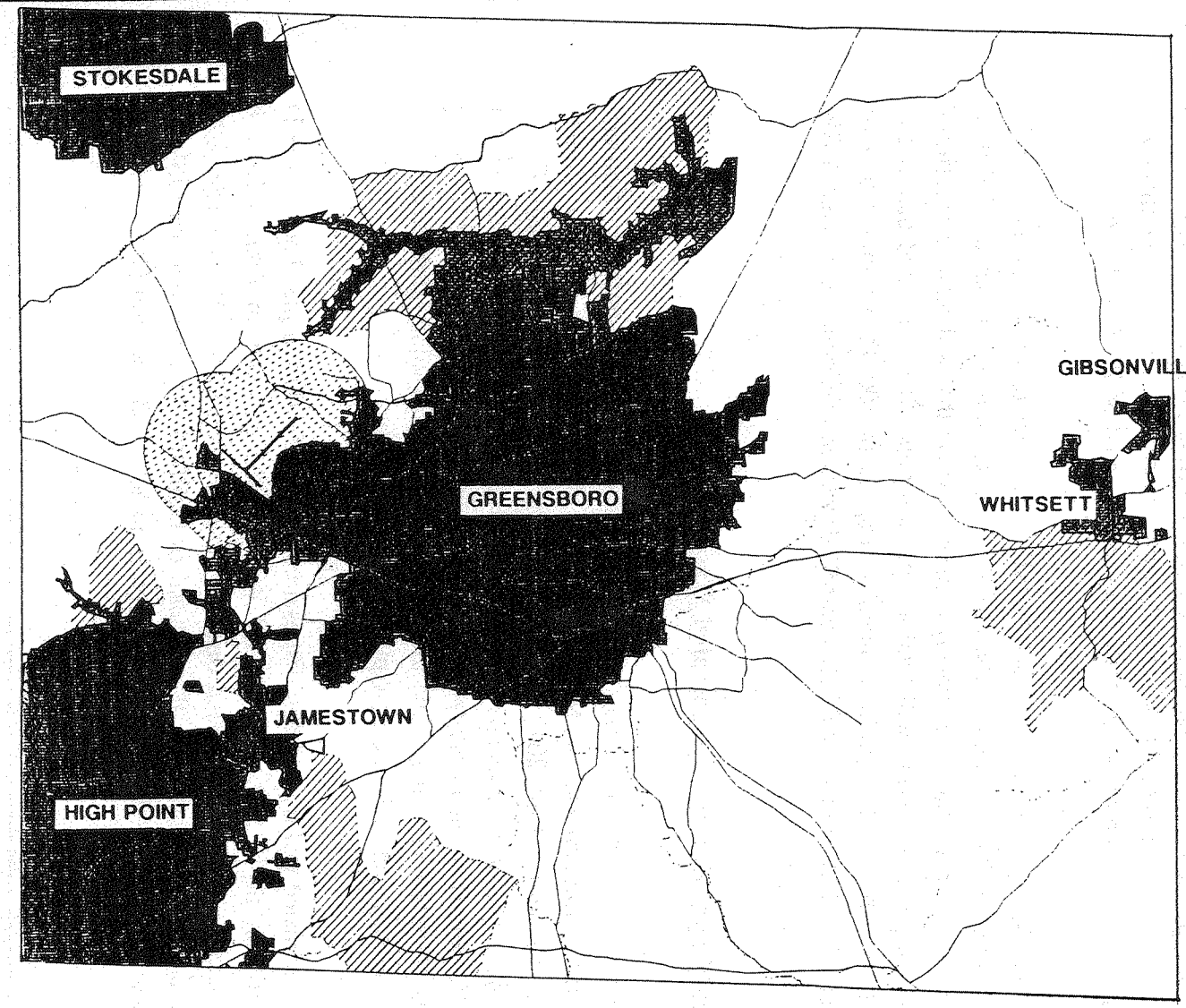
HDR

HDR Engineering, inc. of North Carolina

GUILFORD COUNTY, N.C.
SOLID WASTE MANAGEMENT STUDY
POTENTIAL LANDFILL SITING AREA

Date 12/95

Figure 5-2



N

LEGEND

- HIGHWAYS
- INCORPORATED AREAS
- CRITICAL WATERSHED AREAS
- AIRPORT W/10,000' BUFFER

HDR

HDR Engineering, Inc. of North Carolina

GUILFORD COUNTY, N.C.
SOLID WASTE MANAGEMENT STUDY
APPLICATION OF PRELIMINARY CRITERIA

Date 12/95

Figure 5-3

5.4 PRELIMINARY LANDFILL COST ANALYSIS

5.4.1 Waste Flow Assumptions

For the comparative purposes, two different scenarios have been included in the preliminary analysis of the costs associated with the development of a multi-jurisdictional landfill to serve Guilford County's disposal needs over the 20-year planning period. The first scenario involves sizing the fill areas to accommodate all Guilford County MSW which is projected to be generated over the 20-year planning period (9.135 million tons at a 15% diversion rate). It is projected that a total of 22.8 million cubic yards of landfill airspace (a 1,300 TPD facility) will be required for the disposal of all County-generated MSW (see Table 3-2).

The second scenario involves sizing the MSW fill areas to accommodate only the publicly-controlled portion of the MSW. It was estimated in Section 3.0 that, at a 15% diversion rate, the publicly-controlled MSW that will require landfilling over the planning period will total 4.2 million tons. It is projected that a total of 10.5 million cubic yards of landfill airspace (a 600 TPD facility) will be required to dispose of the publicly-controlled portion of County-generated MSW (see Table 3-4).

5.4.2 Landfilling All County-Generated Waste

The unit costs and economics associated with developing a multi-jurisdictional landfill to accommodate all MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 5-2 and Appendix G this report. The costs associated with the development of the multi-jurisdictional landfill are based on an assumed transport cost of $2.00 per truck mile, an 8-ton payload per packer truck, and the assumption that all County-generated wastes will be disposed of in the new public landfill facility.

It is estimated that the average disposal costs for a 1,300 ton per day Subtitle D landfill would be $19 per ton (1995 dollars). As is shown in Table 5-2, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of Guilford County-generated MSW at a new multi-jurisdictional landfill range from $27 - $35 per ton (1995 dollars),

TABLE 5-2

GUILFORD COUNTY SOLID WASTE MANAGEMENT STUDY
SUMMARY OF ECONOMIC ANALYSES:
MULTI-JURISDICTIONAL LANDFILL

Jurisdiction / Waste Description		Disposal of All County-Generated MSW (1,300 TPD Facility)		Disposal of Publicly-Controlled County-Generated MSW (600 TPD Facility)	
		Total Costs	Cost/Ton[1]	Total Costs	Cost/Ton[1]
City of Greensboro					
Publicly-Controlled Waste	37%	$89,569,000	$27	$109,849,000	$33
Privately-Controlled Waste	22%	$53,257,000	$27	$70,340,000	$35
Subtotal	**59%**	**$142,826,000**		**$180,189,000**	
City of High Point					
Publicly-Controlled Waste	10%	$31,973,000	$35	$37,454,000	$41
Privately-Controlled Waste	14%	$44,762,000	$35	$45,401,000	$36
Subtotal	**24%**	**$76,735,000**		**$82,855,000**	
Other County MSW	**17%**	**$41,930,000**	$27	**$55,906,000**	$36
TOTAL	**100%**	**$261,491,000**	**$29**	**$318,950,000**	**$35**

Note:
(1) Cost/ton include both hauling and disposal costs. All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

for an average of $29 per ton (1995 dollars). The City of High Point will incur the greatest costs as a result of the hauling distance to the new public landfill facility, as it has been assumed that the location of a new multi-jurisdictional landfill would be in the north east quadrant of the County (see Figure 5-3).

5.4.3 Landfilling Only Publicly-Controlled Waste

The unit costs and economics associated with developing a multi-jurisdictional landfill to accommodate only the publicly-controlled MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 5-2 and Appendix G this report. The costs associated with the development of the multi-jurisdictional landfill are based on an assumed transport cost of $2.00 per truck mile, an 8-ton payload per packer truck, and the assumption that only publicly-controlled County-generated wastes will be disposed of in the new public landfill facility. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities. For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County.

To accommodate the publicly-controlled future disposal needs of Guilford County, it is estimated that the average disposal costs for a 600 ton per day Subtitle D landfill would be $25 per ton (1995 dollars). As is shown in Table 5-2, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled MSW at a new multi-jurisdictional landfill range from $33 - $41 per ton (1995 dollars), for an average of $35 per ton (1995 dollars). The City of High Point will incur the greatest costs as a result of the hauling distance to the new public landfill facility, as it has been assumed that the location of a new multi-jurisdictional landfill would be in the northeast quadrant of the County (see Figure 5-3).

The costs associated with the disposal of privately-controlled MSW are based on an assumed transport cost of $2.00 per truck mile, an 8-ton payload per packer truck, and the assumption that all privately-controlled County-generated waste will be hauled to the Piedmont Landfill for disposal at a tipping fee of $27.50 per ton (1995 dollars). As is shown in Table 5-2, once transport costs and associated disposal costs are considered, the average cost estimated to be is $35.00 - $36.00 per ton of waste disposed of at the Piedmont Landfill.

5.5 CONCLUSIONS

As indicated in Figure 5-3, there appears to be significant areas of land that have the potential to meet "Subtitle D" landfill siting criteria and, at the same time, can provide the required 600 acres of contiguous land. Based on this analysis, HDR is of the opinion that it is likely that one or more future landfill sites of 600 acres in size and which meets Subtitle D landfill siting criteria for a 1,300 TPD MSW landfill facility, could be found in Guilford County.

From an economic standpoint, the development of a new landfill which would be sized to accommodate all of the MSW generated within Guilford County over the planning period would be the preferred option, should the County proceed with efforts to site a multi-jurisdictional landfill facility. However, such economic benefits would only be realized if some sort of mechanism was put into place (such as long-term contracts with private haulers) to assure that the flow of all County-generated MSW was indeed under the County's control.

Section 6.0
Review of Waste-to-Energy Alternatives

6.1 INTRODUCTION

The realization of additional resource recovery benefits from municipal waste, after materials recycling efforts have been maximized, can be achieved through energy conversion systems. Energy conversion systems include mass-burn systems and refuse-derived fuel combustion systems.

The purpose of this section is to present a review of waste-to-energy alternatives which are available to Guilford County. In reviewing technologies, the economic and environmental impacts, diversion/recovery potential, and technical feasibility of establishing a multi-jurisdictional waste-to-energy facility are also identified.

6.2 REVIEW OF WASTE-TO-ENERGY SYSTEM OPTIONS

Waste-to-energy facilities are designed to combust solid waste in an environmentally acceptable manner so as to reduce the amount of material that requires landfilling and to generate energy in the form of steam, electricity, or both. Combustion technologies which have demonstrated experience include mass-burn systems and refuse derived fuel (RDF) combustion systems.

6.2.1 Mass-Burn Systems

"Mass-Burn" refers to the combustion of MSW as received, with little or no processing or removal of materials. Combustion occurs in furnaces that have been specifically designed to accommodate the heterogeneous characteristics of the waste stream. Mass-burn is the waste-to-energy technology most widely used worldwide. The principal components of a mass-burn plant include the waste storage and feeding systems, combustion grates, and combustion units (furnace and boiler). Figure 6-1 presents an example of a field-erected mass-burn facility.

the specific chemical reactions that take place. Because of the problems associated with controlling the chemical reactions and maintaining product quality, the marketing of gaseous and solid pyrolysis products has not been successful, and there are no pyrolysis systems in commercial operation in the United States.

6.2.2.5 Technical Feasibility

RDF combustion technology is commercially operational at several facilities in the U.S. There have been shutdowns of earlier projects due to technical problems, including poor fuel quality, high ash quantities leading to lower boiler efficiencies and boiler fouling, and slagging and corrosion; however, these problems seem to have been solved. At present, several facilities located in the U.S. successfully process waste to produce RDF using mechanical means.

6.3 WASTE DIVERSION POTENTIAL

Both mass-burn and RDF combustion options have the potential of realizing landfill diversion rates of up to 75% of the waste stream on a weight basis. The SPSA RDF Plant in Chesapeake, Virginia, processed a total of 394,014 tons of MSW in fiscal year 1994/95. A total of 315,748 tons of refuse-derived fuel (RDF) was produced, while 8,656 tons of ferrous scrap were recovered along with 747 tons of aluminum, for a total diversion rate of 82.5%. A total of 73,765 tons of ash waste was generated by the combustion of RDF to yield a net diversion rate of 61%.

6.4 ENERGY RECOVERY POTENTIAL

Energy from mass-burn systems or RDF combustion in conventional boilers is generally recovered in the form of hot water, steam, or electricity. Hot water is used primarily in district heating application; steam may be used in various industrial processes (including heating and cooling) or passed through a conventional turbine-generator to produce electricity. There is limited experience with the energy recovered from biological and chemical processes such as anaerobic digestion or pyrolysis. It is generally anticipated, however, that the nature of the RDF fuel stock would require some type of fuel cleaning or scrubbing to provide commercial-grade products. The following discussion focuses on the energy recovered by mass-burn and RDF combustion systems.

The amount of energy recovered from MSW is a function of the energy content of the incoming waste and the recovery efficiency of the combustion technology. The energy content of MSW will vary based on the individual waste components and their moisture

6.2.1.1 Waste Storage and Feeding Systems

Mass-burn systems typically have a large pit, or bunker, to store the MSW that has been collected from waste generators and delivered in a variety of collection vehicles. The capacity of the storage pit is primarily a function of the disposal capacity and the delivery schedule (generally referred to as the throughput capacity) of the waste-to-energy plant. Disposal capacity is expressed in tons per day (TPD). Typically, the storage pit capacity is designed to accommodate 3-4 days of MSW storage at the rated plant disposal capacity to provide for continuous operation of the Facility. The storage pit area, and often the adjacent vehicle maneuvering area, is fully enclosed, and a slight negative pressure is maintained to minimize the release of odors. Combustion air is drawn from the storage pit area to produce this negative-pressure condition. An overhead traveling bridge crane system spans the entire length of the pit. The crane system is used to mix the waste in the pit to provide more uniformity and manage storage space by stacking waste against the pit walls. It also removes large, bulky, or non-combustible materials such as furniture or appliances which may cause pluggage of waste flow.

Most mass-burn plants use a gravity feed chute to introduce MSW into the combustion unit. The crane system removes MSW from the storage pit and deposits the MSW into the gravity feed chute. The feed system must be designed to prevent burnback from the furnace and provide an adequate air seal for the furnace. Typically, the chute is water cooled, and the chute and hopper design configuration prevents the MSW from bridging or jamming. The bottom of the feed chute often has a cycling ram to control the waste feed rate onto the combustion grates. Automation of the ram feed system helps maintain efficient combustion.

6.2.1.2 Combustion Grates

Because MSW is heterogeneous, its combustion results in an uneven heat release. This affects the efficiency of the combustion system, which in turn impacts air emissions and energy recovery. To minimize the impacts of a heterogeneous fuel, various waste-to-energy combustion grate systems have been specifically designed to agitate the MSW during the combustion process and thereby provide a more uniform and thorough burnout. Combustion grates are usually inclined and are designed to tumble, turn, and move the waste through the combustion chamber of the furnace. Many mass-burn system designs incorporate air flow control to create various combustion zones in the furnace for drying,

volatilization, ignition, and burnout. Varying the grate speed and combustion air distribution within the zones enhances combustion control.

Combustion grate designs commonly used in mass-burn systems include reciprocating grates, rocking grates, step grates, cascading grates, reverse reciprocation grates, drum or roller grates, and rotary kilns. In addition to agitating the waste, the combustion grate should be designed to provide a relatively uniform depth of bed and combustion surface area. A hydraulic system is typically used to provide grate motion.

Combustion air is introduced through the grates as underfire air in a manner that evenly distributes combustion air through the bed and cools the grates. Grates are generally made from special alloys with heat-resistant properties. Potential problems in the design of combustion grates include blockage of the air opening by small ash particles or melted metals, abrasion of moving grate parts, and wear of hydraulic mechanisms.

6.2.1.3 Combustion Units

Waste-to-energy combustion units generally fall into two categories: field-erected and modular systems. Field-erected systems are used primarily for large-scale facilities (250 TPD and larger), whereas modular systems are used primarily for smaller scale facilities and are normally available in module sizes of 25-125 TPD. As the names imply, field-erected systems are built on site, but modular systems are shop assembled and shipped to the construction site as modules for installation.

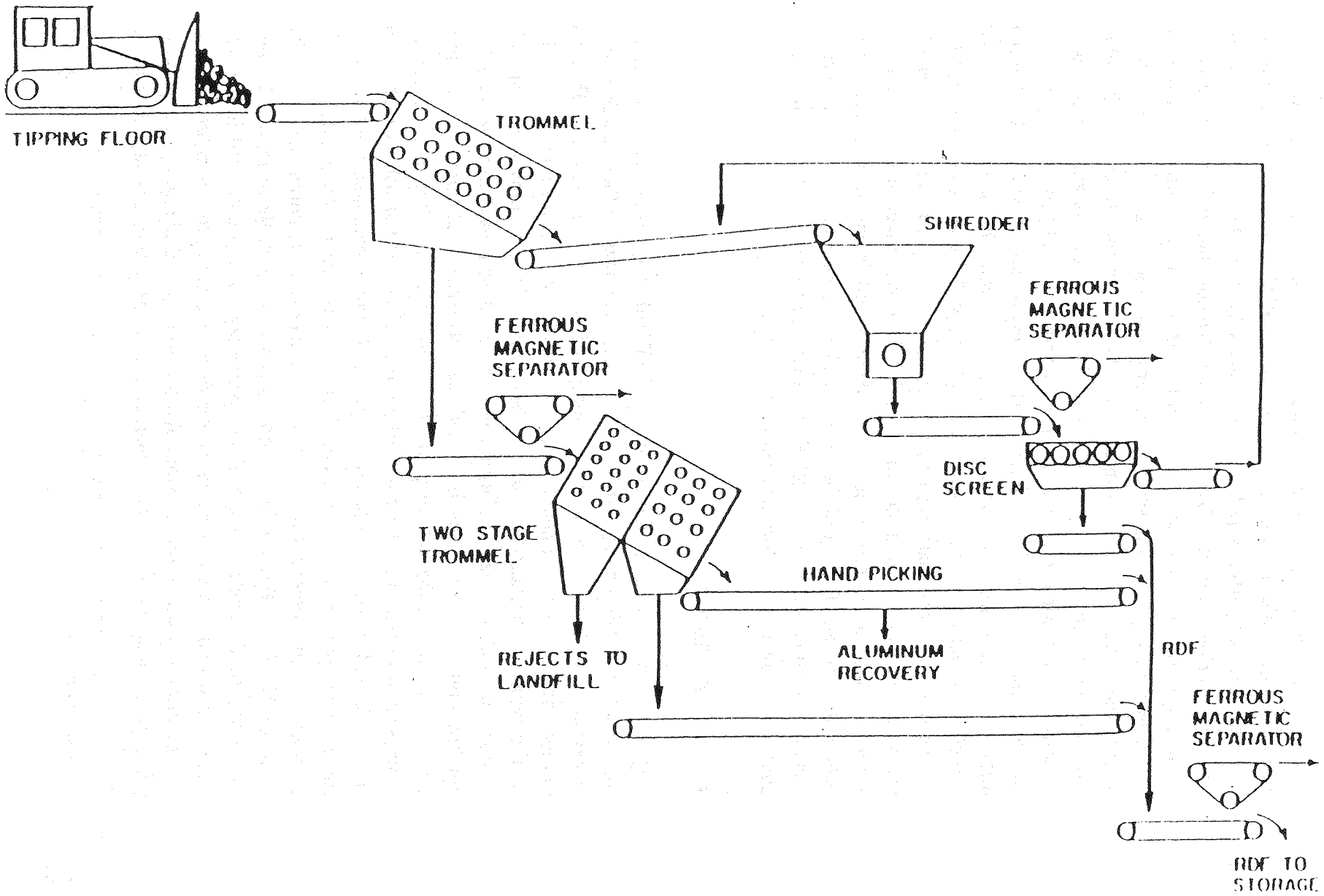
6.2.1.4 Technical Feasibility

The technology associated with mass-burn systems has been suitably demonstrated and is commercially operational at numerous facilities in the U.S. and at nearly 500 facilities worldwide.

6.2.2 RDF Combustion Systems

A second approach to the recovery of energy from waste involves the processing of the waste to produce a "refuse-derived fuel", or RDF. There are four types of RDF combustion systems that can be used for processing MSW: spreader-stoker firing, suspension firing, fluidized-bed incineration, and pyrolytic conversion. Figure 6-2 presents an example of a typical RDF system.

RDF SYSTEM MATERIAL FLOW



SOURCE: HDR

Figure 6-2

6.2.2.1 Spreader-Stoker Firing

In spreader-stoker firing, RDF is fed into the combustion unit through air-swept spouts or pneumatic distributors. Some of the RDF is burned in suspension, while the heavier particles fall onto the grate where combustion is completed. Uniform distribution of the RDF into the combustion unit and onto the grate is required for efficient combustion. Standard traveling, reciprocating, or vibrating grates may be used. Some spreader-stoker combustion units have a waterwall design, with refractory installed in the area above the grates to protect the tubes from corrosion and erosion. Conventional boiler design is appropriate, with combustion air distributed both as overfire air above the fuel bed on the grate and an underfire air through the grate. The overfire air provides the required turbulence and mixing of combustion gases to ensure burnout of suspended particles and volatile matter. Approximately 40-50% excess air is required for combustion. As with mass-burn combustion systems, special alloys are used in the water tubes along the grates to resist the corrosive effect of the combustion gases, and the boiler section must have adequate provisions for ash cleaning to reduce plugging and fouling of the tubes. Older, existing fossil fuel combustion units can be modified to accept RDF as a fuel. The use of existing combustion units may provide an opportunity for cost savings.

6.2.2.2 Suspension Firing

Suspension firing involves the co-firing of RDF in suspension with pulverized coal. RDF normally supplies 10-20% of the total heat input in these applications. Suspension firing requires a more highly refined and processed RDF than spreader-stoker firing. Although there are a variety of fuel feed techniques, the RDF is typically introduced into the combustion unit by a pneumatic system with a surge bin. Either heated combustion air or ambient air is used to blow the RDF into the boiler at various levels around the pulverized coal burners. A dump grate is required in the bottom of the boiler to allow any RDF not completely combusted in suspension to burn out before being discharged as ash. Combustion air may be added above and below the grates to ensure complete combustion of the heavier particles. Suspension-fired systems have more efficient air distribution than spreader-stoker systems, and excess air requirements are in the range of 10-20%. Because of the high gas velocities in the combustion unit, suspension-fired systems have a higher percentage of ash entrained in the flue gas. Similar to the case of spreader-stoker firing, the boiler design must take into consideration the corrosion, erosion, and ash fouling and plugging. Suspension firing is most applicable when a market exists for a supplemental fuel to be

burned in an existing boiler designed for suspension firing of coal, such as utility plants. Because of the additional problems of dealing with multiple fuels and repermitting issues, utilities have not historically expressed much interest in this approach.

6.2.2.3 Fluidized-Bed Firing

Fluidized-bed combustors have a bed of thermally inert material, such as sand and/or limestone, which is kept suspended in the combustion unit through the action of fluidizing air distributed below the bed. RDF can be introduced into or on top of the bed, mixed by the fluidizing air and bed material, and combusted in the turbulent bed of inert material. The turbulence of the fluidized bed allows the combustion to take place at a lower temperature than in conventional combustion system without a significant effect on the combustion efficiency. This is beneficial in reducing certain air emissions, particularly sulfur dioxide and nitrogen oxides. Figure 6-3 presents an example of a fluidized-bed combustor.

RDF is typically not fired alone in fluidized-bed combustion systems; coal or wood are co-fired with the RDF to help in maintaining stable firing conditions. Although fluidized-bed combustion has been used for a variety of fuels, experience with RDF is limited. The level of processing required may vary depending on the design characteristics of the specific fluidized-bed technology used. Problems may occur if the RDF contains excessive amounts of glass, which can cause agglomeration of bed particles. Accumulation of noncombustible objects may lead to defluidization of the bed. Ash and residue from the RDF may also change the physical and chemical composition of the bed, thus requiring continuous bed replacement.

6.2.2.4 Pyrolysis

Pyrolysis systems convert organic materials in an oxygen-deficient environment into a combustible gaseous or liquid product and a solid, carbon-rich residue. Although unprocessed MSW may be subjected to pyrolytic conversion, a more homogenous feedstock is necessary to improve operation efficiency and product quality. MSW must generally be finely shredded and screened to produce a high-quality RDF material that has the majority of glass, sand, grit, and metals removed. The composition and yield of the pyrolysis products can be varied by controlling operating parameters such as feedstock composition, pressure, temperature, time, and feedstock particle sizing and by using catalysts or co-fired auxiliary fuels. The variable nature of RDF composition complicates control of

content. As a rule of thumb, the higher heating value of unprocessed MSW will vary from 3800 to 5500 Btu/lb of MSW, with an average higher heating value of 4500 Btu/lb. (This is roughly equal to half the heat value of coal.) MSW processing will result in removal of a portion of the waste material (ranging from 20-40%, depending on the level of processing) and subsequent increase in the higher heating value of the remaining RDF. The higher heating value of RDF can vary from 5200 to 7500 Btu/lb of RDF.

MSW combustion technologies have varying levels of energy recovery efficiency. Field-erected mass-burn units have an expected thermal efficiency of 65-74% for waterwall systems and a lightly lower range of 60-70% for refractory systems. Modular mass-burn units vary widely, with energy recovery efficiencies ranging from 40-60%. Dedicated RDF combustion units can be expected to have an energy recovery efficiency of 70-75%. Typically, 2-8 lb of steam per pound of unprocessed MSW can be generated in mass-burn and processed waste systems. Steam conditions are limited by flue gas temperatures and corrosion concerns. Steam conditions can range from 315 degrees C for modular mass-burn systems to 454 degrees C for field-erected mass-burn systems.

The net electrical output is affected by in-plant power consumption. Mass-burn systems have steam or electrical demands to run motors, fans, and other plant equipment. Process waste systems use varying amounts of electricity, depending on the specific equipment and the degree of processing. Plant-specific factors include differing air pollution control requirements and the use of air-cooled versus water-cooled condensers. Given the fact that energy recovery will vary widely, the net electrical production for various technologies ranges from 300 to 400 kWh/ton of incoming MSW for modular mass-burn systems, from 400-600 kWh/ton for field-erected mass-burn system, and from 420-525 kWh/ton for processed waste systems.

6.5 ECONOMIC CONSIDERATIONS

6.5.1 Mass-Burn Systems

Mass-burn projects are capital intensive, with an anticipated cost of $125K - $150K per ton throughput. Including energy revenues, tipping fees in the $50 - $100 range are typical. Because of the high capital costs of mass-burn systems, consistent waste flows and energy market security are vital to the long-term viability of such projects. Therefore energy markets should be carefully evaluated for the price offered for the energy, willingness to negotiate long-term purchase contracts, and their long-term viability as a business enterprise. In the case of electric sales, federal regulations under the Public Utilities Regulatory Policy Act require that public utilities purchase electricity generated from

qualifying facilities which can include waste-to-energy facilities. In certain cases, cogeneration systems can be utilized which generate both steam and electricity, which provides the most efficient use of the energy created. Energy revenues may be used to offset some of the construction and operating costs associated with the system.

6.5.2 RDF Combustion Systems

As is the case with mass-burn projects, RDF combustion systems are capital intensive. The initial capital investment required to purchase combustion systems used for RDF are generally lower than combustion systems required for mass-burn projects. However, these initial expenses may be offset by higher maintenance costs for both the process system and boilers.

Some facilities have been forced into closure due to the absence of markets for the RDF, termination of support grants for pilot programs, and higher-than-anticipated operating costs.

The capital costs of RDF systems can be divided into two major components: 1) the RDF production facility, and 2) the RDF combustion facility. Historically, when compared with mass-burn systems, savings achieved by building smaller combustion facilities to burn RDF are more than offset by the added costs (both capital and O&M) of the RDF production facility.

In the 1970's, RDF systems were originally developed with the concept that the RDF combustion facility would be an industrial boiler (constructed and owned by an industry and co-fired with other fuels). Because of contractual problems associated with selling RDF, system developers began to construct dedicated RDF combustion facilities as a part of the system. While this approach drove up the costs of RDF systems, it eliminated the contractual problems of selling RDF and instead, sold steam, electricity, or both to industrial and utility customers.

The Clean Air Act Amendments of 1990 tightened limits of industrial boilers regarding sulfur dioxide emissions. This development has spurred industrial interest in low-sulfur fuels such as RDF.

As a case in point, the 850 TPD BCH facility in Fayetteville, North Carolina, includes the construction of an RDF combustion facility (consisting of a fluidized bed boiler) on the site of a Dupont manufacturing plant. The reported capital investment for the BCH project (for both the RDF production and combustion facilities) is $70,000,000, which translates to $82,000 per ton of design capacity.

6.6 ENVIRONMENTAL ISSUES

Mass-burn systems substantially reduce waste disposal volumes and prolong the life of landfills. The primary environmental concerns are: air emissions, ash disposal, and the increased levels of noise, odors, and traffic near the facility.

RDF mechanical processing systems substantially reduce waste disposal volumes and prolong the life of landfills. The primary environmental concerns are the content of the exhaust gas and the ash disposal methods.

Any environmental impact analysis of either mass-burn or RDF combustion should consider the positive environmental benefits of reducing the environmental impacts associated with landfill disposal of waste and the offsetting of the air pollution associated with the combustion of an equivalent amount of fossil fuel (or whatever fuel is being displaced). In the case of the BCH Energy project, it is reported that NO_x and SO_2 emissions will be reduced by 50% when compared with emissions from existing oil-fired boilers. In a comparison made between municipal waste and fossil fuel combustors, oil-based FFCs emitted 2.6 times the amount of particulates and 5.2 times the amount of SO_2, but only 0.6 times the amount of NO_x (see Table 6-1).

TABLE 6-1
EMISSION RATE IN POUNDS PER 1,000 KILOWATT HOURS[1]

Pollutant	MWC	Coal	Oil	Ratio	
				Coal/MWC	Oil/MWS
Particulates	0.41	0.95	1.05	2.3	2.6
SO_2	1.61	11.35	8043	7.0	5.2
NO_X	5.45	6.62	3016	1.2	0.6

Notes: 1) Based on calculations from regulatory limits and reference plant scalers.

Source: "Municipal Waste Combustors: Environmentally Sound Power Plants", by Walter R. Niessen, P.E., Solid Waste & Power, January/February, 1993, p.14.

6.7 REGIONAL PROJECT EXAMPLES

6.7.1 Mass-Burn Systems

6.7.1.1 University City

A 235 TPD facility began operations in Mecklenburg County, North Carolina, in June of 1989. The facility, which incorporated the Volund mass-burn technology, operated as a cogeneration energy system, with steam being sold to the University of North Carolina at Charlotte and Duke Power Company. Due to financial problems associated with non-competitive tipping fees, the facility shut down mid-1995 and has no plans to reopen at this time.

6.7.2 RDF Spreader Stoker Firing

6.7.2.1 SPSA (RDF-Spreader Stoker Firing)

The RDF processing plant located in Portsmouth, Virginia, began commercial operations in January of 1988. The plant serves as a disposal point for the majority of the Portsmouth-area solid waste. Non-processible waste is separated upon its arrival and is either recycled or landfilled. The plant processes the remaining waste as RDF for use in the nearby power plant which serves the Norfolk Naval Shipyard with steam and electricity.

The RDF plant contains three identical processing lines, each having a design capacity of 70 tons per hour. Since the beginning of operations, the RDF quality has consistently exceeded the requirements of the contract. The RDF plant is capable of providing more than the quantity of RDF required by the power plant. However, during months of low waste quantities, the solid waste supply has not been adequate for the demands of the RDF plant and the energy needs are met by increasing coal input.

6.7.3 RDF- Fluidized Bed Combustion

6.7.3.1 BCH - Energy Project

In November 1993, VEDCO Energy Corp. began construction of a 600 TPD waste-to-energy facility located in Fayetteville, North Carolina. The facility, known as the BCH Energy Facility, came on line in August 1995. The facility is the first of its kind to incorporate a fluidized-bed boiler to combust refuse-

derived fuel. The BCH Energy Project receives the solid waste from Bladen, Cumberland, Hoke, and Brunswick Counties and converts it into useful recyclables, process steam for DuPont, and electricity for Carolina Power & Light Company. The $90 million dollar project is privately financed, with no debt to the participating communities.

The BCH Energy Project is broken down into two stages: the recycling and materials recovery facility, and the energy generation facility. In the first stage, 90% of the incoming waste is diverted for beneficial use. Recyclables such as cardboard, aluminum, metals, plastic, and glass are separated and baled for sale. The remaining combustible materials are separated to form refuse-derived fuel, leaving only a small portion of the original waste to be landfilled. The RDF is then trucked to the second stage, the energy generation facility. In this stage, the RDF is burned in specially designed fluid-bed boilers to produce process steam for DuPont and electricity for Carolina Power & Light. This technology results in greatly reduced emissions and a non-toxic ash that may be used in the manufacture of concrete and asphalt.

One attraction of fluidized bed combustors is a competitive capital cost compared to conventional MSW combustors. The turnkey cost (including financing costs and a capital cost of $70,000,000) of the Fayetteville project is approximately $90 million, which was all privately financed. The tipping fees are in the range of $35 per ton for the three sponsoring counties, and this fee includes the cost of transportation from two transfer stations in Hoke and Bladen Counties. Steam sales, power sales, and recyclable material sales provide revenues to help reduce the tipping fee. Revenues from sale of recyclables are split between the MRF operator and the three counties.

By making use of the BCH Energy Project, Bladen and Hoke Counties were able to suspend operations at existing landfills, which would not meet new landfill standards without expensive upgrades. Cumberland County expects to extend its landfill capacity by 100 years.

The facility will also help the counties meet state recycling and reduction goals. The level of recycling has increased to approximately 40 percent, up from 10 percent before the facility came on line. Also, beginning in 2001, North Carolina will give WTE a 10 percent recycling credit to account for the energy recovered from the waste burned.

The energy generating facility (EGF) produces four times the energy of the oil-fired boilers replaced. The EGF will reduce emissions by nearly 50 percent, primarily in sulfur and nitrogen oxides. The BCH Energy Project also reduces particulates and produces a non-toxic ash that can be used in beneficial road construction projects. Other environmental benefits include the conservation of fossil fuels, and the reduction of odors, emissions, and other environmental impacts from landfills.

6.7.3.2 VEDCO- Carolina Energy

VEDCO has plans to open a plant in Kinston, in Lenoir County, by 1997. The project, the Carolina Energy Project, will serve the counties of Pitt, Lenoir, Wilson, Nash, and Edgecombe and the City of Rocky Mount. Once received by the project, the waste will be converted into useful recyclables, process steam for DuPont, and electricity for Carolina Power & Light Company.

The Carolina Energy Project is a $135 million project, comprised of two facilities located at separate sites. The first facility, located in Wilson, incorporates a materials recovery facility, a metal shredder, and an energy generation facility. Together they will process all incoming waste, recover recyclables, and supply a fuel source to the steam generation facility in Kinston. The second facility, the steam generation facility, is located adjacent to the DuPont plant in Kinston. Powered by RDF fuel produced at the Wilson site, this facility will supply process steam to DuPont.

6.8 REGULATORY AND IMPLEMENTATION CONCERNS

6.8.1 Federal Regulations

The final air emission standards which apply to new municipal waste combustion (MWC) units located at plants with capacities to combust greater than 35 MG/day of residential, commercial, and/or institutional discards can be found in the Federal Register, Vol. 60. No. 243. These rules and regulations were issued on December 19, 1995. It should be noted that MWC units that combust less than 30% MSW (on a calendar quarter basis) are exempt.

6.8.2 State Regulations

State application requirements for incinerators require the following: site and operation plans of the proposed facility; an air quality permit; an approval letter

from local government stating that the site meets all of the requirements of the local zoning ordinance; and the type, quantity, and source of waste for disposal.

Operational requirements are as follows:

(1) All incinerators shall be designed and operated in a manner so as to prevent the creation of a nuisance or potential health hazard;
(2) The incinerator plant shall be so situated, equipped, operated, and maintained as to minimize interference with other activities in the area;
(3) All solid waste to be disposed of at the site shall be confined to the dumping area. Adequate storage facilities shall be provided;
(4) Effective vector control measures shall be applied to control flies, rodents, and other insects or vermin;
(5) Equipment shall be provided in the storage and charging areas and elsewhere as needed or as may be required in order to maintain the plant in a sanitary condition;
(6) All residue from the incinerator plant shall be promptly disposed of at an approved sanitary landfill site;
(7) An air quality permit issued by the Division of Environmental Management, Department of Environment, Health, and Natural Resources, shall be obtained prior to operation;
(8) A site shall only accept those solid wastes which it is permitted to receive; and
(9) Water that comes into contact with solid waste will be contained on-site or properly treated prior to discharge. An NPDES permit may be required prior to discharge to surface waters.

6.8.3 Local Regulations

Generally, local regulations stipulate that an air permit be obtained for the operation of incinerators units.

6.8.4 Implementation Concerns

6.8.4.1 Flow Control

In order to ensure the economic viability of waste-to-energy systems, some sort of mechanisms need to be put into place (such as long-term contracts with MSW haulers) to assure that daily MSW throughput goals are met. Such flow control

mechanisms should be discussed during the design phase of the facility, and implemented by the time the new incineration facility becomes operational.

6.8.4.2 Social/Political Considerations

Strong vocal minority opposition makes it difficult for decision makers which are in favor of waste-to-energy systems to stand their ground. The concerns raised have included: negative environmental impacts; facility shutdowns due to new environmental regulations and/or flow control; the oversizing of some earlier facilities which created a disincentive for materials recycling, and over-optimistic expectations of RDF processing advocates.

6.9 PRELIMINARY WASTE-TO-ENERGY COST ANALYSIS

6.9.1 Facility Assumptions

For comparative purposes, two different scenarios have been included in the preliminary analysis of the costs associated with the development of a multi-jurisdictional waste-to-energy (WTE) facility to serve Guilford County's disposal needs over the 20-year planning period. Both scenarios involve sizing the WTE facility to accommodate only the publicly-controlled portion of the MSW.

As indicated in Table 6-2, the publicly-controlled waste in 1998 would be sufficient to support a waste-to-energy facility with a nominal capacity of 600 tons per day (7 days/week operation: 15% annual facility maintenance downtime).

TABLE 6-2
FACILITY CAPACITY EVALUATION FOR WASTE-TO-ENERGY FACILITY

Jurisdiction	Public-Controlled MSW	WTE Facility Size (TPD_7)
High Point	40,946	132
Greensboro	154,034	492
Total	194,980	628

Based on 1998 projection of publicly-controlled MSW of 194,980 tons/year.
Assumes facility availability factor of 85%.

The first scenario involves the implementation of a 600 TPD mass-burn, waste-to-energy facility. It was assumed that the facility would be financed with publicly-issued revenue bonds but would be designed, constructed and operated (under a 20-year operating contract) by a full service vendor.

To estimate the "tipping fees" that would be charged by a full service vendor, HDR analyzed the most recent bids received for a 600 TPD mass-burn WTE facility, which happened to be received by Mecklenburg County, North Carolina, in 1992 for the Arrowood WTE project. Based on this analysis, which is presented in Table 6-3, HDR estimates that the tipping fee for a 600 TPD mass-burn facility for Guilford County would have an average tipping fee of $62 per ton (reported in 1995$).

TABLE 6-3
ESTIMATION OF AVERAGE TIPPING FEES FOR MASS-BURN WASTE-TO-ENERGY FACILITY

Vendor	Capital Cost		Average LCC Tipping Fee	
	1992	1995	1992	1995
Rust/Wheelabrator	$119,800	$134,759	$42	$47
American Ref-Fuel	$164,500	$185,040	$69	$78
Foster Wheeler	$135,300	$152,194	$52	$58
MK Ferguson	$136,500	$153,544	$56	$63
Ogden Martin	$146,500	$164,793	$58	$65
Average		$158,066		$62

Assumptions

Inflation Rate:	4%
Throughput (TPD - 7 days/week)	600

Based on 1992 bids received for Mecklenburg County, North Carolina, Arrowood Facility (600 TPD_7).

The second scenario involves the implementation of a 600 TPD RDF Production/ Combustion System. In this case, it was assumed that the system would also be designed, constructed, and operated by a full-service vendor. It was also assumed that the combustion facility would be constructed on an industrial site and that the major portion of the costs of the combustion facility would be borne by the industrial energy user. The County and its municipalities would bear the costs associated with the RDF production facility.

To estimate the potential tipping fees associated with this scenario, HDR assumed an initial tipping fee at the RDF Production facility of $50 per ton (1995$). It was assumed that 50% of the tipping fee would be escalated at an assumed inflation rate of 4%/year over the life of the facility. (These assumptions are based on information provided for the BHC Energy Project in Fayetteville, NC, which is a 1,000 TPD facility with a tipping fee currently in the range of $35 per ton and which is escalated at 50% of the CPI.)

The results of this preliminary analysis, as presented in Table 6-4, indicate an average tipping fee of $33 per ton (1995$) for the RDF Production Facility. (Again, it should be noted that this tipping fee assumes that the costs of the RDF combustion facility are largely borne by the industrial energy user.)

6.9.2 System Costs and Economics

The unit costs and economics associated with developing a multi-jurisdictional waste-to-energy facility to accommodate only the publicly-controlled MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 6-5 and Appendix H of this report. The costs associated with the development of the multi-jurisdictional facility are based on an assumed transport cost of $2.00 per truck mile, an 8 ton payload per packer truck, and the assumption that only publicly-controlled County-generated wastes will be disposed of in the new public landfill facility. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities. For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County.

TABLE 6-4
ESTIMATION OF AVERAGE TIPPING FEES FOR RDF WASTE-TO-ENERGY FACILITY

Year	Projected Tip Fees	
	Actual	1995$
1998	$53.12	$44.60
1999	$54.25	$42.97
2000	$55.42	$41.41
2001	$56.63	$39.92
2002	$57.90	$38.51
2003	$59.21	$37.15
2004	$60.58	$35.86
2005	$62.01	$34.62
2006	$63.49	$33.44
2007	$65.03	$32.32
2008	$66.63	$31.24
2009	$68.29	$30.21
2010	$70.02	$29.22
2011	$71.82	$28.27
2012	$73.70	$27.37
2013	$76.65	$26.50
2014	$77.67	$25.67
2015	$79.78	$24.88
2016	$81.97	$24.11
2017	$84.25	$23.38
Average	$66.57	$32.58

Assumptions

Base Year:	4%
Tip Fee - 1995:	$50/ton
Inflation Rate:	4.00%
Discount Rate:	6.00%

Notes

Based on tipping fee of $35 per ton for 1,000 TPD BCH energy project.
Inflation rate applied to O&M costs only, estimated to be 50% of the tipping fee.
Revenues from the sale of recovered materials assumed to be $0 per ton.
Assumes construction of RDF power plant for industrial steam user.

TABLE 6-5
GUILFORD COUNTY SOLID WASTE MANAGEMENT STUDY
SUMMARY OF ECONOMIC ANALYSES:
MULTI-JURISDICTIONAL WASTE-TO-ENERGY FACILITIES

JURISDICTION Waste Description		Disposal of Publicly-Controlled County-Generated MSW (600 TPD Mass-Burn Facility)		Disposal of Publicly-Controlled County-Generated MSW (600 TPD RDF Facility)	
		Total Costs	Cost/Ton[1]	Total Costs	Cost/Ton[1]
City of Greensboro					
Publicly-Controlled Waste	37%	$234,907,554	$70	$136,888,574	$41
Privately-Controlled Waste	22%	$70,339,808	$35	$70,340,000	$35
Subtotal	**59%**	**$305,247,362**		**$207,228,382**	
City of High Point					
Publicly-Controlled Waste	10%	$71,253,312	$78	$44,761,696	$49
Privately-Controlled Waste	14%	$45,401,149	$36	$45,401,000	$36
Subtotal	**24%**	**$116,654,461**		**$90,162,845**	
Other County MSW	**17%**	**$55,906,445**	$36	**$55,906,445**	$36
TOTAL	**100%**	**$477,808,268**	**$52**	**$353,297,672**	**$39**

Note:
(1) Cost/ton include both hauling and disposal costs. All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

To accommodate the publicly-controlled future disposal needs of Guilford County, it is estimated that the average disposal costs for a 600 ton per day Subtitle D landfill would be $62/ton for a mass-burn facility and $33 per ton for an RDF facility (1995 dollars). As is shown in Table 6-2, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled MSW at a new multi-jurisdictional WTE facility range from $41 - $78 per ton (1995 dollars) for an average of $39 - $52 per ton (1995 dollars) for this alternative.

6.10 CONCLUSIONS

The recovery of energy from municipal solid waste through the implementation of a waste-to-energy facility is an option that is proven from a technical standpoint. The major concerns associated with this option involve the areas of cost, changing regulations, and public perception.

The projected costs for the waste-to-energy option are significantly higher than those projected for the landfill-based options of either expanding existing landfills or developing a new multi-jurisdictional landfill.

Changing regulations continue to hamper the implementation of new facilitates and have caused a number of existing facilities to close in recent years. Regulations promulgated under the Clean Air Act of 1990 and the 1993 ruling on flow control by the U.S. Supreme Court have caused a number of facilities to close when faced with reduced waste volumes and increased tipping fees (due to lack of flow control) and increased capital costs (due to the need for additional air pollution control equipment.)

Finally, waste-to-energy facilities continue to have a negative public perception despite the obvious natural resource, economic, and environmental benefits they provide by displacing imported non-renewable fossil fuels burned in less efficient, more polluting industrial boilers.

Section 7.0
Review of MSW Composting Alternatives

7.1 INTRODUCTION

The interest in the composting of municipal solid waste as a means of maximizing recovery and minimizing waste disposal has grown in recent years. Composting is an age-old process, and its application to the municipal solid waste stream has been attempted in the U.S., with varying degrees of success, numerous times over the last 30 years.

The recent surge of interest in composting can be attributed to a number of factors, including an apparently higher public acceptance and perceived environmental benefit over the recovery option of waste-to-energy. This interest has been heightened by the construction and operation of a full-scale MSW composting facility in the region (Sevierville, TN).

These factors support the need for a preliminary evaluation of the MSW composting alternative and its potential application in Guilford County.

7.2 COMPOSTING BASICS

Composting can be defined as the biological decomposition and stabilization of organic wastes in a controlled environment to produce a marketable or usable product.

The composting process is one which occurs naturally. The conversion of leaves and dead vegetation to humus, in forests and other natural areas, is accomplished by natural composting.

7.2.1 The Process

As the definition indicates, composting is a biological process. The process involves the metabolism of the waste by microscopic organisms such as bacteria and fungi.

Engineered compost systems generally try to control and accelerate this process through controlling the temperature of the compost pile, the supply of air, and the

pH. The characteristics of the waste to be composted are also controlled through the addition of bulking agents, water (if needed), and bacterial inoculums.

As also indicated in the definition, organic wastes are stabilized through the composting process. This means that wastes are converted to byproducts which, for the most part, are not biodegradable. The capability of composting to stabilize wastes is an important benefit of the process.

7.2.2 Composting Stages

The composting process occurs in two stages, as illustrated in Figure 7-1. The first stage, which can be referred to as the "high rate" phase, is one which involves a high rate of biological activity. Associated with this activity are corresponding high rates of oxygen usage and high temperatures, which can reach 140 degrees F or more. The high rate stage generally lasts on the order of a few days to six weeks, depending on the technology and system utilized.

The high temperatures associated with the high rate stage serve to destroy most of the pathogens which may be in the waste being composted. However, it is important to note that, while a high rate of pathogen destruction is generally achieved, the composting process does not result in a product that is 100 percent sterile, or pathogen free.

The high rate stage is also the stage which has the greatest potential for odor generation.

The second stage of composting is referred to as the "curing" stage. This stage is characterized by lower temperatures and reduced oxygen use. It also has a lower odor production potential. The curing stage generally lasts from 30 days up to a year, again depending on the technology and system used.

7.2.3 Compost as Useful or Marketable Product

Compost is a humus-like material which can be used as a soil conditioner. With a deep brown to dark grey color, compost contains nitrogen, phosphorus, and potassium, although not enough to be classified as a fertilizer. Compost also contains valuable trace elements, such as magnesium, and it improves the structure and water holding capacity of the soil.

Figure 7-1
Stages of Composting

Processed MSW	Duration
↓	
1st Stage **High-Rate Decomposition**	**2 - 42 Days**
↓	
2nd Stage **Curing**	**30 - 365 Days**

Total Required Process Time for Composting

3 Months to 1 Year

7.3 OVERVIEW OF MSW COMPOSTING

7.3.1 Introduction

Municipal solid waste (MSW) composting is the biological decomposition of the organic components of the municipal solid waste stream under controlled conditions. MSW is collected, delivered to a central location, processed for size reduction and/or removal of non-compostable materials, composted using one of several technologies, and further processed in preparation for markets. Composting MSW usually is a complex effort, influenced by the extent and type of separation required, as well as by end use requirements (market specifications and regulatory standards).

7.3.2 Waste Reduction Potential

Waste stream composition surveys indicate that about 60 percent of residential waste is organic. Evaporation and decomposition will reduce the organic portion by roughly one-half, by weight. A pre-processing system can be used to recover recyclables and further reduce material output. The inorganic materials must be screened out to meet most marketing specifications yielding a residue of about one-third (by weight) of the incoming waste. Since markets are difficult to find for MSW compost, the compost and residue may both have to be landfilled. Table 7-1 shows the range of potential outputs from an MSW composting facility.

Table 7-1
MSW Composting Process

	% of Incoming Waste (by weight)
Residue[1]	35 - 45%
Compost Product	30 - 35%
Evaporation and Decomposition	20 - 35%

(1) Includes recyclable materials, rejects, and screenings.

Markets for MSW compost include mine land reclamation; landfill cover or compost application in municipal (e.g. parks, roads, and right-of-ways) landscaping and nurseries. If no markets or uses can be found, the compost will require landfilling. However, the initial waste stream will still have been reduced by about one-third, on a weight basis.

7.3.3 History and Status of MSW Composting in the U.S.

While references to composting date back to biblical times, the modern era of composting began in 1905 - 1934 in India through the work of Sir Albert Howard. Composting began in the U.S. as a solid waste disposal process with the development of the Frazer-Eweson process in 1949. In the 1950s - 1970s, at least 16 MSW composting systems were constructed and operated. Unfortunately, many of these systems were closed down due to problems with odor and lack of markets for the compost product.

The overcoming of these two problems -- odor and compost markets -- is the major hurdle facing MSW composting systems today. To address the odor problem, a number of systems are enclosing the high rate processing area, the curing area, or both. Firms are also using "biofilters" and wet scrubbing systems to treat process air for odor control.

The problems associated with the marketing of the compost product are also being addressed through new approaches. Front-end systems are being added to pull out recyclables and contaminants before the waste is composted. One front-end approach to improving product quality involves the elimination of the shredding operation. Shredding, while accomplishing size reduction of the compost feed, also embeds glass pieces into the compost feed and shreds plastics to sizes which cannot be efficiently screened out.

Additionally, "back-end" systems are being used to "finish" the compost. These systems rely on screens to remove physical contaminants such as glass shards and bits of plastics. Destoners are also used for glass removal.

A third approach to improving compost market quality involves the source separation and separate collection of the "compostable" fraction of the waste stream. In this approach, the resident or business keeps compostables, such as fruit and vegetative food waste and yard wastes, separate from the MSW stream. These materials are then collected separately and delivered to the composting facility. This approach generally results in a very clean compost product.

The composting of source-separated organics is being implemented more and more in Europe, where the buyer specifications and adoption of stringent compost standards has severely limited the marketability of MSW compost.

7.3.4 Current Status of MSW Compost Systems in the U.S.

While numerous facilities in the U.S. are in various stages of planning or implementation, currently only 19 are in operation (Table 7-2). Facility throughputs range from two to 700 tons per day. The existing MSW composting facilities in the U.S. are characterized by relatively low throughput and capital investment, and an over-simplification of design. Many systems exist in Europe, but markets are also a problem there. Stiff environmental regulations on the use of MSW compost have been developed by most European countries.

7.3.5 Environmental Issues

Odor, dust, litter, and noise will exist at MSW compost facilities in varying degrees of severity. MSW composting may attract disease vectors such as insects, predatory birds, and rodents. To mitigate these impacts, MSW composting operations are usually located in an enclosed building with a leachate collection and treatment system and odor control equipment. Typical compost operations also raise concern about airborne bacteria and fungi inherent in the feedstock waste stream and produced during the composting process. Accepted methods of control for bacteria and fungi include uniform mixing, moisture content, temperature control, and aeration. Trace metals and organic toxins such as dioxins, pesticides, and PCBs in the mixed MSW feedstock can contaminate the finished compost product. The contaminant levels of trace metals in various MSW compost are shown in Table 7-3. Research on the environmental and health effects of compost is an on-going effort.

German data on mixed waste compost also indicates dioxin and furan levels ranging from 22.6 to 186 ng/kg toxic equivalents (TE). Germany has restricted agricultural use of compost when dioxin and furan levels range between 5 and 40 ng/kg, and prohibited its agricultural use above 40 ng/kg.

7.3.6 Economic Considerations

The initial investment costs for MSW composting include the processing building, land and site improvements, processing equipment, start-up and shakedown, engineering design, and construction supervising and contingency costs. The major operating costs are those associated with operating labor, maintenance, electrical power, fuel, and residue disposal. Preprocessing, which may include sorting, size reduction, air classification, screening, and magnetic separation, can comprise the greatest fraction of total costs.

Table 7-2
Operating MSW Compost Facilities in the U.S.

Facility/Startup Date	Feedstock	Technology	Capital Cost (MM $)	Design Capacity (TPC)	Published Tip Fee ($/Ton)	Percent of Material Composted	Compost Price ($/cu.yd.)
Pinetop-Lakeside, AZ August 1991	MSW & Sludge	Bedminster Drum, aerated windrow	0.9	15	$0	75	$6
Escambia, FL November 1991	MSW	Turned open windrow	0.5	400	$30	95	$0
Sumter County, FL March 1988	MSW	Turned open windrow	5.0	200	$35	55	N/A
Buena Vista, IA December 1990	MSW	Turned open windrow	1.9	70	$37	34	$0
Montgomery County, KS March 1986	MSW	Open windrow	N/A	300	$16.40	65	$0
FERST, Baltimore, MD March 1993	MSW	Simon Tunnel, aerated piles	42	700	N/A	N/A	N/A
Mackinac Island, MI May 1992	MSW, horse manure, yard waste	Open aerated static pile	2.3	2	$0	45	$0
Filmore County, MN August 1987	MSW	Open aerated windrow	1.8	11	$40	43	$0
Lake of the Woods, MN March 1989	MSW	Static pile, open windrow	0.7	10	$0	60	$0
Pennington County, MN November 1985	MSW	Open windrow	1.7	80	$45	30	N/A
Prairieland, MN August 1991	MSW	OTVD aerated windrow	7.1	100	$50	63	$0
St. Cloud, MN March, 1985	MSW, organics	Rotary drum, with Royer agitated bed for curing	7.0	75	$82.70	60	$0-$10
Swift County, MN May 1990	Source separated organics	Aerated windrow	1.7	40	$80	45	$0
Wright County, MN June 1992	MSW	Buhler aerated windrow	13.8	165	$89	62	$1.70
Big Sandy, TX 1972	MSW, brewery sludge	Bedminster/ Eweson Drum, aerated piles for curing	N/A	25	$12-20	85	$15-20
Sevier County, TN October 1992	MSW, sludge	Bedminster/ Eweson Drum, aerated piles for curing	6.5	225	$30	75	$5
Whatcom County, WA December 1991	MSW	Recomp; rotary drum with agitated bed curing	8.0	125	$90	60	$0

Source: Gamelsky, Steven M., "The Quest for Success in MSW Composting," Solid Waste Technologies, March/April, 1994.

Table 7-3
Heavy Metal Contaminant Levels of MSW Compost in Milligrams per Kilogram

Metal	European[1] Standards	Bedminster[2] Analysis	EPA 503 Standards[3]	Netherlands[4]
Zinc	400 - 900	464	2,800	240
Lead	150 - 200	185	300	160
Copper	150 - 300	175	1,500	40
Chromium	100 - 200	31.6	1,200	30
Nickel	50	35	420	10
Cadmium	2 - 3	NA1	4.2	1

Notes:
(1) Range of standards for Germany, Switzerland , and the Netherlands .
(2) Analysis supplied by Bedminster Bid conversion and performed by Lancaster Laboratories, Inc. (Lancaster, PA) in August 1993.
(3) EPA 503, Maximum Allowable Concentration for Exceptional Quality Compost.
(4) Results of separate collection of degradable organic fraction of MSW in deBilt Netherlands (VAM).

Data provided by MSW compost system operators places the cost of building and operating a facility at approximately $40 to $60 per ton, excluding collection and transportation of MSW, transportation of residuals to landfill, and revenues from the sale of finished compost. Capital costs alone can range from $35,000 to $60,000 per daily ton of design capacity. Operation and maintenance costs are in the $30 per ton range, and will vary depending on the type of system.

7.3.7 Compost Markets

Markets for MSW compost have been practically non-existent in the U.S. Therefore, the economics for composting MSW should assume little or no revenues from the sale of the compost. State level agencies may allow the use of MSW compost as landfill cover. If not, a disposal cost plus transportation charges should be added for the compost.

7.4 FEASIBILITY ANALYSIS OF MSW COMPOSTING

7.4.1 Facility Assumptions

The purpose of this section is to provide a preliminary analysis of the feasibility of implementing a MSW composting facility in Guilford County. This analysis was performed by sizing the composting facility to accommodate only the publicly-controlled portion of the MSW.

As indicated in Table 7-4, the publicly-controlled waste in 1998 would be sufficient to support a composting facility with a nominal capacity of 600 tons per day (6 days/week operation, 5% annual facility maintenance downtime).

Table 7-4
Estimation of Average Tipping Fees for Composting Facilities

Jurisdiction	Publicly-Controlled MSW	Facility Size (TPD_6)
High Point	40,946	138
Greensboro	154,034	520
Total	194,980	658

Based on 1998 projection of publicly-controlled MSW of 194,980 tons/year.
Assumes facility availability factor of 95%.

This analysis assumes the implementation of a 600 TPD (6 days/week) composting facility. Based on previous project experience, HDR estimates that the capital costs of a 600 TPD MSW Composting Facility would be on the order of $39,600,000. Operating costs were estimated to be $2.24 million per year.

A life cycle cost analysis was performed to develop preliminary estimates of the likely tipping fees of the 600 TPD facility over its 20-year life. The projected tipping fees for the 600-TPD composting facility range from $48 per ton in 1998 to $87 per ton in 2017. The average tipping fee over the 20-year life of the facility is projected to be $64 per ton. In 1995 dollars, the average tipping fee is projected to be $34 per ton.

7.4.2 System Costs and Economics

The system costs and economics associated with developing a multi-jurisdictional composting facility to accommodate only the publicly-controlled MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 7-5 and Appendix I of this report. The costs associated with the development of the multi-jurisdictional facility are based on an assumed transport cost of $2.00 per truck mile, an 8 ton payload per packer truck, and the assumption that only publicly-controlled County-generated wastes will be processed at the MSW composting facility. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities. For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County.

Table 7-5
Guilford County Solid Waste Management Study
Summary of Economic Analyses:
Multi-Jurisdictional Composting Facility

Jurisdiction / Waste Description		Disposal of Publicly-Controlled County-Generated MSW (600 TPD Composting Facility)	
		Total Costs	Cost/Ton[1]
City of Greensboro			
Publicly-Controlled Waste	37%	$140,268,546	$41
Privately-Controlled Waste	22%	$70,339,808	$35
Subtotal	**59%**	**$210,608,354**	
City of High Point			
Publicly-Controlled Waste	10%	$31,059,136	$50
Privately-Controlled Waste	14%	$45,401,149	$36
Subtotal	**24%**	**$91,076,349**	
Other County MSW	**17%**	**$55,906,445**	$36
TOTAL	**100%**	**$357,591,148**	$39

Note: (1) Cost/ton include both hauling and disposal costs. All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

To accommodate the publicly-controlled waste generated in Guilford County, it is estimated that the average disposal costs would be $34/ton for a 600 TPD composting facility (1995 dollars). As is shown in Appendix I, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled MSW at a new multi-jurisdictional composting facility range from $41 - $50 per ton (1995 dollars).

7.4.3 Compost Markets and Revenues

7.4.3.1 Product Types and Specifications

Compost which is recovered from municipal solid waste must meet certain specifications in order to be of use as a soil amendment. These specifications are generally determined by the types of markets available locally and regionally, and ultimately differ by the use intended for the product. Specifications most often address parameters such as the form the material must be in (i.e., bulk or bagged), as well as the physical, chemical, organic, and biological characteristics of the compost.

The types of products to be marketed will vary depending on the desired end use. Typically, composted MSW is marketed as a soil amendment or soil conditioner. It may or may not be mixed with other organic material such as sawdust or soil; it may be used as a component of an "artificial soil" or as a top dressing material; or, in cases where the MSW is incompletely degraded, the material may be dried and used as boiler fuel.

To date, the State of North Carolina has not yet adopted a formal set of standards for regulating MSW compost. However, a new set of regulations is currently under review by the NC DEHNR and may soon be implemented. These new regulations will include maximum allowable metal concentrations, as well as a compost classification system. Proposed distribution of the defined grades shall be as follows:

1) Grade A Compost shall have unlimited, unrestricted distribution (bagged or bulk). This product may be distributed directly to the public;

2) Grade B compost shall be restricted to distribution for land and mine reclamation, silviculture, and agriculture (on non-food chain crops) projects; and

3) Compost or mulch made from yard waste or yard waste and vegetative agricultural waste or silviculture waste which contains minimal pathogenic organisms, is free from offensive odor, and contains no sharp particles which would cause injury to persons handling the compost, shall have unrestricted applications and distribution if directions are provided with the compost product.

Quality standards which have been implemented elsewhere in the country have often been patterned after those adopted for sludge and are focused on public health and safety issues. However, with the growing realization that marketability is greatly influenced by the quality and consistency of a product, more consideration is being given to establishing standards that will provide the end user of a product with specifications related to the particular grade of compost being marketed.

Table 7-6 presents an example of a voluntary grading system developed by the State of Washington which would provide guidance in determining the value and, in turn, the marketability of compost products.

Table 7-6
Example of Compost Grading Scheme

Compost Characteristic	Unit	Recommended Standard	
		Grade A	Grade B
Bulk density	lb/cu yd	600 - 800	400 -1000
Cation exchange capacity (CEC)	meq/100 g	> 100	>100
Foreign matter			
Moisture content	Maximum %	2	5
Odor	%	40 - 60	30 - 70
Organic matter		Earthy	Minimal
pH	Minimum %	50	40
Size distribution		5.5 - 6.5	5 - 8
Water holding capacity	Nominal in.	< ½	< 7/8
C:N	Minimum %	150	100
Nitrogen	Maximum	15	20
Conductivity (soluble salts)	Minimum %	1	0.5
Seed germination	mmhos/cm	< 2	< 3
Viable weed seeds	Minimum %	95	90
		none	none

Source: Diaz, L.F. et al, "Composting and Recycling Municipal Solid Waste", Lewis Publishers, 1993, p. 185.

7.4.3.2 Identification of Potential Markets

The market for MSW compost is not as developed as that of compost derived from yard waste, and certainly as developed as that of the commodity recyclable materials such as metals, glass, plastics, etc. Table 7-7 presents some typical markets for MSW compost by user type. In terms of acceptability, it appears that the greatest marketing success will be realized if MSW compost is promoted for use by the public sector as well as for land reclamation and certain non-food horticultural activities. Marketing the product for food horticultural activities is not recommended due to the concern regarding the heavy metal content of the MSW compost.

Table 7-7
Potential MSW Compost Markets

User Type	Potential Market
Private Residential	Non-food Garden Applications
Private Commercial	Greenhouses Nurseries Golf Courses Landscaper Contractors Turfgrass Farmers Industrial Park Grounds Cemeteries Agriculture Top Soil Suppliers
Public Agencies	Public Parks Playgrounds Roadside and Median Strip Military Installations
Land Reclamation	Landfill Cover Strip Mined Lands Sand and Gravel Pits

Source: "Economics and Feasibility of Co-Composting Solid Waste in McHenry County" Final Report, prepared for the Illinois Department of Energy and Natural Resources, 1987, p. 5-5.

If marketing efforts are focused on bulk users representing the private sector, some of the more likely potential users of MSW compost in the Guilford County region include landscape contractors and landscape maintenance firms, golf courses, and turf farmers.

7.4.3.3 Market Demand and Pricing

Secondary materials markets compete directly with markets for virgin materials and are influenced by the same factors that affect virgin markets. These factors include general economic conditions and trends, transportation costs, and manufacturing capacity and demand. Such factors impact virgin material demand and prices on a daily basis, which, in turn, determine the market conditions (price and demand) for secondary materials.

In the case of MSW compost serving as a secondary material, it is often in direct competition with soils (i.e., top soil, fill dirt), and other organic materials (peat, potting soil, animal manure). In order for MSW compost to be marketable, end users must be convinced that there will be a quality product consistently available at a price that is competitive with that of similar products. Without consistency in the quality of the product and availability to meet demand, a market cannot be sustained.

To estimate potential market demand, the local Agricultural Extension Service following crops: tobacco, corn, wheat, oats, barley, rye, sorghum, soybeans, and hay. The "Non-Food" percentage of these crops was estimated by the Extension Service. It was assumed that 20% of the non-food acreage was treated with compost every five years, and that 44 cubic yards per acre were applied to pastureland, while 52 cubic yards per acre were applied to other cropland. Based on these assumptions, it was estimated that the potential compost demand in Guilford County for the agricultural sector at 425,412 cubic yards per year (see Table 7-8). A 600 ton per day facility would produce approximately 154,165 cubic yards per year of compost, and would require a market penetration rate, for the agricultural market, of 36%.

A variety of factors can be used as a basis for setting the price of MSW compost. These include:

1) Establishing the costs of producing, distributing, and marketing the MSW compost.

2) Following pricing schemes set by producers of comparable products (i.e., top soil, manure, peat).

3) Determining the end user's ability and willingness to pay as well as the price of comparative products.

Table 7-8 Potential Compost Demand		
Crop	Non-Food Acreage	Potential Compost Demand (CY/Year)
Tobacco	4,300	44,720
Corn	10,300	107,120
Wheat	6,480	67,329
Oats	1,100	11,440
Barley	900	9,360
Rye	250	2,600
Sorghum	375	3,900
Soybeans	4,200	43,680
Hay	13,000	135,200
TOTAL	**40,905**	**425,412**
Assumptions: Harvested cropland treated every 3 yrs, 52 cy/acre		
TPD	600	
TPY	187,200	
% Compost	35%	
TPY Compost	65,520	
Compost Bulk Density	850	
Cubic Yards/Year	154,165	
Required Market Penetration Rate		36%

4) Deciding that profit is not the primary motivation for producing MSW compost; but rather interpreting the value of MSW compost as being the creating of a material that is more stable, more aesthetically acceptable, and which represents a smaller volume of matter than the municipal solid waste from which the compost was derived.

The experience with MSW compost thus far has shown that, if the material is to be used, it is best to market it in bulk form at no cost or relatively low cost. As a soil amendment, compost that is derived from municipal solid waste has not yet proven to be as attractive for use as compost that is derived from yard waste.

7.5 CONCLUSIONS

Based on this preliminary analysis, the following conclusions are offered regarding the MSW composting alternative as a multi-jurisdictional processing option for Guilford County:

1) A number of commercially available compost technologies appear to be able to produce a mature compost from a municipal solid waste stream which has been subjected to some degree of preprocessing and/or sorting.

2) Current approaches of enclosing both MSW receiving, MSW pre-processing, composting and curing processes, coupled with more sophisticated odor control systems, appear to be able to control odors to an acceptable degree.

3) The marketability of the compost product is still in question from a regulatory standpoint as well as from market demand. From a regulatory perspective, there are no national or North Carolina state regulations regarding the use of MSW compost (North Carolina regulations have been proposed). From a market demand perspective, the potential market demand appears to be moderate, with a market penetration rate of 36% of the agricultural market required for the output of a 600 TPD MSW compost facility. However, the price, if any, that will be paid for the compost is uncertain.

4) From an economic perspective, the estimated average tipping fees, in 1995 dollars, for a MSW compost facility are roughly $10 per ton higher than those which would be charged for multi-jurisdictional landfill disposal.

LIST OF APPENDICES

APPENDIX A

GUILFORD COUNTY SOLID WASTE DATA - INFORMATION SOURCES

References

In compiling this report, information has been gathered from the following documents:

- Guilford County's Solid Waste Management Annual Report for the period July 1, 1994 -- June 30, 1995, as submitted to NC DEHNR.

- City of High Point, Solid Waste Study -- Preliminary Report, 1995, prepared by HDR Engineering.

- The Expansion of the White Street Sanitary Landfill, City of Greensboro, Site Study, April 7, 1995, prepared by HDR Engineering.

- North Carolina Solid Waste Management Rules and Law 15A NCAC 13B, as amended through January 4, 1994.

- Characterization of Municipal Solid Waste in the United States: 1994 Update, U.S. Environmental Protection Agency, 530-R-94-042, November 1994.

- Transition Plan for the White Street Sanitary Landfill, City of Greensboro, April 1994, prepared by HDR Engineering.

- North Carolina Recycling and Solid Waste Management Plan, Volume I, prepared by the Department of Environment, Health, and Natural Resources, February 1992.

- Solid Waste Management Plan, Greensboro Urbanized Area, 1990, prepared by the City of Greensboro Public Works Department, Solid Waste Management Advisory Committee.

- State of North Carolina, Solid Waste Management Annual Reports (July 1, 1994 - June 30, 1995).

  - Guilford County
  - City of Greensboro
  - City of High Point
  - Town of Gibsonville
  - Town of Jamestown
  - Town of Stokesdale
  - Town of Whitsett

APPENDIX B

OVERVIEW OF DISPOSAL OPTIONS

Guilford County, North Carolina
Solid Waste Management Study
Overview of Disposal Options

Parameter	City of Greensboro, NC
Background Information:	Currently filling Phase II, an unlined area encompassing approximately 135 acres, of which 90 acres is active. City is preparing to construct new Subtitle D facility, known as Phase III. Landfill is used for disposal of MSW generated within the City of Greensboro and Guilford County. A select portion of C&D waste stream is managed at the facility. Only LCID accepted is yard waste.
Facility Name: **Facility Contact:** **Facility Location:**	White Street Sanitary Landfill (910) 375-2218 Frank Coggins, Landfill Manager 2503 White Street Greensboro, NC 27405
Facility Status:	Public Facility
Landfill Owner **Landfill Operator**	City of Greensboro City of Greensboro
Landfill Size: Unlined Portion Lined Portion Anticipated Expansion Total Site	 90 Acres 0 Acres in the first cell 52 Acres in additional cells 142 Acres
Liner Type **Leachate Collection**	New facility will have approved composite liner and leachate collection system.
Waste Quantities Currently Received: **Remaining Capacity:** **Projected Life of Permitted Areas:**	20,800 TPM (July 1, 1994 - June 30, 1995) filling until December 31, 1997 total 52 acre lined area expected to provide for 7 yrs capacity.
Operating Hours: **Current MSW Tipping Fee:**	Mon - Fri: 7:00 A.M. - 4:50 P.M. Saturday: 7:00 A.M. - 1:00 P.M. $26.25/ton current unlined fill area -- Tel. quote.
Prospects for Receiving Additional Waste Streams:	The landfill is permitted to receive waste generated within Guilford County. The City of High Point is, in part, within the boundaries of Guilford County. Waste collected by the City of High Point could be disposed of at White Street if an intergovernmental agreement was arranged between the City of High Point and the City of Greensboro.

Guilford County, North Carolina
Solid Waste Management Study
Overview of Disposal Options

Parameter	City of High Point, NC
Background Information:	Facility at present is operated as a balefill, however city is considering changing to area fill, and developing new lined disposal areas. Landfill is used for disposal of MSW generated within the City of High Point and communities in Davidson, Forsyth, Randolph, and Guilford Counties. No C&D accepted at present, and only LCID accepted is yard waste.
Facility Name: **Facility Contact:** **Facility Location:**	Kersey Valley Landfill (910) 883-3215 Perry A. Kairis, Dir. of Public Services Kivett Drive High Point, NC 27261
Facility Status:	Public Facility
Landfill Owner **Landfill Operator**	City of High Point City of High Point
Landfill Size: Lined Portion Anticipated Expansion Total Site	 16 Acres in active fill area (Phase I) 9 Acres permitted area proposed for Phase II 46 Acres owned for potential future development 71 Acres (16 active and 55 potential)
Liner Type: **Leachate Collection:**	Clay/geosynthetic composite liner Perforated HDPE pipe in stone trench
Waste Quantities Currently Received: **Remaining Capacity:** **Projected Life of Permitted Areas:**	8,770 TPM (July 1, 1994 - June 30, 1995) filling until December 31, 1997 first lined cell - 4 years capacity; total 60 acre lined area expected to provide for 12 yrs capacity.
Operating Hours: **Current MSW Tipping Fee:**	Mon - Fri: 7:30 A.M. - 5:00 P.M. Saturday: 7:30 A.M. - 1:00 P.M. - Residential only $36.00/ton current lined fill area -- Tel. quote.
Potential for Receiving Additional Waste Streams:	The landfill is permitted to receive waste generated within the City of High Point, and Guilford, Davidson, Forsyth, and Randolph Counties. Waste collected by the City of Greensboro could be disposed of at Kersey Valley if an intergovernmental agreement was arranged between the City of High Point and the City of Greensboro.

Guilford County, North Carolina
Solid Waste Management Study
Overview of Disposal Options

Parameter	City of Winston-Salem, NC
Background Information:	Service area includes Forsyth, Davie, Stokes, Yadkin, and Surry Counties; waste is only received from Forsyth, Davie and Stokes Counties. No C&D accepted at present, but new site is being developed for C&D. Yard waste is only LCID accepted at facility separate from Hanes Mill.
Facility Name: **Facility Contact:** **Facility Location:**	Hanes Mill Road Sanitary Landfill (910) 727-8418 Tom Griffin, Dir. of Public Utilities Hanes Mill Road Winston-Salem, NC 27102-2511
Facility Status:	Public Facility
Landfill Owner **Landfill Operator**	City of Winston-Salem City of Winston-Salem
Landfill Size: Unlined Portion Lined Portion Anticipated Expansion Total Site	 140 Acres 37 Acres being developed 350 acres is available (potential areas of landfill is undetermined) Currently: 140 unlined and 37 lined
Liner Type **Leachate Collection**	Piggy back design with leak detection zone will be used and beyond piggy back area will be lined with a standard composite liner. Leachate collection system for new area still being decided upon.
Waste Quantities Currently Received: **Remaining Capacity:** **Projected Life of Permitted Areas:**	24,000 TPM (July 1, 1994 - June 30, 1995) filling until October 9, 1996 first lined cell - 20 mths capacity; total 37 acre lined area expected to provide for 5 yrs of capacity. Future plan to transition filling to City owned 350 acre parcel, estimated additional 40 yrs capacity.
Operating Hours: **Current MSW Tipping Fee:**	Mon - Fri: 7:30 A.M. - 5:00 P.M. Saturday: 8:00 A.M. - 4:00 P.M. $23.00/ton at present -- tel. quote.
Potential for Receiving Additional Waste Streams:	Potential for inclusion of Guilford County waste is unknown.

Guilford County, North Carolina
Solid Waste Management Study
Overview of Disposal Options

Parameter	BFI/Charlotte Motor Speedway
Background Information:	The BFI Charlotte Motor Speedway Landfill has contracts with private individuals, commercial/industrial establishments, and a variety of municipal governments to provide MSW disposal services. A lined area is currently the site of active filling operations. Facility is licensed to accept C&D waste; LCID wastes are not accepted.
Facility Name: **Facility Contact:** **Facility Location:**	BFI/Charlotte Motor Speedway (704) 394-1353 Harold Watson -- District Manager 5105 Moorehead Road Harrisburg, NC 28075
Facility Status:	Private Facility
Landfill Owner **Landfill Operator**	Browning Ferris Industries Browning Ferris Industries
Landfill Size: Unlined Portion Lined Portion Anticipated Expansion Total Site	 Information not provided Information not provided Information not provided Information not provided
Liner Type **Leachate Collection**	Information not provided Information not provided
Waste Quantities Currently Received: **Waste Quantities Under Contract:** **Remaining Capacity:** **Projected Life of Permitted Areas:**	44,710 TPM (July 1, 1993 - June 30, 1994) Information not provided Information not provided BFI said that their facility could serve as a resource for the disposal of MSW for the next 15 years.
Operating Hours: **Current MSW Tipping Fee:**	Mon - Fri: 7:00 A.M. - 4:00 P.M. Saturday: 7:00 A.M. - 2:00 P.M. $29.70/ton for lined area -- Tel. quote
Potential for Receiving Additional Waste Streams:	BFI would welcome additional contracts with other municipalities or haulers.

Guilford County, North Carolina
Solid Waste Management Study
Overview of Disposal Options

Parameter	Uwharrie Regional Recycling Complex
Background Information:	Facility located 4 miles west of Troy, NC. Currently operating in unlined facility until new lined facility is completed. First 8 acre lined cell expected to open as soon as hydrogeologic study is finalized. No C&D accepted at present, and only LCID accepted is yard waste.
Facility Name: **Facility Contact:** **Facility Location:**	Uwharrie Regional Recycling Complex Farrell Kid (910) 576-3697 Rt. 2, Box 92D Mt. Gilead, NC 27306
Facility Status:	Private Facility
Landfill Owner **Landfill Operator**	Addington Environmental Addington Environmental
Landfill Size: Unlined Portion Lined Portion Anticipated Expansion Total Site	 35 Acres 32 Acres in Phase I 65 Acres in additional cells 132 Acres (35 unlined and 97 lined)
Liner Type **Leachate Collection**	New facility will have approved composite liner and leachate collection system.
Waste Quantities Currently Received: **Waste Quantities Under Contract:** **Projected Life of Permitted Areas:**	7,910 TPM (July 1,1993-June 30,1994) Most of waste received is under contract Permitted lined area expected to provide 20 years capacity.
Operating Hours: **Current MSW Tipping Fee:**	Mon - Fri: 7:00 A.M. - 4:00 P.M. Saturday: 7:00 A.M. - Noon $22.50/ton gate rate, vert. exp. New area tip fee not set yet. Tel. quote.
Potential for Receiving Additional Waste Streams:	An additional 100 acres of land has been purchased, and eventually hope to permit area. Welcome additional contracts for MSW disposal and/or recyclable processing services.

APPENDIX C

NORTH CAROLINA SOLID WASTE MANAGEMENT RULES AND SOLID WASTE MANAGEMENT LAW

APPENDIX C

NORTH CAROLINA SOLID WASTE MANAGEMENT RULES AND SOLID WASTE MANAGEMENT LAW

The following regulations are taken from the North Carolina Solid Waste Management Rules and Solid Waste Management Law, effective January 4, 1994.

- (15A NCAC 13B .1626 (2)(a)) states the following: Except as provided in (2)(b) of this paragraph, the owners or operators of all MSWLF units must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging.

- (15A NCAC 13B .1626 (2)(b)) states the following: Alternative material of an alternative thickness (other than at least six inches of earthen material) may be approved by the Division if the owner or operator demonstrates that the alternative material and thickness control disease vectors, fires, odors, blowing litter, and scavenging without presenting a threat to human health and the environment.

- (15A NCAC 13B .1626 (2)(c)) states the following: Areas which will not have additional wastes placed on them for 12 months or more, but where final termination of disposal operations has not occurred, shall be covered with a minimum of one foot of intermediate cover.

- (15A NCAC 13B .1627 (1)(B)) states the following: Minimize infiltration through the closed MSWLF by the use of a low-permeability barrier that contains a minimum 18 inches of earthen material; and

- (15A NCAC 13B .1626 (1)(C)) states the following: Minimize erosion of the cap system and protect the low-permeability barrier from root penetration by use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

In accordance with current permits being issued by the state of North Carolina, HDR assumes that C&D waste is required to be covered weekly with 6 inches of suitable cover material.

- (15A NCAC 13B .0566 (4)) states the following: Adequate soil cover shall be applied monthly, or when the active area reaches one acre in size, whichever occurs first.

According to the North Carolina Solid Waste Management Rules and Solid Waste Management Law, the definition of solid waste is the following:

> "Solid waste" means any hazardous and nonhazardous garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; domestic sewage and sludges generated by the treatment thereof in sanitary sewage collection, treatment, and disposal systems; and other material that is either discarded or is being accumulated, stored, or treated prior to being discarded, or has serve its original intended use and is generally discarded, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, institutional, commercial and agricultural operations, and from community activities. The term does not include:
>
> (a) Fowl and animal fecal waste; or
>
> (b) Solid or dissolved material in:
>
> (i) domestic sewage and sludges generated by the treatment thereof in sanitary sewage collection, treatment and disposal systems which are designed to discharge effluents to the surface waters;
> (ii) irrigation return flows; and
> (iii) wastewater discharges and the sludges incidental thereto and generated by the treatment thereof which are point sources subject of permits granted under Section 402 of the Federal Water Pollution Control Act, as amended (P.L. 92-500), and permits granted under G.S. 143-215.1 by the Environmental Management Commission; except that any sludges that meet the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended, shall also be a solid waste for the purposes of this Article; or
>
> (c) Oils and other liquid hydrocarbons controlled under Article 21A of Chapter 143 of the North Carolina General Statute; except that any such oils or other liquid hydrocarbons that meet the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended, shall also be a solid waste for the purposes of this Article; or
>
> (d) Any radioactive material as defined by the North Carolina Radiation Protection Act, G.S. 104E-1 through 104E-23; or
>
> (e) Mining refuse covered by the North Carolina Mining Act, G.S. 74-46 through 74-68 and regulated by the North Carolina Mining Commission (as defined under G.S. 143B-290); except that any specific mining waste that meets the criteria for hazardous waste under the Federal Resource Conservation and Recovery Act (P.L. 94-580) as amended, shall also be a solid waste for the purposes of this Article.

Local Government Solid Waste Responsibilities (GS 130A-309.09A.):

(a) The governing board of a designated local government shall provide for the operation of solid waste disposal facilities to meet the needs of all incorporated and unincorporated areas designated to be served by the facility. Pursuant to this section and notwithstanding any other provision of this Chapter, designated local governments may adopt ordinances governing the disposal in facilities which they operate of solid waste generated outside of the area designated to be served by such facility. Such ordinances shall not be construed to apply to privately operated disposal facilities located within the boundaries of a designated local government. In accordance with this section, municipalities are responsible for collecting and transporting solid waste form their jurisdictions to a solid waste disposal facility operated by the municipality or county, any other municipality or county, or by any other person. Counties and municipalities may charge reasonable fees for the handling and disposal of solid waste at their facilities. The fees charged to municipalities without facilities at a solid waste management facility specified by the county shall not be greater than the fees charged to other users of the facility except as provided in G.S. 130A0309.08(d). Solid waste management fees collected on a countywide basis shall be used to fund solid waste management services provided throughout the county.

(b) Each unit of local government, either individually or in cooperation with one or more other units of local government, shall participate in the development an implementation of a solid waste management plan designed to meet the waste reduction goals set out in G.S. 130A-309.04 within the geographic area covered by the plan.

(c) The Department may reduce or modify the municipal solid waste reduction goal that a unit of local government is required to attempt to achieve pursuant to subsection (b) of this section if the unit of local government demonstrates to the Department that:

(i) The achievement of the goal would have an adverse effect on the financial obligations of the unit of local government incurred prior to 1 October 1989 that are directly related to a waste-to-energy facility owned or operated by or on behalf of a unit of local government; and

(ii) The unit of local government cannot remove normally combustible materials from solid waste that is to be processed at a waste-to-energy facility permitted prior to 1 July 1991 because of the need to maintain a sufficient amount of solid waste to ensure the financial viability of the facility. The goal may not be waived entirely and may be reduced or modified only to the extent necessary to alleviate the adverse effects of achieving the goal on the financial viability of a unit of local government's waste-to-energy facility. Nothing in this subsection shall exempt a unit of local government from developing and implementing a recycling program pursuant to this Part.

(d) In order to assess the progress in meeting the goals set out in G.S. 130A-309.04, each county, either individually or in cooperation with one or more other counties, shall, by 1 December 1991 and each year thereafter, report to the Department on the solid waste management programs and recycling activities within the county or the geographic area covered by the county's solid waste management plan. This report by the county must include:

(i) A description of public education programs on recycling;
(ii) The amount of solid waste received at municipal solid waste management facilities, by type of solid waste;
(iii) The amount and type of materials from the solid waste stream that were recycled;
(iv) The percentage of the population participating in various types of recycling activities instituted;
(v) The annual reduction in municipal solid waste, measured as provided in G.S. 130A-309.04;
(vi) A description of the recycling activities attempted, their success rates, the perceived reasons for failure or success, and the recycling activities which are ongoing and most successful; and
(vii) In its first report, a description of any recycling activities implemented prior to 1 July 1991.

(e) Any municipality that does not participate in the preparation of a county report shall prepare its own report in accordance with the provisions of subsection (d) of this section.

(f) On and after 1 July 1991, each operator of a municipal solid waste management facility shall weigh all solid waste when it is received.

APPENDIX D

ECONOMIC ANALYSIS OF PUBLIC DISPOSAL OPTIONS

ECONOMIC ANALYSIS OF GUILFORD COUNTY PUBLIC DISPOSAL OPTION
Jurisdiction: City of Greensboro

Description: Assumes development of Phases II-V at the Kersey Valley Landfill and Phases III and IV at the White Street Sanitary Landfill. All County generated waste will be disposed of at the White Street Sanitary Landfill and the Kersey Valley Landfill through the year 2013. Beyond the year 2013, all County generated waste will be disposed of at another public landfill facility.

Waste Stream	Years 1998-2012[1]	Year 2013	Years 2014-2017	Total
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	6,722,960 tons	475,690 tons	1,936,390 tons	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)				
Tons (37% of MSW disposed):	2,487,495 tons	176,005 tons	716,464 tons	3,379,965 tons
Transport Costs[2]:				
Disposal Site	White Street	Kersey Valley	Public Landfill	
Distance (1-way)[3]	5 miles	10 miles	27 miles	
Cost	$6,218,738	$880,027	$9,672,268	$16,771,033
Disposal Costs[4]:	$57,212,390	$4,576,138	$13,612,822	$75,401,349
Total Costs:	**$63,431,128**	**$5,456,164**	**$23,285,090**	**$92,172,382**
Cost/Ton:	$26	$31	$33	$27
Privately-Controlled Waste (City of Greensboro)				
Tons (22% of MSW disposed):	1,479,051 tons	104,652 tons	426,006 tons	2,009,709 tons
Transport Costs[2]:				
Disposal Site	White Street	Kersey Valley	Public Landfill	
Distance (1-way)[5]	5 miles	10 miles	27 miles	
Cost	$3,697,628	$523,259	$5,751,078	$9,971,965
Disposal Costs[3]:	$34,018,178	$2,720,947	$8,094,110	$44,833,235
Total Costs:	**$37,715,806**	**$3,244,206**	**$13,845,189**	**$54,805,200**
Cost/Ton:	$26	$31	$33	$27
City of Greensboro MSW[5] -- Total Costs:	**$101,146,933**	**$8,700,370**	**$37,130,278**	**$146,977,582**

1. Year at which White Street (Phases III and IV) reach capacity as follows: Available landfill airspace = 9,800,000 cubic yards. Waste disposed of at White Street = 58.7% of total County MSW disposed. 9,800,000 CY/0.587=16,695,000 CY cumulative landfill space used by the year in which White Street Phases III and IV reach capacity. From Table 3-~~1~~ 2 waste stream projections, this would be the year 2012 (16,807,450 CY cumulative landfill space needed at a 15% diversion rate).
2. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
3. Years 1998-2012, distance between the geographic center of the City of Greensboro and the White Street Sanitary Landfill; year 2013, distance between the geographic center of the City of Greensboro and the Kersey Valley Landfill; years 2014-2017, distance between the geographic center of the City of Greensboro and the public landfill facility (average of distance between two existing public facilities - Hanes Mill and Davidson County - not currently receiving Guilford Co. waste).
4. Assumes average disposal costs of $26 per ton for 500 TPD (1995$) Subtitle D landfill (Kersey Valley). Assumes average disposal costs of $23 per ton (1995$) for 800 TPD Subtitle D landfill (White Street). Assumes average disposal costs of $19 per ton (1995$) for 1,300 TPD Subtitle D landfill (New Public Landfill).
5. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY PUBLIC DISPOSAL OPTION
Jurisdiction: City of High Point

Description: Assumes development of Phases II-V at the Kersey Valley Landfill and Phases III and IV at the White Street Sanitary Landfill. All County generated waste will be disposed of at the White Street Sanitary Landfill and the Kersey Valley Landfill through the year 2013. Beyond the year 2013, all County generated waste will be disposed of at another public landfill facility.

Waste Stream	Years 1998-2012[1]	Year 2013	Years 2014-2017	Total
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	6,722,960 tons	475,690 tons	1,936,390 tons	9,135,040 tons
Publicly-Controlled Waste (City of High Point)				
Tons (10% of MSW disposed):	672,296 tons	47,569 tons	193,639 tons	913,504 tons
Transport Costs[2]:				
Disposal Site[3]	Kersey Valley	Kersey Valley	Public Landfill	
Distance (1-way)	5 miles	5 miles	18 miles	
Cost	$1,680,740	$118,923	$1,742,751	$3,542,414
Disposal Costs[4]:	$17,479,696	$1,236,794	$3,679,141	$22,395,631
Total Costs:	**$19,160,436**	**$1,355,717**	**$5,421,892**	**$25,938,045**
Cost/Ton:	$29	$29	$28	$28
Privately-Controlled Waste (City of High Point)				
Tons (14% of MSW disposed):	941,214 tons	66,597 tons	271,095 tons	1,278,906 tons
Transport Costs[2]:				
Disposal Site[3]	Kersey Valley	Kersey Valley	Public Landfill	
Distance (1-way)	5 miles	5 miles	18 miles	
Cost	$2,353,036	$166,492	$2,439,851	$4,959,379
Disposal Costs[4]:	$24,471,574	$1,731,512	$5,150,797	$31,353,883
Total Costs:	**$26,824,610**	**$1,898,003**	**$7,590,649**	**$36,313,262**
Cost/Ton:	$29	$29	$28	$28
City of High Point MSW[5] – Total Costs:	**$45,985,046**	**$3,253,720**	**$13,012,541**	**$62,251,307**

1. Year at which White Street (Phases III and IV) reach capacity as follows: Available landfill airspace = 9,800,000 cubic yards. Waste disposed of at White Street = 58.7% of total County MSW disposed. 9,800,000 cy/0.587 = 16,695,000 CY cumulative landfill space used by the year in which White Street Phases III and IV reach capacity. From Table 3-1 waste stream projections, this would be the year 2012 (16,807,450 CY cumulative landfill space needed at a 15% diversion rate).
2. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
3. Years 1998-2013, distance between the geographic center of the City of High Point and the Kersey Valley Landfill; years 2014-2017, distance between the geographic center of the City of High Point and the public landfill facility (average of distance between two existing public facilities -- Hanes Mill and Davidson County -- not currently receiving Guilford County waste).
4. Assumes average disposal costs of $26 per ton for 500 TPD (1995$) Subtitle D landfill (Kersey Valley). Assumes average disposal costs of $23 per ton (1995$) for 800 TPD Subtitle D landfill (White Street). Assumes average disposal costs of $19 per ton (1995$) for 1,300 TPD Subtitle D landfill (New Public Landfill).
5. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY PUBLIC DISPOSAL OPTION
Jurisdiction: Other Guilford County MSW

Description: Assumes development of Phases II-V at the Kersey Valley Landfill and Phases III and IV at the White Street Sanitary Landfill. All County generated waste will be disposed of at the White Street Sanitary Landfill and the Kersey Valley Landfill through the year 2013. Beyond the year 2013, all County generated waste will be disposed of at another public landfill facility.

Waste Stream	Years 1998-2012[1]	Year 2013	Years 2014-2017	Total
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	6,722,960 tons	475,690 tons	1,936,390 tons	9,135,040 tons
Other Guilford County MSW[2]:				
Tons (17% of MSW disposed):	1,142,903 tons	80,867 tons	329,186 tons	1,552,957 tons
Transport Costs[3]:				
Disposal Site	Kersey Valley	Kersey Valley	Public Landfill	
Distance (1-way)[4]	11 miles	11 miles	31 miles	
Cost	$6,285,968	$444,770	$5,102,388	$11,833,125
Disposal Costs[5]:	$29,715,483	$2,102,550	$6,254,540	$38,072,573
Other Guilford County MSW[2] – Total Costs:	**$36,001,451**	**$2,547,320**	**$11,356,927**	**$49,905,698**
Cost/Ton:	$32	$32	$35	$32

1. Year at which White Street (Phases III and IV) reach capacity as follows: Available landfill airspace = 9,800,000 cubic yards. Waste disposed of at White Street = 58.7% of total County MSW disposed. 9,800,000 cy/0.587=16,695,000 CY cumulative landfill space used by the year in which White Street Phases III and IV reach capacity. From Table 3-1 waste stream projections, this would be the year 2012 (16,807,450 CY cumulative landfill space needed at a 15% diversion rate).
2. Includes waste stream fraction of County MSW currently disposed of at the Piedmont Landfill
3. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
4. Years 1998-2013, distance between the geographic center of Guilford County and the Kersey Valley Landfill; years 2014-2017, distance between the geographic center of Guilford County and the public landfill facility (average of distance between two existing public facilities -- Hanes Mill and Davidson County -- not currently receiving Guilford County waste).
5. Assumes average disposal costs of $26 per ton for 500 TPD (1995$) Subtitle D landfill (Kersey Valley). Assumes average disposal costs of $23 per ton (1995$) for 800 TPD Subtitle D landfill (White Street). Assumes average disposal costs of $19 per ton (1995$) for 1,300 TPD Subtitle D landfill (White Street).

APPENDIX E

ECONOMIC ANALYSIS OF PRIVATE DISPOSAL OPTION

ECONOMIC ANALYSIS OF GUILFORD COUNTY
PRIVATE DISPOSAL OPTION
Jurisdiction: City of Greensboro

Description: Assumes closure of the Kersey Valley Landfill and the White Street Sanitary Landfill in 1997, after which time, all County generated waste in a private landfill facility.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)	
Tons (37% of MSW disposed):	3,379,965 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)[3]	15 miles
Cost	$25,349,736
Disposal Costs[4]:	$92,949,032
Total Costs:	**$118,298,768**
Cost/Ton:	$35
Privately-Controlled Waste (City of Greensboro)	
Tons (22% of MSW disposed):	2,009,709 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)[3]	15 miles
Cost	$15,072,816
Disposal Costs[4]:	$55,266,992
Total Costs:	**$70,339,808**
Cost/Ton:	$35
City of Greensboro MSW[5] -- Total Costs:	**$188,638,576**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill
3. Distance between the geographic center of the City of Greensboro and the Piedmont Landfill.
4. Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).
5. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
PRIVATE DISPOSAL OPTION
Jurisdiction: City of High Point

Description: Assumes closure of the Kersey Valley Landfill and the White Street Sanitary Landfill in 1997, after which time, all County generated waste in a private landfill facility.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of High Point)	
Tons (10% of MSW disposed):	913,504 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)	16 miles
Cost	$7,308,032
Disposal Costs[3]:	$25,121,360
Total Costs:	**$32,429,392**
Cost/Ton:	$36
Privately-Controlled Waste (City of High Point)	
Tons (14% of MSW disposed):	1,278,906 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)[3]	16 miles
Cost	$10,231,245
Disposal Costs[4]:	$35,169,904
Total Costs:	**$45,401,149**
Cost/Ton:	$36
City of High Point MSW[5] -- Total Costs:	**$77,830,541**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill
3. Distance between the geographic center of the City of High Point and the Piedmont Landfill.
4. Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).
5. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
PRIVATE DISPOSAL OPTION
Jurisdiction: Other Guilford County MSW

Description: Assumes closure of the Kersey Valley Landfill and the White Street Sanitary Landfill in 1997, after which time, all County generated waste in a private landfill facility.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Other Guilford County MSW[1]:	
Tons (17% of MSW disposed):	1,552,957 tons
Transport Costs[2]:	
Disposal Site[3]:	Private
Distance (1-way)[4]	17 miles
Cost	$13,200,133
Disposal Costs[5]:	$42,706,312
Other Guilford County MSW[1] -- Total Costs:	**$55,906,445**
Cost/Ton:	$36

1. Includes waste stream fraction of County MSW currently disposed of at the Piedmont Landfill
2. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
3. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill
4. Distance between the geographic center of Guilford County and the Piedmont Landfill.
5. Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).

APPENDIX F

ECONOMIC ANALYSIS OF COMBINED DISPOSAL OPTION

(Public to Public, Private to Private)

ECONOMIC ANALYSIS OF GUILFORD COUNTY
COMBINED DISPOSAL OPTION
(Public to Public, Private to Private)
Jurisdiction: City of Greensboro

Description: Assumes development of Phases II & IV at the Kersey Valley Landfill and Phases III & IV at the White Street Sanitary Landfill and the disposal of all County generated publicly-controlled waste at these two facilities throughout the planning period (1998-2017). Assumes all County generated privately-controlled waste will be disposed of at a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)	
Tons (37% of MSW disposed):	3,379,965 tons
Transport Costs[1]:	
Disposal Site[2]	White Street
Distance (1-way)[3]	5 miles
Cost	$8,449,912
Disposal Costs[4]:	$87,879,085
Total Costs:	**$96,328,997**
Cost/Ton:	$29
Privately-Controlled Waste (City of Greensboro)	
Tons (22% of MSW disposed):	2,009,709 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)[5]	15 miles
Cost	$15,072,816
Disposal Costs[4]:	$55,266,992
Total Costs:	**$70,339,808**
Cost/Ton:	$35
City of Greensboro MSW[6] -- Total Costs:	**$166,668,805**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill
3. Distance between the geographic center of the City of Greensboro and White Street.
4. Assumes average disposal costs of $57 per ton for 100 TPD (1995$) Subtitle D landfill (Kersey Valley). Assumes average disposal costs of $26 per ton for 500 TPD (1995$) Subtitle D landfill (White Street reduced tonnage). Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).
5. Distance between the geographic center of the City of Greensboro and the Piedmont Landfill.
6. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
COMBINED DISPOSAL OPTION
(Public to Public, Private to Private)
Jurisdiction: City of High Point

Description: Assumes development of Phases II & IV at the Kersey Valley Landfill and Phases III & IV at the White Street Sanitary Landfill and the disposal of all County generated publicly-controlled waste at these two facilities throughout the planning period (1998-2017). Assumes all County generated privately-controlled waste will be disposed of at a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of High Point)	
Tons (10% of MSW disposed):	913,504 tons
Transport Costs[1]:	
Disposal Site[2]	Kersey Valley
Distance (1-way)[3]	5 miles
Cost	$2,283,760
Disposal Costs[4]:	$52,069,728
Total Costs:	**$54,353,488**
Cost/Ton:	$60
Privately-Controlled Waste (City of High Point)	
Tons (14% of MSW disposed):	1,278,906 tons
Transport Costs[1]:	
Disposal Site[2]	Private
Distance (1-way)[5]	16 miles
Cost	$10,231,245
Disposal Costs[4]:	$35,169,904
Total Costs:	**$45,401,149**
Cost/Ton:	$36
City of High Point MSW[6] -- Total Costs:	**$99,754,637**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill
3. Distance between the geographic center of the City of High Point and Kersey Valley.
4. Assumes average disposal costs of $57 per ton for 100 TPD (1995$) Subtitle D landfill (Kersey Valley - reduced tonnage). Assumes average disposal costs of $26 per ton (1995$) for 500 TPD Subtitle D landfill (White Street). Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).
5. Distance between the geographic center of the City of High Point and the Piedmont Landfill.
6. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
COMBINED DISPOSAL OPTION
(Public to Public, Private to Private)
Jurisdiction: Other Guilford County MSW

Description: Assumes development of Phases II & IV at the Kersey Valley Landfill and Phases III & IV at the White Street Sanitary Landfill and the disposal of all County generated publicly-controlled waste at these two facilities throughout the planning period (1998-2017). Assumes all County generated privately-controlled waste will be disposed of at a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Other Guilford County MSW[1]:	
Tons (17% of MSW disposed):	1,552,957 tons
Transport Costs[2]:	
Disposal Site[3]:	Private
Distance (1-way)[4]	17 miles
Cost	$13,200,133
Disposal Costs[5]:	$42,706,312
Other Guilford County MSW[1] -- Total Costs:	**$55,906,445**
Cost/Ton:	$36

1. Includes waste stream fraction of County MSW currently disposed of at the Piedmont Landfill.
2. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
3. Private disposal site for the purposes of this analysis is assumed to be the Piedmont Landfill.
4. Distance between the geographic center of Guilford County and the Piedmont Landfill.
5. Assumes average disposal costs of $57 per ton for 100 TPD (1995$) Subtitle D landfill (Kersey Valley). Assumes average disposal costs of $26 per ton (1995$) for 500 TPD Subtitle D landfill (White Street). Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill -- see High Point Study, Table 4-7).

APPENDIX G

ECONOMIC ANALYSIS OF MULTI-JURISDICTIONAL LANDFILL

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(All County-Generated MSW -- 1,300 TPD Facility)
Jurisdiction: City of Greensboro

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve all County-generated MSW disposal needs, with operations starting in 1998.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)	
Tons (37% of MSW disposed):	3,379,965 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	15 miles
Cost	$25,349,736
Disposal Costs[3]:	$64,219,331
Total Costs:	**$89,569,067**
Cost/Ton:	$27
Privately-Controlled Waste (City of Greensboro)	
Tons (22% of MSW disposed):	2,009,709 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	15 miles
Cost	$15,072,816
Disposal Costs[3]:	$38,184,467
Total Costs:	**$53,257,283**
Cost/Ton:	$27
City of Greensboro MSW[4] -- Total Costs:	**$142,826,350**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of Greensboro and potential Multi-Jurisdictional Landfill site.
3. Assumes average disposal costs of $19.00 per ton (1995$) for 1,300 TPD Subtitle D landfill (Multi-Jurisdictional Landfill.
4. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(All County-Generated MSW -- 1,300 TPD Facility)
Jurisdiction: City of High Point

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve all County-generated MSW disposal needs, with operations starting in 1998.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of High Point)	
Tons (10% of MSW disposed):	913,504 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	32 miles
Cost	$14,616,064
Disposal Costs[3]:	$17,356,576
Total Costs:	**$31,972,640**
Cost/Ton:	$35
Privately-Controlled Waste (City of High Point)	
Tons (14% of MSW disposed):	1,278,906 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	32 miles
Cost	$20,462,490
Disposal Costs[3]:	$24,299,206
Total Costs:	**$44,761,696**
Cost/Ton:	$35
City of High Point MSW[4] -- Total Costs:	**$76,734,336**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of High Point and potential Multi-Jurisdictional Landfill site.
3. Assumes average disposal costs of $19.00 per ton (1995$) for 1,300 TPD Subtitle D landfill (Multi-Jurisdictional Landfill.
4. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(All County-Generated MSW -- 1,300 TPD Facility)
Jurisdiction: Other Guilford County Waste

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve all County-generated MSW disposal needs, with operations starting in 1998.

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Other Guilford County MSW	
Tons (17% of MSW disposed):	1,552,957 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	16 miles
Cost	$12,423,654
Disposal Costs[3]:	$29,506,179
Total Costs:	**$41,929,834**
Cost/Ton:	$27

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of Guilford County and potential Multi-Jurisdictional Landfill site.
3. Assumes average disposal costs of $19.00 per ton (1995$) for 1,300 TPD Subtitle D landfill (Multi-Jurisdictional Landfill).
4. Includes waste stream fraction of County MSW currently disposed of at private landfill facilities.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD Facility)
Jurisdiction: City of Greensboro

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)	
Tons (37% of MSW disposed):	3,379,965 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	15 miles
Cost	$25,349,736
Disposal Costs[3]:	$84,499,120
Total Costs:	**$109,848,856**
Cost/Ton:	$33
Privately-Controlled Waste (City of Greensboro)	
Tons (22% of MSW disposed):	2,009,709 tons
Transport Costs[1]:	
Disposal Site	Private LF
Distance (1-way)[4]	15 miles
Cost	$15,072,816
Disposal Costs[5]:	$55,266,992
Total Costs:	**$70,339,808**
Cost/Ton:	$35
City of Greensboro MSW[6] -- Total Costs:	**$180,188,664**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of Greensboro and potential Multi-Jurisdictional Landfill site.
3. Assumes average disposal costs of $25.00 per ton (1995$) for 600 TPD Subtitle D landfill (Multi-Jurisdictional Landfill.
4. Estimated distance between the geographic center of the City of Greensboro and private landfill (Piedmont Landfill).
5. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
6. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD Facility)
Jurisdiction: City of High Point

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of High Point)	
Tons (10% of MSW disposed):	913,504 tons
Transport Costs[1]:	
Disposal Site	Multi-Juris. LF
Distance (1-way)[2]	32 miles
Cost	$14,616,064
Disposal Costs[3]:	$22,837,600
Total Costs:	**$37,453,664**
Cost/Ton:	$41
Privately-Controlled Waste (City of High Point)	
Tons (14% of MSW disposed):	1,278,906 tons
Transport Costs[1]:	
Disposal Site	Private LF
Distance (1-way)[4]	16 miles
Cost	$10,231,245
Disposal Costs[5]:	$35,169,904
Total Costs:	**$45,401,149**
Cost/Ton:	$36
City of High Point MSW[6] -- Total Costs:	**$82,854,813**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of High Point and potential Multi-Jurisdictional Landfill site.
3. Assumes average disposal costs of $25.00 per ton (1995$) for 600 TPD Subtitle D landfill (Multi-Jurisdictional Landfill.
4. Estimated distance between the geographic center of the City of High Point and private landfill (Piedmont Landfill).
5. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
6. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY
MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD Facility)
Jurisdiction: Other Guilford County Waste

Description: Assumes development of a new, multi-jurisdictional landfill in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

Waste Stream	Years 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Other Guilford County MSW	
Tons (17% of MSW disposed):	1,552,957 tons
Transport Costs[1]:	
Disposal Site	Private LF
Distance (1-way)[2]	17 miles
Cost	$13,200,133
Disposal Costs[3]:	$42,706,312
Total Costs:	**$55,906,445**
Cost/Ton:	$36

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of Guilford County and private landfill (Piedmont Landfill).
3. Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill).
4. Includes waste stream fraction of County MSW currently disposed of at private landfill facilities.

APPENDIX H

ECONOMIC ANALYSIS OF WASTE-TO-ENERGY OPTIONS

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: Multi-Jurisdictional Mass Burn Waste-to-Energy Facility
Jurisdiction: City of Greensboro

Description:

Assumes development of a multi-jurisdictional mass burn WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (Greensboro)		
Tons (50% MSW Disposed)		4,567,520
Transport Costs	1.	
Disposal Site		Mass Burn WTE Facility
Distance (1-Way)		15
Cost		$34,256,400
Disposal Costs	2.	$283,186,240
Total Costs		$317,442,640
Cost/Ton		$70
Privately-Controlled Waste (Greensboro)		
Tons (9% MSW Disposed)		822,154
Transport Costs	1.	
Disposal Site		Piedmont Landfill
Distance (1-Way)		15
Cost		$6,166,152
Disposal Costs	3.	$22,609,224
Total Costs		$28,775,376
Cost/Ton		$35
Total Greensboro MSW (4)		
Total Costs		$346,218,016

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of $62.00 per ton (1995$) for 900 TPD mass burn facility. This cost based on assumption that no significant economy of scale would be achieved by scaling up from a 600 TPD facility to a facility with a 900 TPD throughput.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at the White Street Landfill.

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Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional Mass Burn Waste-to-Energy Facility**
Jurisdiction: **City of High Point**

Description:

Assumes development of a multi-jurisdictional mass burn WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

		Estimated Costs (1995$) Years 1998-2017
Waste Stream		
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (High Point)		
Tons (18% MSW Disposed)		1,644,307
Transport Costs	1.	
Disposal Site		Mass Burn WTE Facility
Distance (1-Way)		32
Cost		$26,308,915
Disposal Costs	2.	$101,947,046
Total Costs		$128,255,962
Cost/Ton		$78
Privately-Controlled Waste (High Point)		
Tons (6% MSW Disposed)		548,102
Transport Costs	1.	
Disposal Site		Piedmont Landfill
Distance (1-Way)		16
Cost		$4,384,819
Disposal Costs	3.	$15,072,816
Total Costs		$19,457,635
Cost/Ton		$36
Total High Point MSW (4)		
Total Costs		$147,713,597

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of $62.00 per ton (1995$) for 900 TPD mass burn facility. This cost based on assumption that no significant economy of scale would be achieved by scaling up from a 600 TPD facility to a facility with a 900 TPD throughput.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at the Kersey Valley Landfill.

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Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional Mass Burn Waste-to-Energy Facility**
Jurisdiction: **Other Guilford County MSW**

Description:

Assumes development of a multi-jurisdictional Mass Burn WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Other Guilford County MSW		
Tons (17% MSW Disposed)		1,552,957
Transport Costs	1.	
Disposal Site		Piedmont Landfill facility
Distance (1-Way)		17
Cost		$13,200,133
Disposal Costs	2.	$42,706,312
Total Costs		$55,906,445
Cost/Ton		$36

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
3. Includes waste stream fraction of County waste currently disposed of at Piedmont Landfill.

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APPENDIX I

ECONOMIC ANALYSIS OF MSW COMPOSTING OPTIONS

ECONOMIC ANALYSIS OF GUILFORD COUNTY MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD MSW Composting Facility)
Jurisdiction: City of Greensboro

DESCRIPTION: Assumes development of a new, multi-jurisdictional MSW composting facility in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

WASTE STREAM	YEARS 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of Greensboro)	3,379,965 tons
Tons (37% of MSW disposed):	
Transport Costs[1]:	MSW Compost Facility
Disposal Site	15 miles
Distance (1-way)[2]	$25,349,736
Cost	$114,918,810
Disposal Costs[3]:	**$140,268,546**
Total Costs:	$41
Cost/Ton:	
Privately-Controlled Waste (City of Greensboro)	2,009,709 tons
Tons (22% of MSW disposed):	
Transport Costs[1]:	Private LF
Disposal Site	15 miles
Distance (1-way)[4]	$15,072,816
Cost	$55,266,992
Disposal Costs[5]:	**$70,339,808**
Total Costs:	$35
Cost/Ton:	
City of Greensboro MSW[6] -- Total Costs:	**$210,608,354**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of Greensboro and potential Multi-Jurisdictional Regional Landfill site.
3. Assumes average disposal costs of $34.00 per ton (1995$) for 600 TPD MSW Composting Facility.
4. Estimated distance between the geographic center of the City of Greensboro and private landfill (Piedmont Landfill).
5. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
6. Includes waste stream fraction of County MSW currently disposed of at White Street Sanitary Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD MSW Composting Facility)
Jurisdiction: City of High Point

DESCRIPTION: Assumes development of a new, multi-jurisdictional MSW composting facility in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

WASTE STREAM	YEARS 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Publicly-Controlled Waste (City of High Point)	
Tons (10% of MSW disposed):	913,504 tons
Transport Costs[1]:	
Disposal Site	MSW Composting Facility
Distance (1-way)[2]	32 miles
Cost	$14,616,064
Disposal Costs[3]:	$31,059,136
Total Costs:	**$45,675,200**
Cost/Ton:	$50
Privately-Controlled Waste (City of High Point)	
Tons (14% of MSW disposed):	1,278,906 tons
Transport Costs[1]:	
Disposal Site	Private LF
Distance (1-way)[4]	16 miles
Cost	$10,231,245
Disposal Costs[5]:	$35,169,904
Total Costs:	**$45,401,149**
Cost/Ton:	$36
City of High Point MSW[6] -- Total Costs:	**$91,076,349**

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of the City of High Point and potential Multi-Jurisdictional Regional Landfill site.
3. Assumes average disposal costs of $62.00 per ton (1995$) for 600 TPD MSW Composting Facility.
4. Estimated distance between the geographic center of the City of High Point and private landfill (Piedmont Landfill).
5. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
6. Includes waste stream fraction of County MSW currently disposed of at Kersey Valley Landfill.

ECONOMIC ANALYSIS OF GUILFORD COUNTY MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES
(Publicly-Controlled MSW -- 600 TPD MSW Composting Facility)
Jurisdiction: Other Guilford County Waste

DESCRIPTION: Assumes development of a new, multi-jurisdictional MSW composting facility in Guilford County to serve only publicly-controlled MSW disposal needs, with operations starting in 1998. Assumes all County-generated privately-controlled MSW will be disposed in a private landfill facility throughout the planning period (1998-2017).

WASTE STREAM	YEARS 1998-2017
Total County Projected MSW Disposal Requirements (15% Diversion Rate):	9,135,040 tons
Other Guilford County MSW	
Tons (17% of MSW disposed):	1,552,957 tons
Transport Costs[1]:	
Disposal Site	Private LF
Distance (1-way)[2]	17 miles
Cost	$13,200,133
Disposal Costs[3]:	$42,706,312
Total Costs:	**$55,906,445**
Cost/Ton:	$36

1. Assumes transport costs of $2.00 per truck mile and an 8 ton payload (packer truck).
2. Estimated distance between the geographic center of Guilford County and private landfill (Piedmont Landfill).
3. Assumes average disposal costs of $27.50 per ton (1995$) for private Subtitle D landfill (Piedmont Landfill).
4. Includes waste stream fraction of County MSW currently disposed of at private landfill facilities.

APPENDIX J

EVALUATION OF MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES TO LANDFILL DISPOSAL FOR MANAGING PUBLICLY-CONTROLLED AND FRANCHISED-CONTROLLED MSW

APPENDIX J

EVALUATION OF MULTI-JURISDICTIONAL DISPOSAL ALTERNATIVES TO LANDFILL DISPOSAL FOR MANAGING PUBLICLY-CONTROLLED AND FRANCHISED-CONTROLLED MSW

I. INTRODUCTION

In Sections 6.0 and 7.0, the costs and benefits of municipal waste energy conversion and MSW composting systems were discussed. In order to ensure their economic viability, these recovery systems were sized only to handle the "publicly-controlled" portion of the municipal solid waste in the County.

A recent ruling by a U.S. Appeals Court has upheld the strategy of achieving flow control over the "privately-controlled" portion of the waste stream through the establishment of collection franchises.

In light of this ruling, HDR was asked to evaluate the economic benefits of implementing a larger recovery system (either waste-to-energy or composting) to handle both the publicly-controlled and franchised-controlled wastes.

The purpose of this technical assessment is to present new recovery facility throughput requirements where a flow control mechanism is implemented involving the franchising of a portion of the waste stream which is currently controlled by private entities. New capital and operating cost estimates for the larger waste-to-energy and MSW composting facilities needed to accommodate the publicly-controlled and franchise-controlled waste streams are also presented.

II. OVERVIEW OF FRANCHISING OPTION

Recently the United States Court of Appeals for the Second Circuit upheld a lower court decision in the case of *USA Recycling, Inc. V. Town of Babylon,* which, in essence, allowed the Town of Babylon to institute flow control over municipal solid waste through the issuance of collection franchises. In this case the, Town of Babylon allowed a private contract hauler to dispose of solid waste at the Town incinerator for free. In turn, the Town paid a lower fee to the contractor for trash pickup due to the free tipping at the

incinerator. Collection services were franchised (contracted); however, the Town did not require the contract hauler nor any other haulers to dispose of waste at the incinerator. In this situation, the Town was acting as a "market participant" rather than a regulator and, from an economic standpoint, the franchised collectors of waste found it to be economically favorable to dispose of waste at the incinerator.

A Franchising Option Potential for Guilford County

As indicated in Section 3.0, a total of 152,813 tons (FY 1994-1995), or 63% of the MSW disposed of at the City of Greensboro's White Street Sanitary Landfill, is waste considered to be "publicly-controlled." The remaining 91,677 tons of the total MSW disposed of at the landfill is waste considered to be "privately-controlled." The City of Greensboro estimates that the potential exists for 60% of the privately-controlled portion of the incoming waste stream to be "franchised" under arrangements similar to those made in the Town of Babylon. This percentage would equate to approximately 55,000 tons of waste based on FY 1994-1995 data.

Similarly, tonnage data provided by the City of High Point indicated that a total of 40,497 tons (FY 1994-1995), or 41% of the MSW disposed of at the Kersey Valley Landfill, is publicly-controlled waste. The remaining 58,298 tons of the total MSW disposed of at the Kersey Valley Landfill is considered to be privately-controlled. The City of High Point estimates that the potential exists for 60% of the privately-controlled portion of the City's waste stream to be "franchised-controlled." This percentage would equate to approximately 34,980 tons of waste based on FY 1994-1995 data.

Table 1 presents the FY 1994-1995 projection of publicly-controlled and franchised-controlled MSW for Guilford County. As indicated, it is estimated that 68% of the total MSW generated within Guilford County has the potential for being controlled through either public collection programs or franchised collection throughout the planning period.

TABLE 1 GUILFORD COUNTY SOLID WASTE MANAGEMENT STUDY PUBLICLY-CONTROLLED AND FRANCHISED-CONTROLLED MSW ESTIMATES FY 1994-1995			
Jurisdiction	**Tons**	**% of Total**	
White Street Sanitary Landfill			
Publicly-Controlled	152,813	37%	
Potential Franchised	55,006	13%	
Private Collection	36,671	9%	
Subtotal	244,490		59%
Kersey Valley Landfill			
Publicly-Controlled	40,497	10%	
Potential Franchised	34,979	8%	
Private Collection	23,319	6%	
Subtotal	98,795		24%
Subtotal - Publicly-Controlled and Franchised-Controlled MSW	283,295	68%	
Other County MSW	73,520		17%
Totals:	**416,805**		**100%**

Note: MSW tonnage data derived from Guilford County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, and information provided by Mr. Dale James (City of Greensboro) and Mr. Perry Kairis (City of High Point).

III. FUTURE PUBLICLY-CONTROLLED AND FRANCHISE-CONTROLLED WASTE PROJECTIONS

The quantities of municipal solid waste estimated to be generated within Guilford County that have the potential for being publicly-controlled and franchise-controlled during the period 1998-2017 are presented in Table 2.

TABLE 2
GUILFORD COUNTY PUBLICLY-CONTROLLED AND FRANCHISE-CONTROLLED MUNICIPAL SOLID WASTE DISPOSAL PROJECTIONS

Year	Population[1]	Total MSW Generated[2]	Materials Expected to be Diverted from LF Disposal (TPY)		Publicly-Controlled and Franchised-Controlled MSW Projections (TPY)[4]	
		TPY	15% Diversion Rate	40% Diversion Rate[3]	15% Diversion Rate	40%[3] Diversion Rate
1998	371,884	498,670	74,800	137,130	288,232	245,847
1999	374,942	502,770	75,420	159,210	290,598	233,621
2000	378,000	506,870	76,030	181,630	292,971	221,163
2001	381,050	510,960	76,640	204,380	295,338	208,474
2002	384,100	515,050	77,260	206,020	297,697	210,140
2003	387,150	519,140	77,870	207,660	300,064	211,806
2004	390,200	523,230	78,480	209,290	302,430	213,479
2005	393,250	527,320	79,100	210,930	304,790	215,145
2006	396,300	531,410	79,710	212,560	307,156	216,818
2007	399,350	535,500	80,330	214,200	309,156	218,484
2008	402,400	539,590	80,940	215,840	311,882	220,150
2009	405,450	543,680	81,550	217,470	314,248	221,823
2010	408,500	547,770	82,170	219,110	316,608	223,489
2011	411,450	551,730	82,760	220,690	318,900	225,107
2012	414,400	555,680	83,350	222,270	321,184	226,719
2013	417,350	559,640	83,950	223,860	323,469	228,330
2014	420,300	563,590	84,540	225,440	325,754	229,942
2015	423,250	567,550	85,130	227,020	328,046	231,560
2016	426,200	571,510	85,730	228,600	330,330	233,179
2017	429,150	575,460	86,320	230,180	332,615	234,790
	Totals:	**10,747,120 tons**	**1,612,080 tons**	**4,173,490 tons**	**6,211,827 tons**	**4,470,068 tons**

Notes:
1. Population estimates based on data provided by the Guilford County Planning and Development Department and straight line interpolation of data.
2. Total MSW tonnage based on waste generation data for Guilford County as reported in the County's Solid Waste Management Annual Report for the period July 1, 1994 - June 30, 1995, constant per capita waste generation rate of 7.35%, and annual population estimates for Guilford County. MSW tonnage does not include C&D waste received at the White Street Sanitary Landfill during fiscal year 1994-1995. Tonnages rounded to the nearest tenth.
3. Landfill diversion rate in 1998 based on FY 1994-1995 diversion rate of 15%. This rate was then increased yearly as follows to achieve a 40% diversion rate by the year 2001 and beyond: 1996, 19%; 1997, 23%; 1998, 28%; 1999, 32%; 2000, 36%; 2001, 40%. Landfill diversion rate of 15% based on County data for the FY 1994-1995 period which indicates that approximately 15% of County generated waste is diverted from landfilling.
4. Assumes 60% of waste currently privately-controlled and disposed at the White Street Sanitary Landfill (60% of 91,677 tons base year total) could potentially be franchised and thereby "controlled" by the City of Greensboro. Assumes 60% of waste currently privately-controlled and disposed at the Kersey Valley Landfill (60% of 58,298 tons base year total) could potentially be franchised and thereby "controlled" by the City of High Point. The total tonnage thereby publicly-controlled (including franchised options) would be 283,295 tons, or 68% of the base year County tonnage of 416,805.

Table 2 presents future publicly-controlled and franchised-controlled MSW estimates for Guilford County based on two waste diversion scenarios. The first scenario assumes that the waste quantities and methods of management reported to have been used during fiscal year 1994-1995 to deal with the MSW generated in Guilford County will continue throughout the planning period; namely, that approximately 85% of the MSW generated within Guilford County will be managed by means of landfill disposal, and the remaining 15% of the MSW generated within Guilford County will be diverted from landfill disposal via recycling, composting, or other reclamation programs.

The second scenario assumes that waste diversion rates in Guilford County will be in keeping with the current State goal of a 40% reduction by weight of solid waste disposed at municipal solid waste disposal facilities by 40% by the year 2001 (through source reduction, reuse, recycling, and composting programs). For this scenario, the 15% landfill diversion rate reported by Guilford County during FY 1994-1995 has been used as the starting point for achieving the 40% reduction goal in 2001. In order to achieve this goal, it has been assumed that, starting with a 15% diversion rate in 1995, the Guilford County diversion rate will increase by approximately 4% annually until the 40% reduction goal is achieved in 2001. Beyond the year 2001, the 40% diversion rate will remain constant throughout the remainder of the planning period.

In both of these scenarios, it has been assumed that the per capita waste generation rate of 7.35 pounds per person per day will remain constant throughout the planning period. The resulting tonnage projections presented in Table 2 reflect the entire waste stream anticipated to be generated within Guilford County and which will require management during the period 1998-2017, as well as that portion of the County's waste stream deemed to have the potential for being under the control of public entities. The estimates are based on the theory that 68% of the total MSW generated within Guilford County will be either directly publicly-controlled (wastes collected by municipalities), or will be "controlled" via franchising arrangements with municipalities throughout the planning period.

IV. WASTE-TO-ENERGY ALTERNATIVES -- FACILITY SIZING AND COSTS

A. Waste Flow Assumptions

For comparative purposes, two different scenarios have been included in the preliminary analysis of the costs associated with the development of a multi-jurisdictional waste-to-energy (WTE) facility to serve Guilford County's disposal needs over the 20-year planning period. These scenarios involve the implementation of: 1) a mass-burn WTE facility, or 2) an RDF facility. Both scenarios involve sizing the WTE facility to accommodate the publicly-controlled and franchise-controlled portion of the MSW.

As indicated in Table 3, the publicly-controlled and franchise-controlled waste in 1998 would be sufficient to support a waste-to-energy facility with a nominal capacity of 900 tons per day (7 days/week operation: 15% annual facility maintenance downtime).

TABLE 3
WASTE-TO-ENERGY FACILITY

Jurisdiction	Publicly-Controlled and Franchise-Controlled MSW	WTE Facility Size (TPD_7)
High Point	60,529	195
Greensboro	227,703	734
Total	288,232	929

Based on 1998 projection of publicly-controlled and franchise-controlled MSW of 288,232 tons/year.
Assumes facility availability factor of 85%.

B. Implementation of a Mass-Burn WTE Facility

The first scenario involves the implementation of a 900 TPD mass-burn, waste-to-energy facility. It was assumed that the facility would be financed with publicly-issued revenue bonds but would be designed, constructed, and operated (under a 20-year operating contract) by a full service vendor.

To estimate the "tipping fees" that would be charged by a full service vendor, recent bid prices were analyzed for a 600 TPD facility and an actual tipping fee for a 1,440 TPD facility to derive a cost estimate for a 900 TPD mass-burn facility.

Bids were analyzed for a 600 TPD mass-burn WTE facility as received by Mecklenburg County, North Carolina, in 1992 for the Arrowwood WTE project. Based on this analysis, which is presented in Table 4, HDR estimates that a 600 TPD mass-burn facility would have an average tipping fee of $62 per ton (reported in 1995$).

As a comparison to the bids received for the 600 TPD facility, HDR gathered information regarding a 1,400 TPD multi-jurisdictional mass-burn WTE facility. It was determined that the 1,400 TPD multi-jurisdictional mass-burn WTE facility, which is owned by Union County, New Jersey and began operations on February 11, 1994, charged a tipping fee of $76 per ton in 1995. The Union County facility achieves a high level of air pollution control through the use of carbon injection (for mercury control) and thermal denox NO_x (for control) in addition to a scrubber/baghouse system.

The $14 per ton higher tip fee estimated for the 1,400 TPD Union County facility may in part be due to higher costs associated with operating facilities in the northeastern part of the United States. However, even adjusting for such variables, HDR has concluded that no significant economy of scale is likely to be achieved in the current U.S. market for mass-burn systems by scaling up from a 600 TPD facility to a facility with a 900 TPD throughput. Therefore, the tipping fee estimate of $62 per ton developed for the 600 TPD mass-burn WTE facility would also apply to the 900 TPD facility.

TABLE 4 ESTIMATION OF AVERAGE TIPPING FEES FOR MASS-BURN WASTE-TO-ENERGY FACILITY				
Vendor	Capital Cost		Average LCC Tipping Fee	
	1992	1995	1992	1995
Rust/Wheelabrator	$119,800	$134,759	$42	$47
American Ref-Fuel	$164,500	$185,040	$69	$78
Foster Wheeler	$135,300	$152,194	$52	$58
MK Ferguson	$136,500	$153,544	$56	$63
Ogden Martin	$146,500	$164,793	$58	$65
Average		$158,066		$62

Assumptions

Inflation Rate: 4%
Throughput (TPD - 7 days/week) 600

Based on 1992 bids received for Mecklenburg County, North Carolina, Arrowood Facility (600 TPD_7).

C. Implementation of an RDF Production/Combustion System

The second scenario involves the implementation of a 900 TPD RDF Production/ Combustion System. In this case, it was assumed that the system would also be designed, constructed, and operated by a full-service vendor. It was also assumed that the combustion facility would be constructed on an industrial site and that the major portion of the costs of the combustion facility would be borne by the industrial energy user. The County and its municipalities would bear the costs associated with the RDF production facility.

To estimate the potential tipping fees associated with this scenario, HDR assumed an initial tipping fee at the RDF Production facility of $50 per ton (1995$). It was assumed that 50% of the tipping fee would be escalated at an assumed inflation rate of 4%/year over the life of the facility. (These assumptions are

based on information provided for the BHC Energy Project in Fayetteville, NC, which is a 1,000 TPD facility with a tipping fee currently in the range of $35 per ton and which is escalated at 50% of the CPI.)

The results of this preliminary analysis, as presented in Table 5, indicate an average tipping fee of $33 per ton (1995$) for the RDF Production Facility. (Again, it should be noted that this tipping fee assumes that the costs of the RDF combustion facility are largely borne by the industrial energy user.)

D. Unit Costs and Economics

The unit costs and economics associated with developing a multi-jurisdictional waste-to-energy facility to accommodate the publicly-controlled and franchise-controlled MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 6 and Appendix K. The costs associated with the development of the multi-jurisdictional facility are based on an assumed transport cost of $2.00 per truck mile, an 8 ton payload per packer truck, and the assumption that only publicly-controlled and franchise-controlled County-generated wastes will be disposed of in the new public landfill facility. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities.

For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County.

To accommodate the publicly-controlled and franchise-controlled future disposal needs of Guilford County, it is estimated that the average disposal costs for a 900 ton per day would be $62/ton for a mass-burn facility and $33 per ton for an RDF facility (1995 dollars). As is shown in Table 6, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled and franchise-controlled MSW at a new multi-jurisdictional WTE facility range from $41 - $78 per ton (1995 dollars) for an average of $39 - $51 per ton (1995 dollars) for this alternative.

TABLE 5
ESTIMATION OF AVERAGE TIPPING FEES FOR
900 TPD RDF WASTE-TO-ENERGY FACILITY

Year	Projected Tip Fees	
	Actual	1995$
1998	$53.12	$44.60
1999	$54.25	$42.97
2000	$55.42	$41.41
2001	$56.63	$39.92
2002	$57.90	$38.51
2003	$59.21	$37.15
2004	$60.58	$35.86
2005	$62.01	$34.62
2006	$63.49	$33.44
2007	$65.03	$32.32
2008	$66.63	$31.24
2009	$68.29	$30.21
2010	$70.02	$29.22
2011	$71.82	$28.27
2012	$73.70	$27.37
2013	$76.65	$26.50
2014	$77.67	$25.67
2015	$79.78	$24.88
2016	$81.97	$24.11
2017	$84.25	$23.38
Average	$66.57	$32.58

Assumptions: Base Year: 4% Tip Fee - 1995: $50/ton
Inflation Rate: 4.00% Discount Rate: 6.00%

Notes: Based on tipping fee of $35 per ton for 1,000 TPD BCH energy project. Inflation rate applied to O&M costs only, estimated to be 50% of the tipping fee. Revenues from the sale of recovered materials assumed to be $0 per ton. Assumes construction of RDF power plant for industrial steam user.

TABLE 6
GUILFORD COUNTY SOLID WASTE MANAGEMENT STUDY
SUMMARY OF ECONOMIC ANALYSES:
MULTI-JURISDICTIONAL WASTE-TO-ENERGY FACILITIES

JURISDICTION Waste Description		Disposal of Publicly-Controlled and Franchise-Controlled County-Generated MSW (900 TPD Mass-Burn Facility)		Disposal of Publicly-Controlled and Franchise-Controlled County-Generated MSW (900 TPD RDF Facility)	
		Total Costs	Cost/Ton[1]	Total Costs	Cost/Ton[1]
City of Greensboro					
Publicly-Controlled and Franchised-Controlled Waste	50%	$317,442,640	$70	$184,984,560	$41
Privately-Controlled Waste	9%	$28,775,376	$35	$28,775,376	$35
Subtotal	**59%**	**$346,218,016**		**$213,759,936**	
City of High Point					
Publicly-Controlled and Franchise-Controlled Waste	18%	$128,255,962	$78	$80,571,053	$49
Privately-Controlled Waste	6%	$19,183,584	$35	$19,183,584	$35
Subtotal	**24%**	**$147,439,546**		$99,754,637	
Other County MSW	**17%**	$55,906,445	$36	$55,906,445	$36
TOTAL	**100%**	**$549,564,007**	**$51**	**$369,421,018**	**$39**

Note: (1) Cost/ton include both hauling and disposal costs. All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

V. MSW COMPOSTING ALTERNATIVES -- FACILITY SIZING AND COSTS

A. Facility Assumptions

The purpose of this section is to provide a preliminary analysis of the costs associated with the development of a multi-jurisdictional MSW Composting facility to serve Guilford County's disposal needs over the 20-year planning period. This analysis was performed by sizing the composting facility to accommodate the publicly-controlled and franchise-controlled portion of the MSW.

As indicated in Table 7, the publicly-controlled and franchise-controlled waste in 1998 would be sufficient to support a composting facility with a nominal capacity of 900 tons per day (6 days/week operation, 5% annual facility maintenance downtime).

TABLE 7
ESTIMATION OF AVERAGE TIPPING FEES FOR COMPOSTING FACILITIES

Jurisdiction	Publicly-Controlled and Franchise-Controlled MSW	Facility Size (TPD_6)
High Point	60,529	259
Greensboro	227,703	713
Total	288,232	972

Based on 1998 projection of publicly-controlled and franchise-controlled MSW of 288,232 tons/year. Assumes facility availability factor of 95%.

This analysis assumes the implementation of a 900 TPD (6 days/week) composting facility. Based on conversations with a leading U.S. compost consulting firm, it was estimated that an economy of scale factor of 10-15% can be applied when scaling up a facility by the degree represented by going from 600 TPD to 900 TPD throughput. Therefore, applying an economy of scale factor of 10% to the average tipping fee of $34 per ton calculated for the 600 TPD facility. It should

be noted that at present there are no 900 TPD composting facilities operating in the U.S.; the largest operating facilities in the U.S. at present process 600 TPD of materials.

Applying an economy of scale factor of 10% to the $34 per ton tipping fee estimated for the 600 TPD facility, HDR estimates an average tipping fee of $31 per ton for the 900 TPD MSW compost facility.

B. System Costs and Economics

The system costs and economics associated with developing a multi-jurisdictional composting facility to accommodate only the publicly-controlled and franchise-controlled MSW estimated to be generated in Guilford County over the period 1998-2017 are presented in Table 8 and Appendix L.

The costs associated with the development of the multi-jurisdictional facility are based on an assumed transport cost of $2.00 per truck mile, an 8 ton payload per packer truck, and the assumption that only publicly-controlled and franchise-controlled County-generated wastes will be processed at the MSW composting facility. All remaining County-generated MSW (privately-controlled MSW) requiring landfill disposal would be hauled to private facilities. For the purposes of this study, it is assumed that the Piedmont Landfill would be the facility used to dispose of all privately-controlled waste generated in Guilford County.

To accommodate the publicly-controlled and franchise-controlled waste generated in Guilford County, it is estimated that the average disposal costs would be $40/ton for a 900 TPD composting facility (1995 dollars). As is shown in Attachment B, once transport costs and associated disposal costs are considered, the average costs estimated to be incurred for the disposal of publicly-controlled and franchise-controlled MSW at a new multi-jurisdictional composting facility range from $39 - $47 per ton (1995 dollars).

TABLE 8
GUILFORD COUNTY SOLID WASTE MANAGEMENT STUDY
SUMMARY OF ECONOMIC ANALYSES:
MULTI-JURISDICTIONAL MSW COMPOSTING FACILITY

JURISDICTION Waste Description		Disposal of Publicly-Controlled and Franchise-Controlled County-Generated MSW (900 TPD Composting Facility)	
		Total Costs	Cost/Ton[1]
City of Greensboro			
Publicly-Controlled and Franchise-Controlled	50%	$175,849,520	$39
Privately-controlled	9%	$28,775,376	$35
Subtotal	**59%**	**$204,624,896**	
City of High Point			
Publicly-Controlled and Franchise-Controlled	18%	$77,282,438	$47
Privately-controlled	6%	$23,842,454	$44
Subtotal	**24%**	**$101,124,893**	
Other County MSW	**17%**	**$55,906,445**	$36
TOTAL:	**100%**	**$361,656,007**	$40

Note: (1) Cost/ton include both hauling and disposal costs. All costs reported in 1995 dollars. Costs based on the disposal of 9,135,040 tons of MSW over the period 1998-2017 and assume a 15% waste diversion rate.

VI. CONCLUSIONS

Changing court decisions when it comes to issues involving flow control mechanisms regulations continue to present challenges to managers of solid waste systems. Should the findings of *USA Recycling, Inc. V. Town of Babylon* be upheld in the United States Supreme Court and the 1993 ruling on flow control be repealed by the same judicial body, then the financial risks associated with capital intensive solid waste management systems such as waste-to-energy facilities would be substantially reduced.

From this analysis of managing publicly-controlled and franchise-controlled waste it can be concluded that the economic viability of the MSW composting alternative improves slightly (in terms of cost per ton of waste disposed) as daily throughputs of waste increase (see the economic analyses presented in Section 6.0). It has also been concluded that, at best, the cost per ton of waste disposed associated with the waste-to-energy alternative will stay the same as daily throughputs of waste increase (see the economic analyses presented in Section 7.0). The findings of this Appendix are all dependent upon the success of instituting a mechanism, such as the mechanism used by the Town of Babylon, in assuring that a facility processes the daily tonnages of waste for which it was designed.

ATTACHMENT K

UNIT COSTS AND ECONOMICS OF WTE FACILITY OF PUBLICLY-CONTROLLED AND FRANCHISE-CONTROLLED WASTE

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: Multi-Jurisdictional RDF Waste-to-Energy Facility
Jurisdiction: City of Greensboro

Description:

Assumes development of a multi-jurisdictional RDF WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (Greensboro)		
Tons (50% MSW Disposed)		4,567,520
Transport Costs	1.	
Disposal Site		RDF WTE Facility
Distance (1-Way)		15
Cost		$34,256,400
Disposal Costs	2.	$150,728,160
Total Costs		$184,984,560
Cost/Ton		$41
Privately-Controlled Waste (Greensboro)		
Tons (9% MSW Disposed)		822,154
Transport Costs	1.	
Disposal Site		Piedmont Landfill Facility
Distance (1-Way)		15
Cost		$6,166,152
Disposal Costs	3.	$22,609,224
Total Costs		$28,775,376
Cost/Ton		$35
Total Greensboro MSW (4)		
Total Costs		$213,759,936

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of 33.00 per ton (1995$) for 900 TPD RDF facility. This cost based on assumed initial tipping fee at an RDF Production facility of $50 per ton (1995$). It was assumed that 50% of the tipping fee would be escalated at an assumed inflation rate of 4%/year over the life of the facility. (These assumptions based on information provided for the BHC Energy Project in Fayetteville, NC, which is a 1,000 TPD facility with a tipping fee of 900 TPD throughput.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at White Street Landfill.

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: Multi-Jurisdictional RDF Waste-to-Energy Facility
Jurisdiction: City of High Point

Description:

Assumes development of a multi-jurisdictional RDF WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (High Point)		
Tons (18% MSW Disposed)		1,644,307
Transport Costs	1.	
Disposal Site		RDF WTE Facility
Distance (1-Way)		32
Cost		$26,308,915
Disposal Costs	2.	$54,262,138
Total Costs		$80,571,053
Cost/Ton		$49
Privately-Controlled Waste (High Point)		
Tons (6% MSW Disposed)		548,102
Transport Costs	1.	
Disposal Site		Piedmont Landfill Facility
Distance (1-Way)		16
Cost		$4,384,819
Disposal Costs	3.	$15,072,816
Total Costs		$19,457,635
Cost/Ton		$36
Total High Point MSW (4)		
Total Costs		$100,028,688

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of 33.00 per ton (1995$) for 900 TPD RDF facility. This cost based on assumed initial tipping fee at an RDF Production facility of $50 per ton (1995$). It was assumed that 50% of the tipping fee would be escalated at an assumed inflation rate of 4%/year over the life of the facility. (These assumptions based on information provided for the BHC Energy Project in Fayetteville, NC, which is a 1,000 TPD facility with a tipping fee of 900 TPD throughput.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at Kersey Valley Landfill.

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional RDF Waste-to-Energy Facility**
Jurisdiction: **Other Guilford County MSW**

Description:

Assumes development of a multi-jurisdictional RDF WTE facility in Guilford County to serve all publicly-controlled and franchised-controlled MSW disposal needs with operations starting in 1998.

		Estimated Costs (1995$) Years 1998-2017
Waste Stream		
Total County MSW (15% Recycling)		9,135,040
Other Guilford County MSW		
Tons (17% MSW Disposed)		1,552,957
Transport Costs	1.	
Disposal Site		Piedmont Landfill facility
Distance (1-Way)		17
Cost		$13,200,133
Disposal Costs	2.	$42,706,312
Total Costs		$55,906,445
Cost/Ton		$36

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
3. Includes waste stream fraction of County waste currently disposed of at Piedmont Landfill.

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APPENDIX L

UNIT COSTS AND ECONOMICS OF A MSW COMPOSTING FACILITY FOR PUBLICLY-CONTROLLED AND FRANCHISE-CONTROLLED WASTE

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional Composting Facility**
Jurisdiction: **City of Greensboro**

Description:

Assumes development of a multi-jurisdictional composting facility in Guilford County to serve all publicly controlled and franchised controlled County-generated MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (Greensboro)		
Tons (50% MSW Disposed)		4,567,520
Transport Costs	1.	
Disposal Site		Composting Facility
Distance (1-Way)		15
Cost		$34,256,400
Disposal Costs	2.	$141,593,120
Total Costs		$175,849,520
Cost/Ton		$39
Privately-Controlled Waste (Greensboro)		
Tons (9% MSW Disposed)		822,154
Transport Costs	1.	
Disposal Site		Piedmont Landfill Facility
Distance (1-Way)		15
Cost		$6,166,152
Disposal Costs	3.	$22,609,224
Total Costs		$28,775,376
Cost/Ton		$35
Total Greensboro MSW (4)		
Total Costs		$204,624,896

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of $31.00 per ton (1995$) for 900 TPD composting facility. This cost based on assumption that a 10% economy of scale be used to adjust from a 600 TPD facility (1995 disposal cost estimate of $34/Ton) to a 900 TPD facility.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at White Street Landfill.

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Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional Composting Facility**
Jurisdiction: **City of High Point**

Description:

Assumes development of a multi-jurisdictional composting facility in Guilford County to serve all publicly controlled and franchised controlled County-generated MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Publicly Controlled and Franchised Controlled Waste (High Point)		
Tons (18% MSW Disposed)		1,644,307
Transport Costs	1.	
Disposal Site		Composting Facility
Distance (1-Way)		32
Cost		$26,308,915
Disposal Costs	2.	$50,973,523
Total Costs		$77,282,438
Cost/Ton		$47
Privately-Controlled Waste (High Point)		
Tons (6% MSW Disposed)		548,102
Transport Costs	1.	
Disposal Site		Composting Facility
Distance (1-Way)		32
Cost		$8,769,638
Disposal Costs	3.	$15,072,816
Total Costs		$23,842,454
Cost/Ton		$44
Total High Point MSW (4)		
Total Costs		$101,124,893

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes disposal costs of $31.00 per ton (1995$) for 900 TPD composting facility. This cost based on assumption that a 10% economy of scale be used to adjust from a 600 TPD facility (1995 disposal cost estimate of $34/Ton) to a 900 TPD facility.
3. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
4. Includes waste stream fraction of County waste currently disposed of at Kersey Valley Landfill.

Economic Analysis of Disposal Options: Multi-Jurisdictional Disposal Alternatives

Option: **Multi-Jurisdictional Composting Facility**
Jurisdiction: **Other Guilford County MSW**

Description:

Assumes development of a multi-jurisdictional composting facility in Guilford County to serve all publicly controlled and franchised controlled County-generated MSW disposal needs with operations starting in 1998.

Waste Stream		Estimated Costs (1995$) Years 1998-2017
Total County MSW (15% Recycling)		9,135,040
Other Guilford County MSW		
Tons (17% MSW Disposed)		1,552,957
Transport Costs	1.	
Disposal Site		Composting facility
Distance (1-Way)		17
Cost		$13,200,133
Disposal Costs	2.	$42,706,312
Total Costs		$55,906,445
Cost/Ton		$36

1. Assumes transport costs of $2.00 per truck mile and 8 ton payload (packer truck).
2. Assumes average disposal costs of $27.50 per ton (1995$) for Piedmont Landfill (see High Point Study - Table 4-7).
3. Includes waste stream fraction of County waste currently disposed of at Piedmont Landfill.