BROOME COUNTY
SOLID WASTE MANAGEMENT PLAN UPDATE

Draft Report Submitted to
Broome County Division of Solid Waste Management

STEARNS & WHELER
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1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION OF THE LOCAL SOLID WASTE MANAGEMENT PLAN UPDATE

The Broome County Division of Solid Waste Management (the Division) currently provides for the planning, implementation, management, and funding of Broome County's (the County) Integrated Solid Waste Management Program. The original Solid Waste Management Plan (the Plan) was developed in 1989 and covered a 20-year planning period, from 1990 through 2010, and designated Broome County as the responsible planning unit (the Planning Unit) for implementation and management of the Plan. The Plan was developed in compliance with New York State Solid Waste Management Policy as defined under the Solid Waste Management Act of 1988 (Chapter 70) and regulated under Title 6 of the New York State Code of Rules and Regulations, Subpart 360 (6 NYCRR Part 360 Solid Waste Regulations). Under the current 6 NYCRR Part 360 requirements, a planning unit must prepare a Local Solid Waste Management Plan, including updates every 10 years, which must specifically consider and address current New York State Solid Waste Management Policy. The goal of the State program is to promote consistent strategies among municipalities in the management of municipal solid waste, including efforts to promote and implement actions to reduce, reuse, and recycle both pre-consumer and post-consumer waste products. In addition, State regulations require that all permit applications for new or expanded solid waste management facilities, made by or on behalf of a municipality in a planning unit, be in compliance and consistent with the local Solid Waste Management Plan in effect at the time of the application. A permit application will not be deemed complete if a Local Solid Waste Management Plan has not been adopted (including applicable updates) in accordance with 6 NYCRR Part 360 Regulations.

Beyond State regulations, the Broome County Solid Waste Management Plan has allowed the County to establish program objectives and goals over the past 20 years that have resulted in consistent and reliable levels of service to the public, fiscally responsible fund management, and recycling levels of nearly 50 percent. As part of the original Plan, the County has expanded and developed new programs and made modifications and additions to local laws. Today, the Division of Solid Waste Management provides integrated services to the residents of Broome County related to disposal of various waste streams, environmental compliance, recycling, public education, procurement and contract management, budget preparation, fund management, technical assistance, community public relations, grant preparation, and integration and coordination with private and institutional facilities.

However, the Division also recognizes that the development and implementation of a dynamic Local Solid Waste Management Plan allows the County to optimize services and revenue by critically reviewing opportunities in a timely fashion and adjusting efforts as necessary – in reaction to changing public demands, private sector participation, and regulations. For example, the solid waste business and related markets have recently been influenced by some significant events, such as emerging technologies, reduced solid waste disposal options, New York State's growing interest in organics diversion, and a recent court decision in New York State regarding flow control of municipal solid waste. The court decision provides the legal authority to the Planning Unit to enact a local law that requires all solid waste generated within a planning unit to be processed or disposed of in accordance with the requirements of the planning unit. Given these considerations, the Division also completed a self-evaluation of current programs and planning objectives. As a result, this document, the 2010 *Local Solid Waste Management Plan Update* (the "Plan Update"), was developed and will be submitted to the New York Department of Environmental Conservation (NYSDEC) for review and acceptance after receipt of public comment. The Plan Update follows the recommended format of the "Plan Contents Outline" developed by NYSDEC as described in 6 NYCRR Part 360-15: Comprehensive Solid Waste Management Planning, with some minor variations since this is an update to an existing plan.

1.2 OBJECTIVES OF THE PLAN UPDATE

The objectives of this Plan Update are to evaluate new or expanded solid waste management program options available to the County, assess the impacts thereof, obtain public input related to existing and new programs, recommend the preferred course(s) of action, and specify the action plan required to implement the selected program. Key elements of the Plan include:

- A description of the Planning Unit, including changes to current waste generation or factors that may influence solid waste generation.
- A review of current solid waste generation within the Planning Unit, including an updated characterization of the recycling stream processed in the County.
- A review of existing solid waste management programs and facilities.
- Development of future planning projections and solid waste generation.
- An evaluation of technologies that could increase waste diversion opportunities.

- A review of program enhancement opportunities for waste diversion and selection of initial priorities.
- A proposed implementation schedule related to planning objectives.
- Considerations for new or revised Local Laws.
- Certification of solid waste disposal capacity.
- Current administrative structure and program cost considerations.
- A summary of program enhancements that further supports New York State policy objectives (the Solid Waste Management Hierarchy).
- A summary of comments and views expressed by governmental, environmental, commercial, industrial, and public interests (stakeholders) with respect to the recommended program enhancements. *(To be completed after public comments.)*

1.3 COMPLIANCE WITH NEW YORK STATE SOLID WASTE MANAGEMENT POLICY

New York State has established solid waste management policy objectives under a "preferred hierarchy" that is generally described as follows (in order of descending preferences):

- First, to reduce the amount of waste generated within New York State.
- Second, to reuse material for the purpose for which it was originally intended or recycle material that cannot be reused (composting is considered a form of recycling).
- Third, to recover, in an environmentally acceptable manner, energy from solid waste that cannot be economically and technically reused or recycled.
- Fourth, to dispose of solid waste that is not being reused or recycled, or from which energy is not being recovered, by land burial or other methods approved by the NYSDEC.

Broome County manages solid waste consistent with the policies set forth in the New York State Solid Waste Management Plan. The Division of Solid Waste is responsible for compliance with State and Federal rules and regulations regarding the management and long-term obligations of closed solid waste management facilities and currently operating facilities under their direct control.

The Division's responsibilities also include education and public outreach efforts to encourage, support, and foster participation by the public with respect to reducing, reusing, and recycling portions of the existing solid waste stream. Historically, the County's solid waste programs have relied on both public and private participation to manage a variety of waste streams and recyclable products. These efforts have resulted in current recycling rates between 48 and 50 percent.

The mission of the Division of Solid Waste is to "provide our constituency (residents and businesses) with a comprehensive program for managing solid waste, which is consistent with New York State's Hierarchy for solid waste management, in an economically sound and environmentally safe manner." To this end, potential program expansion elements under this Plan Update will build off of the following existing efforts:

- Safe and reliable disposal of municipal solid waste (MSW).
- Recyclables acceptance and processing through contracts with private companies.
- Continued efforts with local municipalities and private haulers for residential MSW and recyclables transfer stations.
- Yard waste composting in support of the local ban on yard waste disposal to the landfill.
- Periodic household hazardous waste collection for residents and small businesses.
- Periodic electronics recycling for residents and small businesses.
- Development of guidelines and educational materials in support of the County's programs, including a web site.
- Public outreach and assistance to businesses and institutions to assist in setting up recycling programs.
- Purchasing and distributing recycling yellow bin containers.

- Assistance with backyard composting, including compost bins for sale and distribution.

- Beneficially reusing “auto fluff” at the landfill as daily cover.

- Tracking and monitoring of recycling participation through mailers and telephone surveys.

2.0 PLANNING UNIT DESCRIPTION

2.1 GENERAL DESCRIPTION OF BROOME COUNTY

Broome County is located in the southern tier of central New York and consists of approximately 714 square miles. The County is bordered on the south by the State of Pennsylvania and along its remaining boundaries by the Counties of Tioga, Cortland, Chenango, and Delaware in New York. Figure 2-1 shows the location of Broome County with respect to these locations. The County is divided into 24 municipalities, 16 of which are towns, 7 are villages, and 1 is a city. The Village of Deposit is partially located within Broome County and partially within Delaware County. Table 2-1 lists the municipalities within the County.

TABLE 2-1

BROOME COUNTY MUNICIPALITIES

Town of Barker	Town of Maine
City of Binghamton	Town of Nanticoke
Town of Binghamton	Town of Sanford
Town of Chenango	Village of Deposit (partially)
Town of Colesville	Town of Triangle
Town of Conklin	Village of Whitney Point
Town of Dickinson	Town of Union
Village of Port Dickinson	Village of Endicott
Town of Fenton	Village of Johnson City
Town of Kirkwood	Town of Vestal
Town of Lisle	Town of Windsor
Village of Lisle	Village of Windsor

Figure 2-2 shows the location of these municipalities within the County.

2.2 TRANSPORTATION ROUTES

There are several major transportation routes within the County as shown in Figure 2-3. The major north-south routes include Interstate 81, Route 41, and Route 26. Interstate 81 connects Broome County to areas both north and south of the County (i.e., the Syracuse area to the north and Pennsylvania border to the south). Interstate 81 passes through the approximate center of the County, traversing the Towns of Lisle, Triangle,

FIGURE 2-1

NEW YORK STATE COUNTIES

FIGURE 2-2

BROOME COUNTY MUNICIPALITIES

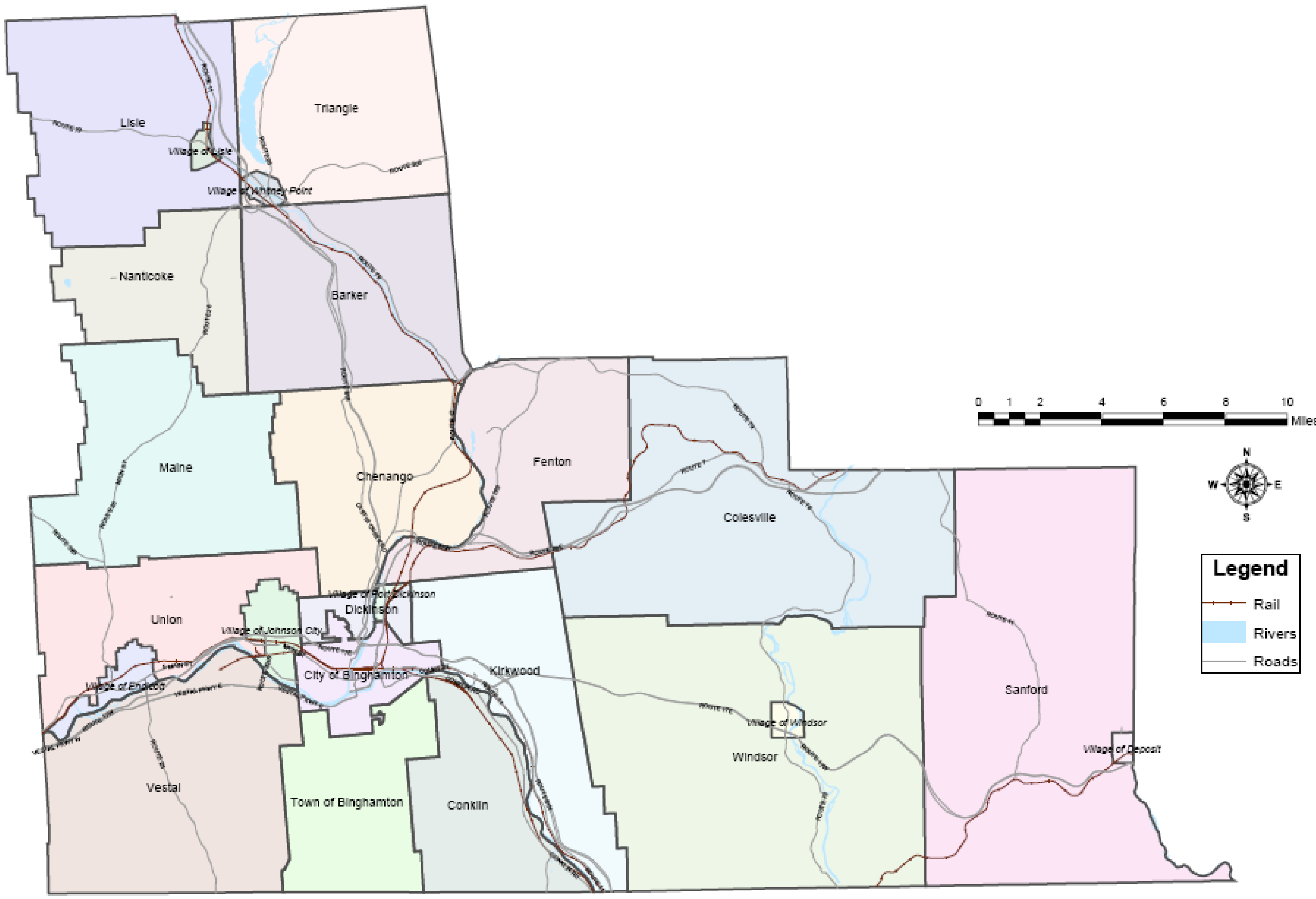
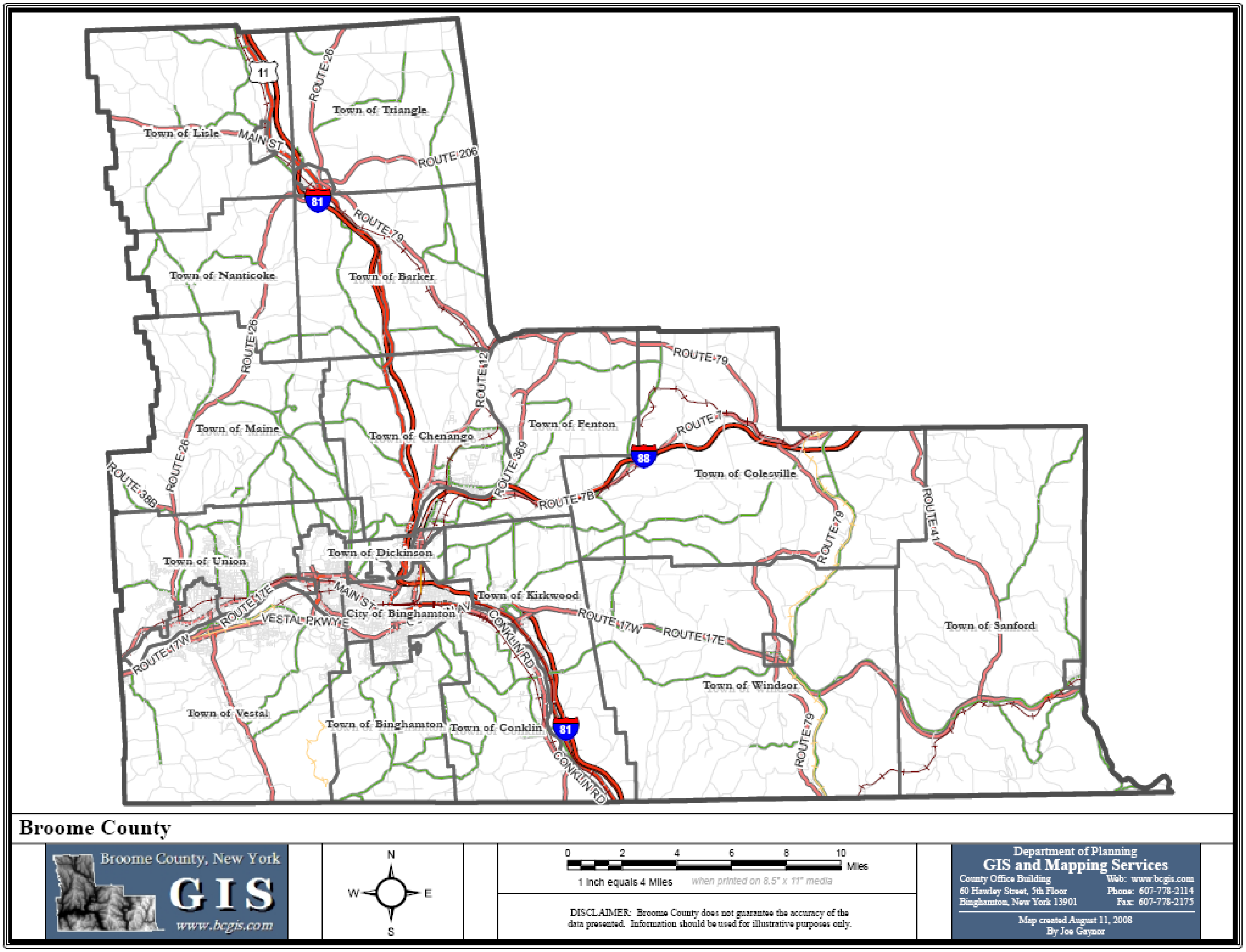


FIGURE 2-3

MAJOR TRANSPORTATION ROUTES WITHIN BROOME COUNTY



Barker, Chenango, Dickinson, Binghamton and Kirkwood. Route 11 parallels Interstate 81 and is the alternate route for north-south travel in the County. Route 26 is the north-south route in the western part of the County. This route passes through the Towns of Triangle, Barker, Maine, Nanticoke, Union, and Vestal. Route 41 is the north-south route in the eastern portion of the County and is located primarily in the Town of Sanford.

East-west transportation is predominately through Route 17 (future Interstate 86) and Route 79. Route 17 services the southern portion of the County, while Route 79 services the northern towns. Route 79 passes through the Towns of Lisle, Triangle, Barker, Fenton, Colesville and Windsor. Route 17 passes through the Towns of Union, Vestal, Dickinson, Kirkwood, Windsor, Sanford, and the City of Binghamton. Interstate 88 also serves as an east-west route for the towns east of Binghamton.

Town railroads also serve the County. The Norfolk Southern and Delaware and Hudson (D&H) Railroads service the southern portions of the County, while the New York Susquehanna and Western (NYS&W) services the central and northern portions of the County.

The County airport is located in the Town of Maine.

Table 2-2 lists the major transportation routes and railroads in each town.

2.3 POPULATION OF THE COUNTY

Table 2-3 lists the current population in the County for each municipality. These populations are based on 2000 Census data. The total County population is approximately 200,500. A large portion of the population (55 percent) is located in the City of Binghamton, the Town of Union, and the Town of Vestal. These municipalities are the most urbanized areas in the County. The remainder of the County is mainly rural areas with sparse populations. Table 2-3 also lists the number of households in each municipality in the County. The number of households is the number of occupied year-round housing units. This data is also based on the 2000 Census. Figure 2-4 illustrates the population distribution in the County.

TABLE 2-2

MAJOR TOWN TRANSPORTATION ROUTES

MUNICIPALITY	NORTH-SOUTH TRANSPORTATION ROUTE	EAST-WEST TRANSPORTATION ROUTE	RAILROAD
Town of Barker	I-81, R-11	R-79	NYS&W
City of Binghamton	I-81, R-11	R-17(future I-86)	D&H
Town of Binghamton	Park Avenue	None	None
Town of Chenango	I-81, R-11	None	NYS&W
Town of Colesville	R-79	I-88, R-7	D&H
Town of Conklin	R-7	None	D&H
Town of Dickinson	I-81, R-11	I-88	D&H
Town of Fenton	R-369	I-88, R-7	D&H
Town of Kirkwood	I-81,R-11	R-17(future I-86)	Norfolk Southern
Town of Lisle	I-81, R-11	R-79	NYS&W
Town of Maine	R-26	None	None
Town of Nanticoke	R-26	None	None
Town of Sanford	R-41	R-17	Norfolk Southern
Town of Triangle	I-81, R-79, R-11	R-206	NYS&W
Town of Union	R-26	R-17	Norfolk Southern
Town of Vestal	R-26	R-206	None
Town of Windsor	R-79	R-17, R-434	None

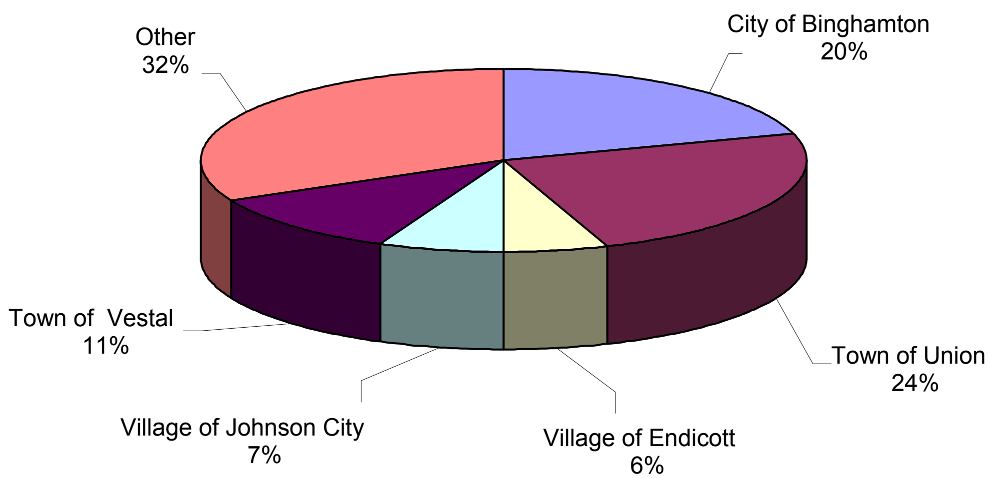
TABLE 2-3

EXISTING POPULATION AND HOUSING UNITS

MUNICIPALITY	POPULATION	PERCENT OF COUNTY	NUMBER OF HOUSEHOLDS	PERCENT OF COUNTY
Town of Barker	2,738	1.4	993	1.1
City of Binghamton	47,380	23.6	21,089	26.1
Town of Binghamton	4,969	2.5	1,813	2.2
Town of Chenango	11,454	5.7	4,519	5.5
Town of Colesville	5,441	2.7	1,944	2.3
Town of Conklin	5,940	3	2,249	2.7
Town of Dickinson	3,638	1.8	1,246	1.4
Village of Port Dickinson	1,697	0.8	734	0.8
Town of Fenton	6,909	3.4	2,763	3.3
Town of Kirkwood	5,651	2.8	5,547	6.8
Town of Lisle	2,404	1.2	855	1.1
Village of Lisle	302	0.2	116	0.1
Town of Maine	5,459	2.7	2,036	2.4
Town of Nanticoke	1,790	0.9	629	0.7
Town of Sanford	778	0.4	267	0.2
Village of Deposit	1,699	0.8	716	0.9
Town of Triangle	2,067	1	734	0.9
Village of Whitney Point	965	0.5	397	0.5
Town of Union	27,725	13.8	11,561	14.3
Village of Endicott	13,038	6.5	5,996	7.4
Village of Johnson City	15,535	7.8	6,981	8.6
Town of Vestal	26,535	13.2	8,525	10.6
Town of Windsor	5,520	2.8	1,970	2.4
Village of Windsor	901	0.5	369	0.6
Total for County	**200,536**	**100**	**80,749**	**100**

FIGURE 2-4

BROOME COUNTY POPULATION DISTRIBUTION



2.4 FACTORS IMPACTING SOLID WASTE GENERATION

2.4.1 Population Density and Land Use

Existing land use in the County is of very rural nature. In 1976, approximately 60 percent of the County was classified as woodlands. Based on 2000 Census data, there are approximately 283.6 people per square mile in the County. The population is not uniformly distributed, creating areas with a low population density and other areas with a high population density. The City of Binghamton, the Village of Endicott, and the Village of Johnson City represent areas of high population density. These areas contain over half of the County's population.

2.4.2 Population Demographics

The County population is projected to show a 2.56 percent increase in population between 2010 and 2030. The aging of the County population will limit growth, and the retention of young adults continues to be a challenge. According to Cornell Institute for Social and Economic Research (CISER) projections, by 2030, the population will be skewed toward older women. This reflects the aging population and greater life expectancy of females. The exception is the non-aging segment of the 15 to 24 age

range associated with the student body of Binghamton University. In general, the profile of the County population in 2030 will be very similar to the nation as a whole.
Demographic changes may affect the types of goods purchased by consumers and therefore the characteristics of materials entering the solid waste stream.

2.4.3 Industries and Institutions

Large industries and institutions generate substantial quantities of solid waste. Large industries in the County include Lockheed Martin and Frito Lay Corporation. Binghamton University is the largest institution in the County. It is anticipated there will be continued commercial/industrial development in the Kirkwood industrial area and the Broome Corporate Park in the Town of Conklin.

3.0 SOLID WASTE QUANTITY AND TYPES

3.1 GENERAL INVENTORY OF SOLID WASTES

Solid waste generated in the County can be classified into five general categories.

- *Residential Waste* - Typically consists of rubbish and garbage characteristic of households.

- *Commercial Waste* - Generated by establishments such as stores, offices, shopping centers and local businesses.

- *Institutional Waste* - Generated by schools, hospitals, prisons, and nursing homes.

- *Non-Hazardous/ Industrial Waste* - Variety of discarded materials consisting of paper, wood, metal, and plastic generated by local industries.

- *Organic Waste* – Any waste product that is biodegradable or can be stabilized through biological digestion, such as food waste, municipal sewage sludge, yard waste, and other carbon-based products (paper products). Food waste is generally classified as "pre-consumer food waste" (prior to purchase or consumption by the public) which is generally comprised of a higher percentage of organic matter, and "post-consumer food waste" (after use or consumption by the public) which generally contains higher percentages of inorganic materials such as plastics (will not decompose).

- *Special Waste* - Special wastes consist of wastes such as municipal sewage sludge, regulated medical wastes and household hazardous wastes, construction and demolition waste, tires and waste oil.

Residential, commercial, institutional, non-hazardous industrial, most organic waste, and special wastes (except for municipal sewage sludge and regulated medical waste) are disposed at the Broome County landfill. In 2007, the County generated approximately 220,000 tons of these wastes based on weighing records at the landfill.

To further define solid waste management programs and subsequent participation levels, various waste streams are characterized under two broad-based management headings: upstream and downstream. The definition of these terms is as follows.

- *Upstream Waste* – Refers to those waste streams that are managed or processed privately (not by Broome County) and do not require disposal at the County's landfill.

- *Downstream Waste* – Refers to those wastes that are delivered to the County at the landfill that can be further processed, recycled, or diverted from the landfill.

3.2 RECYCLABLES AND SOLID WASTE CHARACTERIZATION

To broaden the County's current programs to increase recycling participation, it is important to identify a baseline as a reference point to measure and track performance as a result of future actions. In addition, milestones should be identified and tracked in a parallel fashion where specific data is unavailable or where actions are required to support public and private participation for new or expanded programs. As indicated on Table 3-1, the year 2007 was selected as the baseline for examining current waste generation in the County as well as presenting an overall recycling rate of 48 percent for the year. With respect to MSW generated and recorded at the landfill, there were approximately 164,000 tons delivered to the landfill in 2007. This is very close to the U.S. Environmental Protection Agency (USEPA) estimate of per capita waste generation (4.6 lbs/capita-day) based on a population of 200,000.

To determine the approximate waste composition of the MSW delivered to the landfill, a separate waste composition analysis was used from a community similar in size and character to Broome County. The Cedar Rapids/Linn County Iowa Waste Composition Analysis was completed by R.W. Beck (a project team member) and was used to estimate the type of materials that may be contained within the MSW delivered to the Broome County landfill. The analysis can be found in Appendix A. Table 3-2 presents an estimate of the waste characteristics of the County's MSW based on the Linn County study. The purpose of this exercise is to identify if there are materials within the waste stream that could be removed for recycling or through diversion opportunities.

The next step was to quantify those waste products and materials that were already being removed from the MSW and recycled or reused. Based on County reporting, approximately 215,850 tons of materials were recycled through the combined efforts of local municipalities and private companies. In addition, the County tracked and recorded other materials that were not categorized as MSW such as construction and demolition (C&D), sludges, yard waste, tires, and alternative daily cover. These materials were considered in determining the total amount of waste and recyclables that are generated in the County. Table 3-3 presents a summary of all waste generated

TABLE 3-1

BROOME COUNTY REPORTED WASTE COMPOSITION IN 2007

WASTE STREAM	TONNAGES	DIVERTED
Landfill Disposal		
MSW	163,828	
WWTP sludge	7,089	
Alternative daily cover	36,975	
C&D debris	28,878	
Yard waste	2,280	2,280
Tires	1,499	1,499
Subtotal Landfill Disposal	240,549	3,779
Recycling		
Paper	32,698	32,698
Plastic	687	687
Metals	134,649	134,649
Glass	293	293
Mixed recyclables	12,002	12,002
Co-mingled containers	200	200
Tires	6,043	6,043
Organic	2,714	2,714
Yard waste	12,137	12,137
C&D debris	3,215	3,215
HHW	2,521	2,521
Electronics	272	272
WWTP Sludge	8,422	8,422
Subtotal Recycling	215,852	215,852
Total County Waste	**456,401**	**219,631**
Total Diversion		**48%**

TABLE 3-2

BROOME COUNTY MUNICIPAL SOLID WASTE CHARACTERIZATION

MATERIAL GROUP	MSW COMPOSITION(1)	BROOME COUNTY 2007 MSW(2)
Total paper	25.2%	41,285
Total plastic	15.0%	24,574
Total metals	6.0%	9,830
Total glass	2.3%	3,768
Total textiles and leathers	3.3%	5,406
Total tires	0.2%	328
Total yard waste	1.6%	2,621
Total food waste	12.4%	20,315
Total other organics	1.2%	1,966
Total wood	10.3%	16,874
Total C&D debris	8.9%	14,581
Total HHW	0.5%	819
Total durables (E-waste)	4.3%	7,045
Total miscellaneous MSW	8.8%	14,417
Total		**163,828**

(1) MSW composition taken from R.W. Beck study.
(2) Broome County 2007 MSW total tonnage that entered the landfill as municipal solid waste, as shown on Table 3-1.

within the County and indicates the portion that was recycled, as well as a breakdown of the MSW delivered to the landfill in order to classify and quantify different types of materials. The results show that approximately 456,400 tons of waste materials are generated and tracked by Broome County.

Table 3-4 presents the estimated “baseline composition” of waste generated and managed within the County and compares it to recycling and diversion capture rates for the year 2007. The following observations were noted:

1. There is a very high capture rate of metals within the waste stream (approximately 90 percent). This is likely due to the market value of metals during 2007. However; like other commodities, the value of metals is prone to significant price fluctuations.

2. The remaining “yellow bin” type recyclable materials, including paper, plastic, glass, and co-mingled materials, are being captured at about a 40 percent rate. These numbers support the County’s desire to pursue targeted commercial, institutional, industrial, and multi-family recycling (CII&M) recycling efforts to increase the capture of these materials.

3. Food waste and yard waste currently account for 9 percent of the total waste stream (although other organics such as paper could also be considered as organic waste) and offer opportunity for diversion through private and public composting efforts.

4. Sludges from wastewater treatment facilities are organics that can also be composted for reuse as a solid amendment. Although composting of sludges (biosolids) by local municipalities has occurred in the past, it has grown burdensome in some cases and the County is evaluating potential coordination efforts for a central composting facility. The volume of sludges produced in the County on an annual basis is over 15,000 wet tons with a potential for higher production in the future.

5. C&D debris volumes fluctuate from year to year but contribute to approximately 15 percent of the total waste stream on an average annual basis. This is clearly a source that can be targeted for diversion potential and beneficial reuse of products, but also comes with program management challenges.

TABLE 3-3

BROOME COUNTY ESTIMATED WASTE GENERATED IN 2007

MATERIAL	RECYCLED	AT LANDFILL	IN MSW	TOTAL	PERCENT OF WASTE STREAM
Total paper	32,698		41,285	73,983	16%
Total plastic	687		24,574	25,261	6%
Total metals	134,649		9,830	144,479	32%
Total glass	293		3,768	4,061	1%
Commingled containers	12,202			12,202	3%
Total textiles and leathers			5,406	5,406	1%
Total tires	6,043	1,499	328	7,870	2%
Total yard waste	12,137	2,280	2,621	17,038	4%
Total food waste			20,315	20,315	4%
Total other organics	2,714		1,966	4,680	1%
Total wood			16,874	16,874	4%
Total C&D debris	3,215	28,878	14,581	46,674	10%
Total HHW	2,521		819	3,340	1%
Total durables (E-waste)	272		7,045	7,316	2%
Total miscellaneous MSW			14,417	14,417	3%
WWTP sludge	8,422	7,089		15,511	3%
Alternative daily cover		36,975		36,975	8%
Total	**215,852**	**76,721**	**163,828**	**456,401**	**100%**

6. HHW and E-waste does not comprise a large portion of the waste, but it is a waste stream that should be kept out of the landfill. Current public participation with the HHW and E-waste is relatively low and the County has targeted this waste for increased participation and diversion opportunities.

7. The County currently takes significant advantage of alternative daily cover materials for the landfill in lieu of purchasing soil materials. Although these efforts fall under the State's Beneficial Reuse Program, it is not considered a recycling or diversion program since these materials are ultimately placed in the landfill.

4.0 EXISTING PROGRAM DESCRIPTIONS

4.1 SOLID WASTE MANAGEMENT FACILITY INVENTORY

4.1.1 Solid Waste Collection

The collection and transportation of waste in the County is managed by public and private haulers and individual citizens, depending on the municipality. Commercial generators commonly use private haulers. The Town of Union, City of Binghamton, and the Villages of Endicott and Johnson City have municipal (public) collections. The collection and transportation in these municipalities is managed by either a Department of Public Works or a Highway Department. These communities make up 51.7 percent of the County's population and generate 24 percent of the residential waste, based on data from the 2000 U.S. Census and the Broome County 2007 Executive Summary, respectively. The remaining towns and villages use private haulers. In most cases, residents contract directly with their hauler. The Villages of Lisle, Whitney Point, and Windsor contract with private haulers for village-wide service. The waste is usually hauled directly to the Broome County Sanitary Landfill, except for that from the City of Binghamton and the Town of Chenango, which utilize transfer stations to collect and compact waste before going to the landfill.

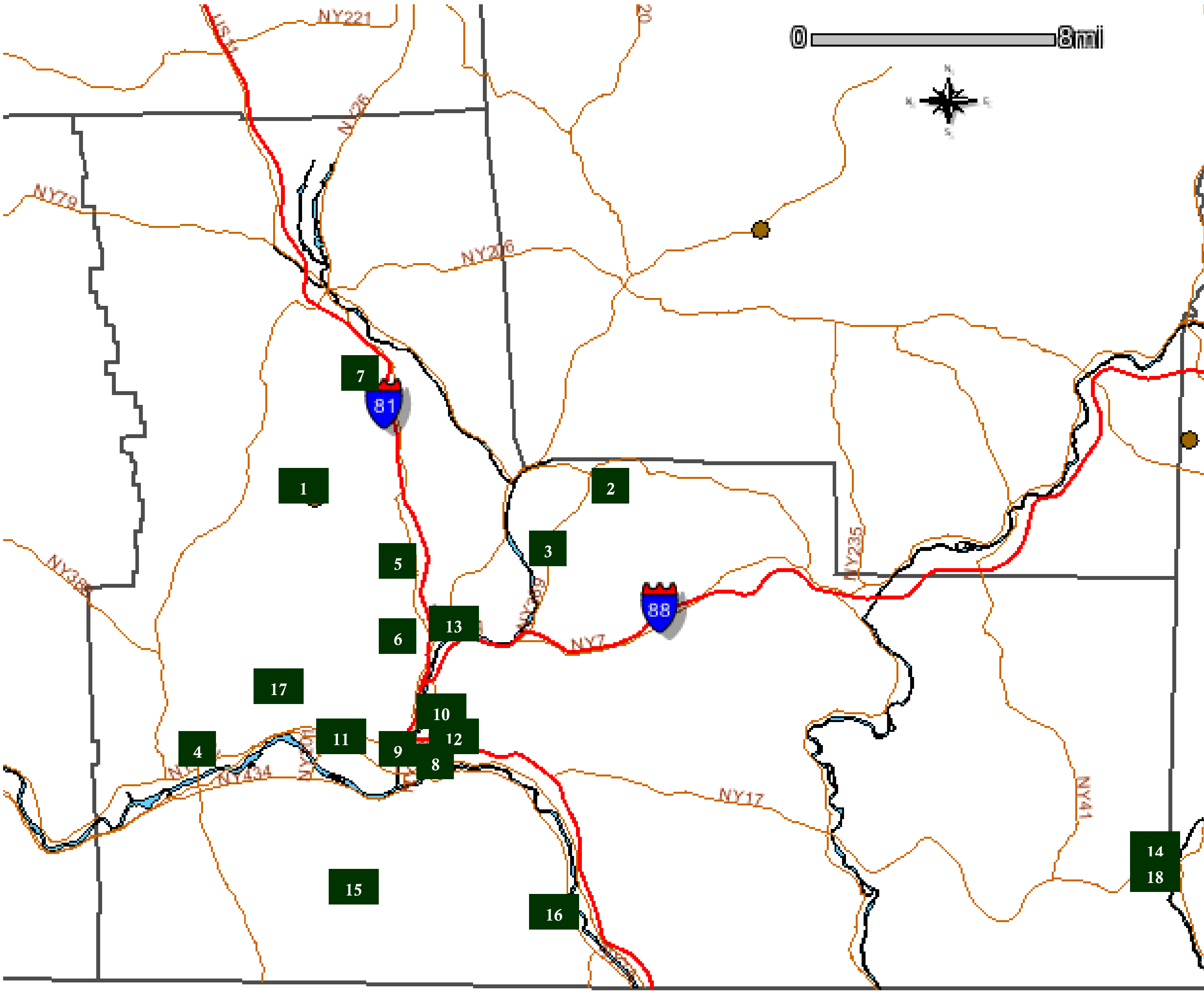
4.1.2 Landfill Operations

The majority of waste generated in the County is disposed at the Broome County Sanitary Landfill, which occupies land in the Towns of Nanticoke, Barker and Maine. This landfill is the only permitted sanitary landfill in the County. The County also used the Colesville Sanitary Landfill as a major landfill site until 1984. The Town of Fenton was the last municipality to operate its own sanitary landfill, but it was closed for solid waste disposal on October 1, 1989. This site is currently being used for the composting of leaves and yard wastes. The Broome County Sanitary Landfill is currently operating under NYSDEC Part 360 and USEPA and RCRA Subtitle D. The permit is due for renewal in March 2011.

4.1.3 Solid Waste Management Facilities

There are 16 existing solid waste management facilities in the County, as shown on Figure 4-1. A solid waste management facility as defined in 6 NYCRR Part 360 as any facility used beyond the initial solid waste collection process to manage solid waste including, but not limited to: storage areas of facilities; landfills; disposal facilities;

FIGURE 4-1
BROOME COUNTY SOLID WASTE FACILITIES



1	Broome County Sanitary Landfill and Recyclables Drop-Off Site
2	Town of Fenton Landfill
3	NYSEG Weber Ash Disposal Landfill
4	Village of Endicott Sewage Sludge Composting Facility
5	Binghamton-Johnson City Joint Sewage Sludge Composting Facility
6	Town of Chenango Sewage Sludge Composting Facility
7	Whitney Point Wastewater Collection & Treatment Facility
8	City of Binghamton Transfer Station
9	A&T Transfer Station
10	Bert Adams Transfer Station
11	WM Recycle America Facility
12	Broome Recycling, Inc.
13	A&W Recycling, Inc.
14	Town of Sanford Recyclables Drop- Off Site
15	American Rendering Company Rinse Water Storage & Land Application
16	Boland's Excavating and Topsoil
17	Robinson Hill Nursery & Mulch
18	Village of Deposit STP

Map and majority of facility locations found by the NYSDEC Environmental Navigator at www.dec.ny.org.

compost facilities; surface impoundments; waste oil storage; reprocessing and refining facilities; recyclables handling and recovery facilities and waste tire storage facilities.

The following sections will provide an overview of existing solid waste management facilities within the Planning Unit.

A. **Broome County Sanitary Landfill.** The Broome County Sanitary Landfill is a County owned and operated landfill and has been in operation since 1969. The landfill is currently the primary disposal site for the County's solid waste. A tipping fee of $40 per ton is charged for solid waste disposal at the site. The landfill is located in the Towns of Nanticoke, Barker, and Maine and occupies an area of approximately 1,300 acres. The actual fill area occupies approximately 145 acres, 124 of which are closed landfill and the remaining 20 acres will be closed in 2011. Another 99 acres are permitted as Section IV, of which 12 acres have been built and recently opened for disposal (2009).

The landfill is divided into several sections due to various lateral expansions constructed over the years. Section I is the original landfill site and consists of approximately 105 acres of the site. The landfill does not have a single type of lining system since it was continuously expanded during a time when State regulations regarding the design and construction of landfills were changing. Section II was constructed in 1985 and occupies 18 acres of the total site. This section is lined with a single composite system.

The design for Section III of the landfill was approved after extensive negotiations with the NYSDEC. The 20-acre double composite lined cell was constructed in 1993. It is anticipated Section III will be closed in the spring of 2011.

In preparation for Section III closure, the County made provisions for a new landfill Section IV. Detailed design work began in 2000, with a permit application submitted to the NYSDEC in mid-2001. Construction activity began in 2001 and was completed by December 2002. As part of the construction of Section IV, two 2,200,000-gallon leachate storage tanks were constructed for storing leachate generated from Section IV. The leachate is subsequently pretreated and transported to the Endicott sewage treatment plant, Chenango sewage treatment plant, or the Ithaca treatment plant. The leachate is then treated and discharged. There are 57 groundwater monitoring wells at the landfill. The County is evaluating the feasibility of on-site leachate discharge.
Figure 4-2 is an aerial photo of the landfill. The old landfill and Section I are shown in the front of the photo, covered in grass, with the leachate pretreatment facility at the far end of the section. Beyond the first tree line are the partially capped Sections II/II and

FIGURE 4-2

AERIAL PHOTOGRAPH OF BROOME COUNTY LANDFILL (2002)

the two leachate storage tanks. Section IV, partially covered with a rain cap, is beyond the leachate storage tanks.

The landfill accepted approximately 220,000 tons of solid waste for disposal in 2007. There is a significant seasonal variation in the waste stream during the spring and fall due to the increase in yard work and construction activities. Leaf and yard waste was banned form the landfill in 1989; a separate area has been designated for composting these materials. White goods are also collected at a specially designated area at the landfill where certified staff removes refrigerants from any units; refrigerant is sent out for recovery and the units are transported to a local scrap metal dealer for recycling. Tires are stockpiled at the landfill and hauled by a private company for recycling. Since 1990, newspaper, kraft, corrugated cardboard, office paper, metals, glass, recyclable plastic, tires, and batteries were banned from the landfill. The landfill also houses a permanent household hazardous waste facility that operates year ground. The facility is open to Broome County and Tioga County residents (April-November) through an intermunicipal agreement. The facility also accepts electronics for recycling. Conditionally Exempt Small Quantity generators can utilize the facility, but must obtain a permit and pay a disposal fee.

B. **The Town of Fenton Landfill.** The Town of Fenton landfill is a town-owned and operated site and occupies an area of approximately 50 acres. Figure 4-1 illustrates the location of the landfill within the town. Actual fill area occupies approximately 10 acres of the 50-acre site. The landfill has not accepted solid waste for disposal other than yard waste since October 1, 1989. In addition, leaves were composted at the site. Before closing, the landfill was used solely for the disposal of residential solid waste. During 1988, it was estimated that approximately 3,700 tons of solid waste was disposed at the site. The town reached an agreement with the NYSDEC to close the landfill according to 6 NYCRR Part 360 regulations. A hydrogeological investigation was conducted and biological treatment of leachate was implemented. Other portions of the closure plan, such as the final cap and the gas control system, were funded through New York State to build a gas venting and collection system, and barrier and topsoil layers at the 6.5-acre Spencer Road site.

C. **NYSEG Weber Ash Disposal Landfill.** The Weber ash disposal landfill was a 16-acre site located in the Town of Fenton (as illustrated in Figure 4-1) and was owned and operated by the New York State Electric and Gas Company (NYSEG). The site was used for approximately 12 to 15 years for the landfilling of by-products generated from the combustion of coal. It is estimated that approximately 1,200 to 1,500 tons per year were landfilled at the site.

AES NY, LLC entered into an Asset Purchase Agreement with NYSEG dated August 3, 1998. In October 1999, AES Creative Resources, LP entered into a consent order with the NYSDEC to resolve alleged violations of water quality standards in the groundwater downgradient of the Weber ash disposal site. The consent order included a suspended civil penalty and a requirement to submit a work plan to initiate closure of the landfill by October 8, 2000. The consent order also called for a site investigation, which was conducted and indicated a possibility that groundwater remediation at the site may be required. Further compliance with this order included a closure investigation report which was submitted to the NYSDEC in the spring of 2000, and a closure plan which was submitted to the NYSDEC in January 2001. The latest part of the consent order was implemented during the 2001 spring/summer construction season when the work scope for covering the site and carrying out the future monitoring of the site per the Closure Plan was implemented.

D. **Village of Endicott Sewage Sludge Composting Facility.** The Village of Endicott sewage sludge composting facility is owned and operated by the Village. As illustrated in Figure 4-1, the facility is located at the village's sewage treatment plant; it was constructed during 1982-1983 and became operational in 1984. The facility processed 4,860 dry tons of sewage sludge in 2007 and 840 tons of compost. Sawdust and compost are used as feed materials in the composting process. Since the Endicott wastewater treatment plant also services the Town of Union and portions of the Town of Vestal, sewage sludge from these municipalities is processed at the Endicott sludge composting facility.

E. **Binghamton-Johnson City Joint Sewage Sludge Composting Facility.** The Binghamton-Johnson City Joint Sewage Treatment Plant (BJCJSTP) is under New York consent order to expand its wastewater treatment facilities to meet effluent limits for discharge to the Susquehanna River, a Chesapeake Bay tributary. The plant upgrade is necessary to increase secondary treatment capacity up to 70 million gallons per day (mgd) during peak storm weather flows.

Planned upgrades included procurement of the biological aerated filter (BAF) system equipment, upgrades to two plant influent pump stations, including three new 200 HP pumps and four 150 HP pumps at the Village of Johnson City's terminal pump station, variable speed controls, and flow meters for each provided pump. A new flow distribution structure was constructed to replace the two Parshall flumes to provide even flow distribution to the six existing primary settling tanks, and piping for four additional primary clarifiers. Modifications were made to the existing SCADA system to incorporate flow information from the new pumps.

The existing sludge control buildings were retrofitted to comply with current electrical and fire codes, and a new addition was added to house the required boilers. Two existing sludge thickeners were retrofitted with a new distribution box, density baffles, sludge pumps, grinders, and controls. Two scum and grease pumping stations were designed to collect and transport grease and scum to the digester complex.

In 2006, there was a fire in the digesters at the existing sludge composting facility. As a result, the sludge generated is being lime stabilized and taken to the Broome County landfill for disposal. Binghamton-Johnson City has no current plans to reopen the sludge composting facility.

F. **Town of Chenango Sewage Sludge Composting Facility.** The Town of Chenango sewage sludge composting facility is owned and operated by the town. This three-basin facility is an expansion of the two-basin CASS™ Sequencing Batch Reactor Project originally commissioned in January 1993. The expansion took the plant from a design flow of 0.5 mgd to 0.8 mgd.

Due to increased flow and loading, the town upgraded its treatment facility in 1997. The upgrade required an expansion of the sludge dewatering operations. The 1997 upgrade included a new gravity belt thickener followed by the original, relocated belt dewatering press and addition of a third basin. The facility processes approximately 4 dry tons per week. Currently, the facility has discontinued composting sludge, but anticipates resuming composting in the future.

G. **Whitney Point Wastewater Collection and Treatment Facility.** The Whitney Point wastewater collection and treatment facility became operational in November 2007 and will eventually provide service to approximately 350 homes and businesses in the area. The facility is owned by the Village of Whitney Point. Preliminary layout of the project began in the spring of 1997; however, obtaining adequate funding to make the project affordable took several years. The $8.3 million project consisted of the development of a new wastewater collection and treatment system including approximately 36,000 lineal feet of gravity sewers, 4,000 feet of force mains, four collection system pump stations, and a 150,000 gallons per day (gpd) sequencing batch reactor treatment plant to serve a population of 1,100 people. The facility is not currently composting, but may do so in the future.

H. **City of Binghamton Transfer Station.** The Binghamton Transfer Station is a City-owned and operated facility which has been in operation since 1984 under a permit from the NYSDEC. The facility is used for the transfer and compaction of solid waste from smaller collection vehicles to larger vehicles that transport the waste to the Broome

County Sanitary Landfill. Residential, commercial, and industrial wastes are processed through this facility. Specific quantities of waste processed at the facility have not been measured, but it is estimated that approximately 16,831 tons per year of the City of Binghamton's municipally collected solid waste passes through the facility.

I. A&T Transfer Station. The A&T Transfer Station is owned and operated by Taylor Garbage Disposal and Bert Adams Disposal and is located in the City of Binghamton. The facility is operating under an original permit issued in February 1998 from the NYSDEC which will expire on June 30, 2019. Waste is currently being transferred to the Broome County as for disposal.

J. **Bert Adams Transfer Station.** The Bert Adams Transfer Station is owned and operated by Bert Adams Disposal and is located in the Town of Chenango. The facility is operating under a permit from the NYSDEC which was issued in January 2008 and will expire December 2017. The facility is predominantly used for the storage of refuse collection vehicles owned by Bert Adams. On Saturdays, the transfer station accepts refuse for disposal from town residents. The volume of refuse collected at the facility is very small. The waste disposed consists solely of residential waste.

K. **WM Recycle America Facility.** The County currently contracts with Waste Management's subsidiary Recycle America for the processing of source separated recyclable materials. The facility is located in the City of Binghamton and is owned and operated by Waste Management. The County has entered into a contract with WM Recycle America to accept, process, and market recyclable material generated from the residential curbside program. The contract was initiated in 2002 and will expire in 2012. The facility initially processed and baled materials on site. It has now shifted to a transfer operation. All materials are transferred to Liverpool, NY to a WM Recycle America Facility for further processing and marketing.

L. **Broome Recycling, Inc.** Broome Recycling, Inc. is a private materials recovery facility located in the City of Binghamton. In 1991, the County entered into a 10-year contract with Broome Recycling, Inc for recycling services, which expired in 2001. The facility is owned and operated by Bert Adams Disposal and Taylor Garbage Service. Currently, the facility process approximately 3,550 tons per year. The facility processes recyclable materials accepted as part of the County's program.

M. **A&W Recycling, Inc.** A&W Recycling is located in Chenango Bridge. It is owned and operated by Bert Adams Disposal. The facility processes approximately 4,000 tons of recyclables from Broome County. The facility collects and processes material in two streams.

N. **Town of Sanford Recyclables Drop-Off Site.** The Town of Sanford recyclables drop-off site is partially supported by the County. The site collects recyclables from residents only. The County supplies and services a roll-off container. The town is responsible for general supervision and maintenance of the site and for providing a platform on which residents can access the container. In 2006, an agreement was made with the town to progressively take over the costs of operating the site and then either contract out for services or provide services on its own. The contract states that from 2006 to 2010, the town will pay an increased percentage of costs until the full cost is attained in 2010. Currently, the County transports the materials to the WM Recycle America Facility.

O. **American Rendering Company Rinse Water Storage and Land Application.** The American Rendering Company is a meat processing facility located in the Town of Binghamton. American Rendering generates approximately 25,000 gallons per year of biosolids. Landspreading is authorized from May 1-December 1. During other times of the year, biosolids are disposed of utilizing a scavenger (the ultimate disposal location would be a sanitary wastewater sewage treatment plant). Approximately 10 acres are available for landspreading; the applicant proposes to use 8 acres of the total available. American Rendering estimates that less than 2,000 gallons per acre per year will be landspread.

P. **Boland's Excavating and Topsoil.** Boland's Excavation and Topsoil is a privately owned and operated soil and landscaping business located in Conklin, NY. Leaves and yard waste are accepted from several municipalities in the County, as well as private generators. A processing fee is charged based on the quantity of material delivered to the facility. The material is shredded and then composted in an aerated in-vessel composting system. The end product is used for the business's landscaping needs. The facility processes less than 3,000 cubic yards of material on an annual basis.

Q. **Robinson Hill Nursery & Mulch.** Robinson Hill Nursery & Mulch is a privately owned and operated business located at 1000 Robinson Hill Road, Johnson City, NY, employing a staff of approximately one to four. The facility sells retail and wholesale nursery supplies which includes a variety of mulches and decorative stones. Yard waste is accepted from some municipalities in the County. A processing fee is charged based on the quantity of material delivered to the facility.

4.2 EXISTING EFFORTS TO RECOVER RECYCLABLES

4.2.1 Municipal, Commercial, Industrial and Private Efforts

The County is currently managing a long-term recycling plan that will maximize the reduction, reuse, and recycling of materials to the extent that is technically and economically practicable. The County's residential recycling program began in October 1987 as the Broome Recycling Project, which was a two-year program piloted to asses the effectiveness of a recycling program. Three municipalities (Village of Endicott and the Towns of Vestal and Chenango) were involved in the original program. The project was funded by monies from Broome County, the 1972 Environmental Quality Bond Act, and the New York State Energy Research and Development Authority.

The Broome Recycling Project consisted of the recycling of newsprint, brown kraftpaper, cardboard, and glass. These materials were placed in 5-gallon plastic pails for curbside collection in Vestal and Endicott. Due to its rural population, the Town of Chenango utilized drop-off centers for these materials. State funding for the demonstration project ended in May 1989, and the program is now being funded by the County.

Effective December 1990, certain materials were banned from land burial and incineration, including newspaper, kraftpaper, corrugated cardboard, magazines, office/computer paper, metals, glass, batteries, recyclable plastic, tires, and white goods. In addition, leaves were banned from the landfill in the fall of 1987, and yard wastes in September 1989.

The Division of Solid Waste Management is responsible for the overall program administration, including public education, procurement, consultant and vendor contract management, budget preparation, technical assistance, community public relations, and grant preparation.

4.3 MARKETS FOR RECOVERED RECYCLABLES

There has been an overall increase in value for recovered recyclables from the mid-1990s through 2007, including steel, aluminum, glass, old corrugated cardboard (OCC 11), old newspaper pulp (ONP 8), and mixed paper. However, in response to the downturn of the global economy (at the end of 2008), the market for all of these and other recovered recyclables suddenly and drastically dropped in price. Because of the overall value drop of materials, a site-specific evaluation of potential markets with cost analysis will not be completed at this time. However, Broome County currently contracts for recyclables processing and the current program has not been impacted to date.

4.3.1 Information Review of Potential Markets

The materials collected from residents, commercial, industrial, and institutional establishments and separated for sale in secondary markets include:

- Paper (OCC, ONP, mixed paper, old boxboard (OBB), old magazines/catalogs (OMG), household office paper and mail (HOMP), phone books, and beverage boxes.

- Plastic (1-7 including polyethylene terephthalate (PET) and high density polyethylene (HDPE).

- Metals (aluminum, steel).

- Glass (flint and colored).

4.3.2 Potential Recyclables Market Survey

Reported prices for recyclables have been found to have similar patterns for the past four years, i.e., slow increase of price from 2005 until around the fall of 2008 when the price dropped to a record low, or close to it, with varying degrees of recovery during 2009. Different types of plastic and paper are still at low prices while metal and white goods have prices of at least 75 percent of the four-year high price. Different types of glass have had a fairly steady price and also decreased in 2008, but have not reached their peak price again.

4.3.3 Recyclables Processing

In Broome County, WM Recycle America has a mixed manual and automatic process system for the commingled recyclables at their Liverpool, NY process plant. Figure 4-3 illustrates a mix manual process system with a worker removing certain items from the conveyor and dropping them into the bins beside him. The other three private recycling companies in Broome County collect either fiber or containers to process and market out of a local facility. Taylor Garbage and Recycling collects some material from Broome County, but is based out of and processes material in Tioga County.

FIGURE 4-3

MIX MANUAL PROCESS SYSTEM

4.3.4 Market Services for Recyclables

There is no market service needed for recyclables because WM Recycle America collects, stores, processes, and markets all residential and some CII&M recyclables in the County. The County has a contract with WM Recycle America for their services and has been assured the capacity of their facility to accept all recyclables produced in the County.

4.3.5 Restrictions to Market Development

There are both physical and institutional restrictions to increasing recycling participation in the County. The first is reliance on the private sector, where they would have to expand their facilities and collection services. With recyclables taken out of the County or collected by outside organizations, the benefits to the County are compromised and market development is restricted. Institutional restrictions include the control, flow, and processing of solid waste within the County in order to fund expanded programs. Flow control is not currently legislated by the County.

4.4 EVALUATION OF UPSTREAM AND DOWNSTREAM DIVERSION OPPORTUNITIES

To increase recycling efforts, the County was interested in further examination of “upstream diversion opportunities” (capture, control, and processing of recycling streams prior to disposal) and “downstream diversion opportunities” (alternative disposal and diversion through waste conversion technologies). The following topics were selected for further consideration under upstream diversion opportunities and “Issue Papers” were then developed for each of the 10 topics listed below and are presented in Appendix B. A further description of the selection process is summarized in Chapters 6 and 7.

1. Environmentally Preferable Purchasing (EPP) Practices & Recycled Content - Policy that encourages communities to purchase materials and services that offer specific environmental benefits.

2. Increase CII&M Recycling Participation – A target strategy directed at the largest generators or under-served portion of the County with respect to recycling efforts.

3. C&D Recycling – Source separation of demolition debris to remove reusable and recyclable products.

4. Use of Alternative Daily Cover (ADC) Materials at the landfill – To beneficially reuse alternative materials in lieu of soils.

5. Franchising Collection Services – An option to further capture recyclables under a consistent collection system with uniform rate structures for customers.

6. Establishment of Collection Districts – An option that would allow the County to contract collection services by district in order to provide “best price” to customers and to specify collection and recycling requirements uniformly across the districts.

7. Expand the Existing Household Hazardous Waste (HHW) and Electronics Recycling – In consideration of growing demands for electronics disposal.

8. Pursue Zero Waste Options – A management philosophy that looks at materials and products from a cradle-to-grave approach to encourage 100 percent reuse.

9. Organics Diversion – Efforts to divert organics from the landfill through the participation of residents, businesses, and institutions.

10. Single Stream Recycling Collection Methods Bins Versus Carts – Consideration of larger recycling containers under a co-mingle collection system that could increase the participation and volume of recyclable products.

For downstream diversion opportunities, the following technologies were considered during an evaluation of alternative technologies:

1. Anaerobic digestion.

2. Thermal technologies, including gasification, pyrolysis, and plasma technologies.

3. Enhanced composting, including MSW composting.

4. Waste–to-energy.

5. Bioreactor landfill methods.

An evaluation of alternative technologies was then developed for each of the five technologies listed above and is presented in Chapter 6.

5.0 FUTURE PLANNING UNIT PROJECTIONS AND SOLID WASTES CHANGES

5.1 FUTURE POPULATION

The projected populations for the County for the 20-year planning period of 2010-2030 are listed in Table 5-1.

TABLE 5-1

BROOME COUNTY POPULATION PROJECTIONS(1)

YEAR	POPULATION
2010	202,170
2015	203,770
2020	205,520
2025	206,770
2030	207,360

(1) Population projections prepared by the Broome County Planning Department based on the Southern Tier East Region's Broome County Profile 2003.

The plan projections were prepared in 2003 by the Southern Tier East Regional Planning Development Board. The projections are based on existing and expected birth, death and migration rates. Figure 5-1 illustrates the population projections in graphical form.

FIGURE 5-1

BROOME COUNTY POPULATION PROJECTIONS PLANNING PERIOD 2010 – 2030

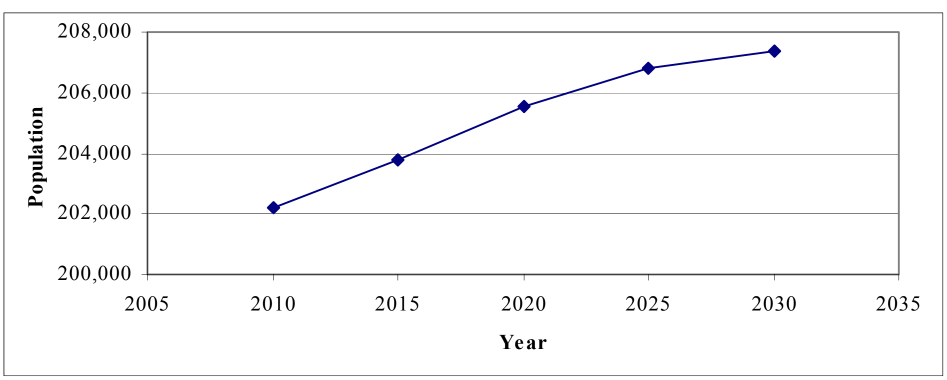


Table 5-2 lists the population projections for each municipality in the County. The town, village, and city projections were developed from the County projection utilizing local population and development trends.

TABLE 5-2

BROOME COUNTY MUNICIPALITY POPULATION PROJECTIONS

MUNICIPALITY	YEAR				
	2010	2015	2020	2025	2030
Town of Barker	2,760	2,782	2,806	2,823	2,831
City of Binghamton	47,768	48,149	48,559	48,854	48,993
Town of Binghamton	5,009	5,049	5,092	5,123	5,137
Town of Chenango	11,547	11,639	11,738	11,810	11,843
Town of Colesville	5,485	5,529	5,576	5,610	5,626
Town of Conklin	5,988	6,036	6,087	6,124	6,142
Town of Dickinson	5,378	5,421	5,467	5,500	5,516
Town of Fenton	6,965	7,021	7,080	7,123	7,144
Town of Kirkwood	5,697	5,742	5,791	5,827	5,843
Town of Lisle	2,729	2,751	2,774	2,791	2,799
Town of Maine	5,504	5,548	5,595	5,629	5,645
Town of Nanticoke	1,805	1,819	1,835	1,846	1,851
Town of Sanford	2,497	2,517	2,538	2,554	2,561
Town of Triangle	3,057	3,081	3,108	3,127	3,135
Town of Union	56,759	57,212	57,698	58,050	58,215
Town of Vestal	26,752	26,965	27,195	27,360	27,438
Town of Windsor	6,474	6,526	6,581	6,621	6,640
Total	**202,174**	**203,786**	**205,520**	**206,772**	**207,359**

Projections based on information provided by the Broome County Planning Department.

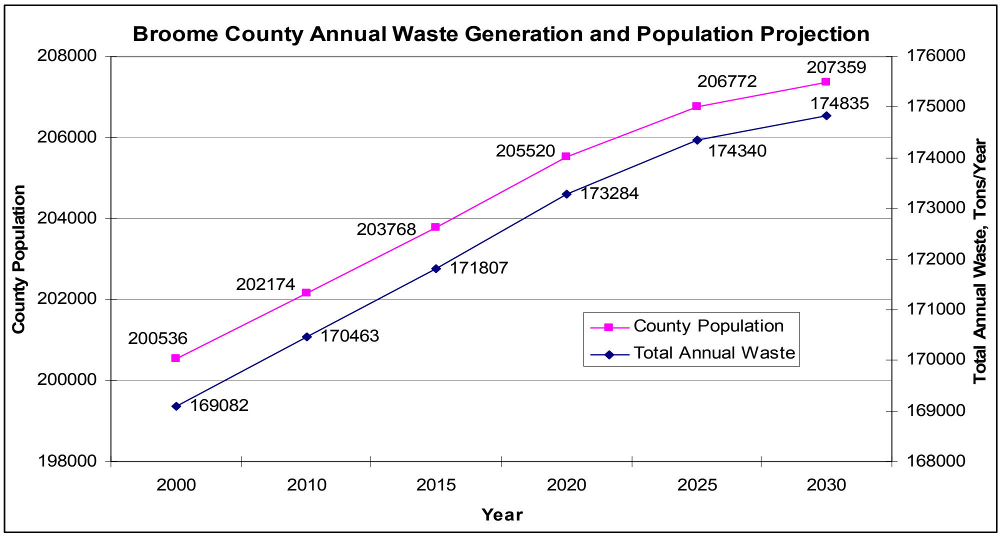
The population projections for Broome County anticipate a net population growth of about 7,000 persons over the next three decades. The projections anticipate that the cycle of employment loss associated with the closing of major manufacturers over the past several decades will cease, largely because there are few such employers left. According to Cornell Institute for Social and Economic Research projections, by 2030, the population of Broome County will be very similar to the nation as a whole.

5.2 WASTE GENERATION

Broome County has projected a population increase of 2.56 percent over the next 20 years. The 20-year population projection is more fully described in Section 1.3. For each increase in population, there is an associated increase in waste generated per year. Over 2007, the USEPA estimated the average waste generation rate in the United States at 4.62 lbs/person-day. Using the USEPA waste generation rate, the projected population and annual waste generation in Broome County is shown in Figure 5-2.

FIGURE 5-2

BROOME COUNTY ANNUAL WASTE GENERATION
AND POPULATION PROJECTION



Broome County has completed permitting activities associated with the next 100-acre landfill expansion. The first cell in Section IV was recently opened and 12 additional cells are planned for the remainder of Section IV. Given the air space capacity (volume available for solid waste disposal) of the landfill, the anticipated waste generation per year, an average waste density of 1,700 lbs. per cubic yard based on historical data at the landfill, and consideration of daily cover and interim cover material, Section IV is expected to have a lifespan of over 40 years.

5.3 POTENTIAL PLANNING UNIT CHANGES

There are no anticipated changes to the Planning Unit.

5.4 SPECIAL CONDITIONS THAT MAY AFFECT THESE CHARACTERISTICS

Currently, the Village of Endicott, Town of Chenango, and Binghamton-Johnson City are able to compost sewage sludge. The Town of Chenango currently processes sludge for part of the year when odor is not as likely, and suspends operations during the summer months. These communities have discovered that composting facilities are costly and difficult to manage on their own, and would prefer to haul the sludge to a regional compost facility or landfill.

5.5 PROJECTED CHANGE TO THE WASTE STREAM AND EFFECT ON CURRENT PRACTICES

If all the biosolids produced in the County were to be hauled to the landfill, the total yearly tonnage entering the landfill would increase by 15,000 to 20,000 tons. Currently, the County is not composting biosolids with yard waste, so the extra material would be directly disposed in the landfill. The effect of the biosolids in the landfill would be increasing the organic content of the waste, in turn increasing landfill gas production. However, wastewater sludges are difficult to handle in a landfill and also contribute to odors.

An anticipated societal change that can affect the waste stream characterization involves an increasing amount of electronics being discarded. Compared to 1989, electronics have a smaller lifespan and are more prevalent, people replace electronic equipment sooner, and the tonnage of disposed electronics is expected to continue to increase with time. It is anticipated the current HHW and E-waste recycling program will need to be expanded (refer to Chapter 6).

6.0 EVALUATION OF ALTERNATIVE TECHNOLOGIES

The objective of the alternative technologies evaluation is to analyze preferred downstream conversion technologies to determine their applicability to Broome County and its solid waste stream. The evaluation process included the following:

- Develop a list of technologies for initial screening.
- Conduct initial screening as part of a continuous improvement workshop with County staff.
- Identify a shortlist of alternative technologies as candidates for further review.
- Identify a set of screening criteria to apply to shortlist of technologies.
- Select two technologies for more detailed analysis.
- Develop recommendations concerning the implementation of these technologies.

6.1 INITIAL TECHNOLOGY SCREENING

The list of technologies identified by the County for initial screening included the following:

- Anaerobic digestion
- Pyrolysis/gasification/plasma technology
- MSW composting
- Landfill reclamation
- Waste-to-energy (WTE)
- Bioreactor landfills

At the July 2008 workshop with County staff, the project team provided an overview of these technologies, including a general description, industry status, and landfill diversion potential. Based on the discussions, the following technologies were identified for review:

- Anaerobic digestion and waste-to-ethanol
- Pyrolysis/gasification/plasma technology
- Enhanced composting, including MSW composting
- WTE (summary only)
- Bioreactor landfills (summary only)

6.2 DESCRIPTION OF SHORTLIST OF ALTERNATIVE TECHNOLOGIES

6.2.1 Overview of Anaerobic Digestion

Anaerobic digestion (AD) is one of the downstream technologies being considered by the County as an option for managing waste that is not targeted upstream to be reduced, reused, recycled or composted. AD is a technology that can potentially reduce methane emitted from agricultural waste and landfills through a biological process in which organic matter is broken down by bacteria. AD has the potential to reduce the volume of waste while producing methane and digestate (i.e., fibrous by-product and water). The co-products of the AD process are a medium-Btu content biogas and a slurry referred to as digestate. The biogas contains approximately 60 to 70 percent methane and is water saturated. The balance of the biogas mixture is carbon dioxide, and parts/million (ppm) of hydrogen sulfide. The digestate consists of undigested solids, cell-mass, soluble nutrients, other inert materials, and water.

A wide variety of engineered systems have been specifically developed for the rapid "in-vessel" digestion of the organic fractions of MSW (OFMSW) and other types of organic wastes. Most of these systems are located in Europe. Although the U.S. has been treating agricultural and municipal wastewater with anaerobic digesters for years, no commercial-scale solid waste digesters are operating today.[1] There are two AD facilities that currently process MSW located near Toronto, Canada.

Most AD systems are classified as either wet or dry, and each has its own benefits and constraints. Although hybrids exist, six basic types of AD systems reduce volume and recover energy from solid wastes: (1) wet single-step; (2) wet multi-step; (3) dry continuous; (4) dry sequencing batch; (5) dry multi-step; and (6) percolation (dry two-step). One-step wet systems are primarily designed to co-digest source-separated OFMSW with a liquid substrate, such as manure or sewage sludge. They are not typically used for the AD of the full OFMSW stream. Approximately 50 of the 90 wet systems in Europe co-digest the OFMSW with manure. Most of them are located in Germany, Sweden, Spain, and Denmark.[2] Generally, wet digestion is economically feasible when the residual liquids can be reused. If the MSW contains relatively high concentrations of heavy metals, this substrate may not be appropriate for beneficial use on agricultural fields.

[1] Source: "Current Anaerobic Digestion Technologies Used for Treatment of Municipal Organic Solid Waste," Contractor's Report to the California Integrated Waste Management Board, 2008.
[2] Source: "Anaerobic Digestion Feasibility Study for the Bluestem Solid Waste Agency and the Iowa Department of Natural Resources," by R. W. Beck, Inc., 2004.

The dry systems have been effective for managing the OFMSW outside the U.S. without the need for a liquid substrate, such as manure. High solids digesters (dry) process a thick slurry requiring more energy input than low solids digesters (wet) to move and process the feedstock, but will typically have a lower land requirement due to the lower volumes of moisture in the process. Several dry continuous and batch technologies, including Linde, Dranco, and Valorga, are being successfully applied to manage the organic fractions within MSW in several locations in Europe.

A. **Feedstocks.** An ideal circumstance for quality feedstock is when the organic fraction can be collected at the source of generation, (e.g., food processing industries, pulp and paper mills, etc.). In addition to the low degree of contamination, there is a more consistent composition of the waste over time that makes it easier to achieve a steady level of biogas production. This is optimal for conversion into a useful energy by-product. The following are possible organic components for feedstock to the AD facility:

- Green waste.
- Residential and commercial food waste.
- Non-recyclable, but compostable paper.
- Biosolids (wastewater sludge).
- MSW.
- Other organic sludges.

B. **Anaerobic Digestion Facility Components.** An AD facility will consist of an enclosed building, including an enclosed waste receiving and storage area, digester area, and ancillary equipment room; operations control center; utilities service area; biogas engine-generator area; and residue storage area. Windrow composting of the AD process residue will occur on a large concrete pad outdoors with stormwater control. The composted residue will require an on-site storage area. Initially, the facility should include digesters with available space to expand the waste receiving and storage enclosure, and potentially add another identical processing unit and biogas engine-generator. The selected site should exist near a major road for ease of access, water supply source, wastewater discharge point to treat wastewater, and electrical interconnection.

C. **Applicability to the Waste Stream.** Program experience in Europe and the U.S. has shown that comprehensive source separation of organics provides the best quality feedstock for AD, with a minimum of heavy metal and plastic contamination. Where source separation has been mandated in Europe, the results have been encouraging. The experience of some European communities indicates that 30 to 50 percent of the total OFMSW can be successfully collected and managed separately. Moreover, industrial organics collected at the source of generation (e.g., food processing industries, pulp and paper mills, etc.) may provide an economically viable opportunity to apply AD for optimal conversion into a useful energy by-product. For Broome County to consider this alternative technology, a program would need to be implemented that minimizes contamination and ensures the collection of a significant proportion of the organic fraction of the disposed MSW to take advantage of needed economies of scale. In addition, a reliable market for the purchase of the biogas would need to be tapped.

D. **Volume Reduction and Diversion Potential.** Anaerobic digestion facilities can result in a 65 to 75 percent volume reduction of the organic solid waste received. Potentially, mixed MSW could be received at an AD facility, and a “dirty” materials recovery facility (MRF) could be integrated into the facility to process the non-organics. However, this approach creates greater risks related to the quality of the feedstock, directly impacts biogas production, increases the capital investment, and increases the quantities of residue.

E. **Environmental Considerations.** As with other solid waste processes, the AD facility may emit fugitive dust (particulate matter) and odors associated with the materials handling components of the process. Depending on the extent of potential fugitive dust, proper industrial ventilation design and control with a baghouse may be required. Organic emissions and odors in materials handling areas may also require local ventilation and control with activated carbon systems. Assuming that the process vents are completely leak-free, no air emissions or odor nuisances are likely to occur from the AD process since it is fully enclosed. A scrubber will remove hydrogen sulfide and moisture, directing the cleaned biogas (composed primarily of methane) to a low nitrogen oxides (NO_x) reciprocating engine to cogenerate electricity and/or thermal energy to heat the digesters. Combustion of the biogas will result in emissions of NO_x, carbon monoxide (CO), volatile organic compounds (VOC), particulate matter, and sulfur dioxide (SO_2).

The AD process will produce some wastewater which would need treatment and disposal. Proper process design and moisture management can minimize this by-product to a negligible level or eliminate this stream. In some instances, the moisture resulting from the process has been treated and used for irrigation or reintroduced into the composting process for the residue.

The AD facility will likely require, at a minimum, both air quality and solid waste permits to construct and operate.

F. **Residuals.** An anaerobic digestion facility can process approximately 95 percent by weight of the diverted organic wastes received. The preprocessing system mechanically separates unacceptable material, which is disposed of at the landfill. The system will employ bag breaking and screening. Depending on the volatile content and quality of the feedstock, the AD facility will produce combined residue that is 25 to 35 percent by weight of the material processed. After the digestion process, post-processing of the resulting residue will occur. The post-processing system includes mechanical dewatering followed by biological treatment by windrow composting outdoors for 10 to 15 days. The final product could be sold as soil conditioner.

6.2.2 Overview of Waste-to-Ethanol

Waste-to-ethanol is considered an emerging chemical/biological technology that uses hydrolysis and other processes to break down the organic fraction of the waste (paper, food waste, yard waste) into sugars, which are then distilled into ethanol. For implementation in the County, a waste-to-ethanol facility would most likely need a pre-processing step such as a MRF to remove contaminants from the organic portion of the waste stream.

There are several recently proposed U.S. waste-to-ethanol processing facilities including, but not limited to, the following:

- Fulcrum BioEnergy – Reno, NV
- Enerken – Pontotoc, MS
- Bluefire – LA. County, CA

One waste-to-ethanol facility that has been in the planning stages by Masada Oxynol LLC for more than six years is in Middletown, NY. Masada also has several projects in development in Latin America. Masada employs a process that uses strong acid hydrolysis to convert the cellulosic fraction of waste to sugars. The sugars are then fermented to ethanol using conventional yeasts. The non-cellulosic fraction of the waste is either recycled from a front-end materials recovery plant (plastics, metals, glass, etc.) or is burned to provide energy to the process. It is our understanding the project has secured most of the needed environmental permits, but construction has yet to be initiated.

6.2.3 Thermal-Based Conversion Technologies

Thermal-based conversion technologies utilize higher temperatures and have higher conversion rates when compared to other conversion pathways. In addition to the traditional combustion technology of WTE, thermal conversion pathways also include emerging processes such as pyrolysis, gasification, plasma arc, and advanced thermal recycling. Each process operates within a specific temperature range and operating pressure. Pyrolysis and gasification are not new technologies, having been used in the coal industry since the early 20th Century. Attempts were made in the 1970s to apply pyrolysis to the processing of MSW waste at several facilities in the U.S., but the projects failed primarily due to difficulties with the front-end waste processing of the solid waste. While the application of these technologies to solid waste feedstocks is once again emerging in the United States, these technologies have been applied in other parts of the world, such as Japan and Europe. In most instances, the County would need to consider the import of applicable waste streams from outside the County to take advantage of the needed economies of scale for these options to be considered competitive.

For the purpose of this section of the Plan, the review of thermal technologies includes proven and emerging thermal technologies. The emerging thermal conversion technologies included pyrolysis, gasification; plasma arc; and advanced thermal recycling. The proven technologies include mass burn combustion in waterwall furnaces and refuse-derived firing in dedicated boilers (WTE). For WTE, we have provided a high level summary.

A. **Pyrolysis**. Pyrolysis is a process that produces pyrolytic oils and fuel gases that can be used directly as boiler fuel or refined for higher quality uses, such as engine fuels, chemicals, adhesives, and other products. Solid residues from pyrolysis contain most of the inorganic portion of the feedstock, as well as large amounts of solid carbon or char. Pyrolysis typically occurs at temperatures in the range of 750°F to 1,500°F and thermochemically degrades the feedstock without the addition of air or oxygen. Because neither air nor oxygen are intentionally introduced or used in the reaction, pyrolysis requires thermal energy that is typically applied indirectly by thermal conduction through the walls of the containment reactor. The reactor is usually filled with an inert gas to aid in heat transfer from the reactor walls and to provide a transport medium for removal of the gaseous products.

The composition of the pyrolytic product is changed by the temperature, speed of process, and rate of heat transfer. Lower pyrolysis temperatures usually produce more liquid products, and higher temperatures produce more gases. Slow pyrolysis is used to maximize the yield of solid char and is commonly used to make charcoal from wood feedstock. Fast or “flash” pyrolysis is a process that uses a shorter exposure time to temperatures of approximately 930°F. Typical exposure times for fast pyrolysis are less than 1 second. Rapid quenching of pyrolytic decomposition products is used to “freeze” the decomposition products and condense the liquids before they become low molecular weight gaseous products. This process results in a product that is up to 80 percent liquid by weight.

Combustion of the gases produced during the pyrolytic reaction in a separate reaction chamber releases significant thermal energy. This thermal energy can serve multiple purposes, including producing steam for electricity generation, heating the pyrolytic reaction chamber, or drying the feedstock that enters the reaction chamber. If pyrolytic gases are combusted to produce electricity, air emission control equipment will be needed to meet regulatory standards.

The MSW feedstock typically requires shredding to a 12-inch maximum size prior to charging the pyrolysis reactors.

The net energy generation rate for the pyrolysis conversion technology can reportedly approach 700 kWh per ton of waste processed. Two facilities using MSW feedstock with WasteGen technology are operating in Germany, where the oldest facility has operated continuously for 22 years. The largest operating unit with over three years of experience processing MSW and similar waste is rated at 175 tons per day (TPD) in Hamm-Uentrop, Germany. A facility built by Brightstar Environmental in Wollongong, New South Wales, Australia, has had problems with the char gasification component of the process and corresponding financial problems with the plant. A proposed facility in the United States with the same conversion technology in Collier County, FL was canceled a few years ago. There are no full-scale facilities in commercial operation in the U.S. However, there are a few proposed U.S. projects that should be monitored in the near future.

B. **Gasification**. Two types of gasification technologies exist: (1) fluid bed gasification; and (2) two-stage (pyrolysis-gasification) fixed bed. The thermal conversion of organic carbon-based materials occurs in the presence of internally produced heat (typically at temperatures of 1,400°F to 2,500°F) and with a limited supply of air/oxygen (less than stoichiometric, or less than is needed for complete combustion) to produce a synthetic gas (syngas) composed primarily of hydrogen (H_2) and carbon monoxide (CO). Inorganic materials are converted either to bottom ash (low temperature gasification) or to a solid, vitreous slag (high temperature gasification that operates above the melting temperature of inorganic components).

Some of the oxygen injected into the system is used in reactions that produce heat, so that pyrolysis (endothermic) gasification reactions can initiate; after which, the exothermic reactions control and cause the gasification process to be self-sustaining.

Like pyrolysis, most gasification systems are closed systems and do not generate waste gases or air emission sources during the gasification phase. An important aspect of gasification is that the chemical reactions can be controlled for the production of different products. The gases produced by gasification can be cleaned to remove any unwanted particulates and compounds prior to use as fuel. After cooling and cleaning in an emission control system, the syngas can be utilized in boilers, gas turbines, or internal combustion engines to generate electricity or to make chemicals. Synthetic gases can produce methanol, ethanol, and other fuel liquids and chemicals.

The MSW feedstock requires shredding from a 2- to 12-inch maximum size prior to charging the fluid bed gasification reactors. Several suppliers' two-stage (pyrolysis-gasification) fixed bed technologies require minimal preprocessing of the MSW before compaction. One fixed bed technology reportedly needs size reduction of the MSW feedstock to a 3-inch maximum size prior to feeding the fixed bed gasification reactors.

In low temperature gasification, below the melting point of most inorganic constituents, a powdery to clinker-type bottom ash is formed. In high temperature gasification, the inorganic ash materials exit the bottom of the gasifier in a molten state, where the slag falls into a water bath and is cooled and crystallized into a glassy, non-hazardous slag. The slag is crushed to form grit that can be easily handled. Slag can be used in the manufacture of roofing tiles, sandblasting grit, and as asphalt filler. Bottom ash may require landfilling, although some suppliers have been able to manufacture ceramic-like bricks or paving stones.

One system that utilizes oxygen injection creates extremely high temperatures in the bottom of the gasifier, reaching the melting temperature of some metals. In that process, metals can be recovered in "ingot" form. Fly ash from the air emission control system is the primary process residue. Reuse of the slag after metal recovery would result in the high reduction rate. A facility with the gasification conversion technology reportedly can reduce the feedstock by more than 90 percent by weight. If this rate of reduction is correct, it would represent an improvement over traditional thermal conversion technologies that can reduce the volume of MSW by 90 percent, but the weight by only 75 percent.

No MSW processing facilities employing the gasification conversion technology are commercially operating in the United States. However, there is a commercial operation in Sanford, FL that processes sewage sludge through a gasifier, and there are several suppliers of the technology that claim to have commercially operating facilities outside of the U.S. and that have proposed projects in the U.S.

For fluid bed technologies, the net energy generation rate ranges from almost 400 to 450 kWh per ton of waste processed, which is somewhat lower than the conversion rate of traditional thermal conversion technologies. For two-stage (pyrolysis-gasification) fixed bed technologies, the net energy generation rate reportedly ranges from almost 700 to over 900 kWh per ton of waste processed, which is significantly higher than traditional thermal conversion technologies. Global Energy Solutions has the largest operating unit rated at 180 TPD in Tokyo, Japan, with over three years of experience while processing MSW.

C. **Plasma Arc**. Plasma arc technology is a heating method that can be used in both pyrolysis and gasification systems. This technology was developed for the metals industry in the late 19th Century. Plasma arc technology uses very high temperatures to break down the feedstock into elemental by-products.

Plasma is a collection of free-moving electrons and ions that is typically formed by applying a large voltage across a gas volume at reduced or atmospheric pressure. When the voltage is high enough and the gas pressure low enough, electrons in the gas molecules break away and flow toward the positive side of the applied voltage. The gas molecules, losing one or more electrons, become positively charged ions that are capable of transporting an electric current and generating heat when the electrons drop to a stable state and release energy. This same phenomenon creates lightning.

Plasma arc devices or “plasma torches” can be one of two types: (1) the transferred torch; and (2) the non-transferred torch. The transferred torch creates an electric field between an electrode, at the tip of the torch, and the reactor wall or conducting slag bath. When the field strength is sufficiently high, an electric arc is created between the electrode and reactor, much like an automotive spark plug. The non-transferred torch creates the electric arc internal to the torch and sends a process gas, such as air or nitrogen, through the arc where it is heated and then leaves the torch as a hot gas.

Very high temperatures are created in the ionized plasma. The plasma can reach temperatures of 7,000ºF and above; the non-ionized gases in the reactor chamber can reach 1,700ºF to 2,200ºF; and the molten slag is typically around 3,000ºF. For applications in processing MSW, the intense heat actually breaks up the molecular structure of the organic material to produce simpler gaseous molecules such as CO, H_2, and carbon dioxide (CO_2). The inorganic material is vitrified to form a glassy residue. A main disadvantage of the plasma arc systems used in power generation is that a large fraction of the generated electricity is required to operate the plasma torches, which reduces net electrical output of the facility.

The MSW feedstock typically requires shredding to a 6-inch maximum size prior to charging the plasma arc reactors.

By-products of plasma gasification are similar to those produced in high temperature gasification, as noted previously. Due to the very high temperatures produced in plasma gasification, carbon conversion nears 100 percent.

The net energy generation rate can reportedly vary significantly depending on the facility throughput. The parasitic load of the torches at plasma arc facilities is significant.

Hitachi Metals, Inc., has developed two commercial plasma arc facilities with the Westinghouse Plasma system in Japan. The facility in Utashinai has the largest operating unit rated at 83 TPD with over three years of experience while processing MSW and auto shredder residue. Existing systems use two operating and one spare torch per reactor. The scale of technology has also been used in a General Motors plant in Defiance, OH since 1989. The plasma arc-based facility melts scrap metal for engine block castings. The plasma heating elements there have logged more than 500,000 hours of operation.

A leading supplier of the plasma arc technology, Westinghouse Plasma system, is Alter NRG. Alter NRG (formerly Geoplasma) was selected to build a 3,000 TPD facility in St. Lucie County, FL nearly five years ago. The project has been revisited and resized to less than 500 TPD and is still in the development stages. Koochiching County, MN is developing a plasma arc facility using MSW, along with other special wastes as feedstock. A independent review is presently being conducted, and funding is being secured from the state and federal governments to support project development. Plasco Energy Group, a plasma arc technology developer, has signed agreements with two provincial governments in Canada to design, build, and operate plasma arc facilities that will use MSW as feedstock. However, no facilities employing the plasma arc conversion technology to manage MSW are presently commercially operating in the United States.

D. **Advanced Thermal Recycling.** Advanced thermal recycling represents a second generation advancement of technology that utilizes complete combustion of organic carbon-based materials in an oxygen-rich environment, typically at temperatures of 1,300°F to 2,500°F, producing an exhaust gas composed primarily of CO_2 and water (H_2O) with inorganic materials converted to bottom ash and fly ash. The hot exhaust gases flow through a boiler, where steam is produced for driving a steam turbine-generator, thereby generating electricity. The cooled waste gases flow through an advanced emission control system designed to capture and recover components in the flue gas, converting them to marketable by-products, such as gypsum (e.g., for wallboard manufacture) and hydrochloric acid (used for water treatment). Typical recovery rates of gypsum and hydrochloric acid from MSW on a weight basis are 0.3 and 1.3 percent, respectively. The bottom ash and fly ash are segregated, allowing for recovery/recycling of metals from the bottom ash and use of the bottom ash as a road base and construction material. The advanced recycling and emission control systems with recovery/recycling reportedly go beyond the technology utilized at conventional resource recovery plants.

The feedstock for advanced thermal recycling systems can be unprocessed MSW or refuse-derived fuel (RDF). Using lower moisture content, RDF improves the heating value of the feedstock, resulting in higher efficiency and lower throughput per kWh of electricity generated. To improve economics and efficiency, facilities can incorporate preprocessing to remove marketable recyclables, such as paper, plastics, metals, and glass.

Materials handling involves extensive recycling and reuse of solid and liquid residues which can include various by-products, such as hydrochloric acid, gypsum, metal scrap, and road base. In addition, some facilities will extract recyclables out of the feedstock before processing. These innovations reportedly result in disposal of less than 5 percent of process residues, which will be inert. The weight reduction rate of the advanced thermal recycling technology can reportedly range from almost 80 percent to over 95 percent.

No facilities employing the advanced thermal recycling conversion technology are commercially operating in the United States. However, Waste Recovery Seattle International LLC (WRSI) is a licensee of the Muellverwertung Rugenberger Damm (MVR) advanced thermal recycling conversion technology. The MVR technology is proven in two full-scale commercial facilities in Hamburg, Germany. Müllverwertung Borsigstrasse Damm (MVB), the oldest facility, has been operational since 1994. The MVR facility has reportedly operated at over 90 percent annual availability. The net energy generation rate is 580 kWh per ton of waste processed.

6.2.4 Overview of Enhanced MSW Composting

In accordance with New York State Regulations, leaf and yard waste (green waste) is not allowed to be disposed of in the Broome County landfill. As a service to County residents and businesses, the Division of Solid Waste Management currently operates a leaf and yard waste composting facility on the landfill property to process and recycle green wastes through the windrow method of composting. These services are provided for a nominal fee to residents and businesses of Broome County (minimum of $2 per visit to $20/ton). Other private enterprises within the County also offer facilities for the processing and recycling of green wastes.

In consideration of expanding the County's current composting operations to increase downstream diversion of organic waste, and in light of recent New York State initiatives to promote greater diversion of organics from landfills, there are two potential management strategies that could enhance and expand composting operations. The first is the addition of other types of organic feedstock to the green waste currently being processed; the second is through a large-scale commercial MSW co-composting facility similar to that built for Delaware County, NY.

A. **Enhanced Yard Waste Composting.** In its simplest form, composting is the biological breakdown and stabilization of organic materials. In nature, this occurs over time through the presence (aerobic) or absence (anaerobic) of air, and the addition of moisture that supports microbial activity and decomposition of organics over a range of temperatures. Formal composting procedures are intended to create a controlled biological process that accelerates the decomposition and stabilization of organics, which can then be reused as a soil amendment.

Enhanced yard waste composting is an organics management strategy that would allow the County to compost other source-separated organics with their current green waste composting operations in a systematic and potentially "phased" approach. A variety of composting methods and engineered systems could be utilized to expand the current green waste composting operations. The following discussion presents an overview of the options that may be available to the County.

1. **Feedstock Availability**. For an enhanced green waste composting program, ideal circumstances for quality feedstock are those materials that can be collected at the source of generation and provide consistent "non-contaminated" (no inorganic materials or paper) feedstock. Although a consistent supply of feedstock can be difficult to achieve, there are also methods and procedures that can be utilized to manage inconsistent feedstock but would require additional capital investment in equipment. The following are typical organic feedstocks that are most suitable for co-composting with leaf and yard waste:

    - Biosolids from wastewater treatment facilities.

- Source-separated food waste from residential, commercial, and institutional facilities. Food waste is often categorized as "pre-consumer" food waste (prior to consumption by consumers, e.g., grocery store organics, food preparation businesses, food processing industries, etc.) or "post-consumer" food waste which is discarded organics that are not consumed after serving (vegetable and meat scraps, spoiled foods, etc.). Pre-consumer food waste will generally have less paper and plastics than post-consumer food waste, but it is rare for food waste to be completely free of paper and plastics.

The benefit of each of these types of organic feedstock is that they offer a higher percentage of nitrogen to carbon-rich green waste. Early blending of feedstock to achieve appropriate carbon:nitrogen ratios can accelerate the active composting phase of the material to achieve a stable compost in less time. The advantages and challenges of these feedstocks are summarized as follows:

TYPE OF FEEDSTOCK	ADVANTAGES	CHALLENGES
Wastewater sludges	◗ Readily available ◗ High nitrogen content ◗ Regular testing at source	◗ Strong odors ◗ Inconsistent moisture content ◗ Requires more processing controls
Pre-consumer food waste	◗ Relatively low odor ◗ Excellent source of nitrogen ◗ Many potential sources locally available	◗ Requires some pre-processing for size reduction ◗ Variable quantity and quality ◗ Requires outreach program
Post-consumer food waste	◗ Source of nitrogen ◗ Locally available	◗ Potentially higher odors ◗ Requires pre-processing ◗ Collection challenges

2. **System Components and Alternative Composting Methods.** There are a variety of composting methods that may be utilized to co-compost multiple organic waste streams. However, given the sensitivity for odor generation, outdoor windrow composting is not the most suitable for nitrogen-rich materials since oxygen is rapidly consumed by microorganisms and compost must be mixed regularly to reintroduce oxygen into the compost. This can often result in the release of fugitive odors that are generated if oxygen is depleted, and ammonia and other gases are generated through

anaerobic activity. However, if the compost site is isolated from downwind odor receptors, windrow composting is the least expensive option to the County. Where odors are a concern, the recommended composting methods are as follows:

a. ***Aerated Static Piles***. This is a process where source-separated organics are received and mixed with green waste and placed on an aeration pad for processing. The pad includes a system of perforated pipes and aeration blowers that regularly feeds air from the bottom of the piles through the organic materials to control the rate of decomposition and compost production. This method does not require the material to be turned, and generally completes the active phase of composting within 30 days, when the material can then be removed from the pad and cured in windrow piles for final processing. The Onondaga Resource Recovery Agency recently completed a pilot test program utilizing static aerated piles to compost green waste and pre-consumer food waste with excellent results, and therefore plans to pursue full-scale development at their site.

b. ***Covered Aerated Static Piles.*** Similar to aerated static pile systems, this process utilizes similar forced aeration systems but adds a fabric cover (the Gore Cover System or equivalent) over the piles to control moisture content and to further prevent the escape of fugitive emissions. These cover systems allow air to circulate and escape through the (breathable) fabric while retaining moisture and off-gases that are bound by moisture. These types of systems are popular in Europe and have recently been developed in the western portion of the United States for green waste and biosolids co-composting.

c. ***In-Vessel Systems***. In-vessel composting systems are those that process organics in a vessel, container, or building by controlling moisture addition and oxygen as required, and mixing the material as decomposition of the material proceeds. The primary advantage of these systems is that they allow the greatest processing controls to accelerate the overall composting process. In-vessel systems generally control odors by retaining or collecting them and treating them prior to release to the atmosphere. In-vessel systems range from relatively small containers for farms (to compost manure) and universities (food waste) to building systems like the IPS Agitated Bin System for composting biosolids (similar to the Rockland County Solid

Waste Authority Co-compost Facility). The larger systems are generally suited to higher volumes of organic processing due to economy of scale.

3. **Applicability to the Waste Stream.** There has been a variety of experiences in both the United States (recently) and Europe (historically) related to organics composting and the trend to divert greater volumes of organic material from landfills. The Western Region of the United States has shown greater activity with source-separated food waste programs than other portions of the U.S. Biocycle Magazine (December 2008) reports that there are nearly 70 food waste composting facilities in Alaska, Arizona, California, Nevada, Oregon, and Washington. The most challenging and expensive portions of the program relate to collection, public outreach, and management of consistent feedstock. For Broome County, the most readily available source-separated organics are from the wastewater treatment facilities located within the County and at institutional facilities (food waste).

4. **Volume Reduction and Diversion Potential.** Source-separated compost facilities can achieve a very high volume reduction of the organic waste received since it primarily consists of compostable materials. For food waste, however, there will always be a fraction of inorganic waste that will need to be screened from the final product. For pre-consumer food waste, the volume reduction can be over 90 percent. For post-consumer waste, the volume reduction will be somewhat less but should still achieve over 80 percent reduction. The challenge is to manage residuals that are removed from the compost on site without cross contamination of the final compost product. The overall program challenge for food waste composting is to achieve reasonable participation through the implementation of effective collection methods at a reasonable cost. It has also been noted by those communities that have implemented these programs that success often occurs at the “grass roots” level where individuals, businesses, and institutions have a strong desire and commitment to implement organics recycling programs since it generally takes more efforts to succeed.

5. **Environmental Considerations.** For composting operations, the most significant challenges for controlling environmental impacts relate to control of odors, fugitive dust emissions, stormwater management, and prevention of leachate generation. New York State requirements pertaining to composting operations are presented in the 6 NYCRR Part 360-5 Solid Waste Rules and Regulations. For those composting operations greater

than 3,000 cubic yards per year, the NYSDEC requires the facility to be registered. For operations greater than 10,000 cubic yards per year, the facility will require a solid waste permit. In addition, if biosolids are processed in any volume, it will require a solid waste permit.

6. **Residuals.** For source-separated organics, there will be some inorganic materials that will need to be removed from the final compost product. Depending on the materials, this could range from 25 percent by volume to less than 10 percent by volume. Residuals would require disposal in the landfill if it consists of paper, plastics, or large organic material. Wood waste could be reused as a bulking agent for feedstock as part of the composting process.

B. **MSW Co-Composting**. MSW co-composting is a waste diversion and organics recycling technology that processes a single mixed stream of solid waste and captures and composts the organic fraction of the waste. The advantage of this technology is that it does not require special separation or collection programs for the organic fraction of the waste stream (utilizes existing waste collection programs) and integrates well with existing recycling programs.

MSW co-composting technologies are aerobic processes that do not produce synthetic gases for conversion to energy; however, the Nantucket Facility in Massachusetts recently received an approved protocol from the Chicago Climate Exchange for receipt of carbon credits.

1. **Feedstock Availability.** The following types of feedstock can be processed through an MSW co-composting facility:

- Mixed MSW
- Green waste
- Wastewater treatment plant sludges
- Non-contaminated waste liquids
- Other organic sludges
- Food waste
- Liquid sludges

As previously discussed, all of these organic materials are readily available within the County. The advantage of this process for feedstock is that inorganics are removed as part of the process and it does not rely on separation of organics at the point of generation. In addition, the process anticipates various levels of moisture content for different feedstocks and can be adjusted throughout the process.

2. **MSW Co-composting Facility Components.** MSW co-composting facilities are fully enclosed facilities that generally consist of a waste receiving area (solid waste, biosolids, liquid waste); an aerobic digester (rotating drum or other mixer); primary refining area where large inorganic material is separated from organic material; an active composting area; a secondary refining area where small inorganics are removed from the compost; operations control center; pre- or post-sorting areas for dry recyclables; automated instrumentation systems; and site utility systems. In some instances, there are enclosed storage areas for compost. The facilities can be developed as modular systems and can be sized for almost any throughput, although economy of scale is a key consideration.

3. **Applicability to the Waste Stream.** *Biocycle Magazine* (November 2008) reports that there are 13 MSW composting facilities operating in the United States ranging in size from 33 to 350 TPD. The largest MSW composting facility in North America is located in Alberta, Canada, and processes over 350 TPD of MSW. The newest facilities to come on line were Delaware County, NY (2006) and Rapid City, SD (2005). Both of these facilities process both MSW and biosolids and are very well run facilities that sell their final compost product.

   A significant advantage of MSW co-composting is that it does not require changes to the County's current solid waste collection methods nor does it require residents to modify habits with respect to separation of recyclables and solid waste. It also potentially allows for greater processing of solid waste, which will lower the volume of material into the landfill to extend the overall life of the facility. However, like all alternative technologies, this process can be more expensive than disposal of waste in a landfill. The economic benefits occur with respect to the longevity of the landfill, the ability to process greater volumes of waste, the ability to utilize alternative energy resources to reduce operating costs, and the receipt of economic incentives such as carbon credits – all of which are potentially available to the County.

4. **Volume Reduction and Diversion Potential.** MSW co-composting facilities can achieve volume reductions of between 50 and 75 percent, depending on the equipment and systems utilized. Where the focus is on

maximizing landfill diversion, additional capital expenditures are utilized for greater separation and reuse of materials (similar to the Conporec Facility in Canada). Where facilities are integrated with an active recycling program (Blue Box Program), the focus is on capturing the organic fraction of the waste stream and not spending additional money on recovering recyclables within the facility (similar to the Delaware County model). Delaware County reports that their total solid waste management program is achieving nearly 85 percent recycling with the implementation of the MSW co-composting facility (includes their MRF). From a volume perspective, Delaware County is achieving a 70 percent diversion rate for their landfill air space.

5. **Environmental Considerations.** For MSW co-composting operations, the most significant challenges for controlling environmental impacts relate to control of odors, fugitive dust emissions, and compost quality. New York State requirements pertaining to composting operations are presented in the 6 NYCRR Part 360-5 Solid Waste Rules and Regulations. All MSW co-composting facilities require a New York State solid waste permit to construct and operate the facility. Registration of odor control facilities is also required under the air regulations.

   Extensive odor control systems are utilized that maintain negative pressures throughout the processing areas and treat air through scrubbers or biofilters prior to releasing to the atmosphere. Dust collection and removal systems are also used to remove particulates from the air during internal screening and processing of the final compost product.

   Worker health and safety is also a significant consideration, and local ventilation systems are utilized extensively in the facilities, as well as sanitary facilities and clean-up areas.

6. **Residuals**. An MSW co-composting facility can process a variety of organic materials in a single stream. Biosolids and liquid waste have very little residuals left after processing, while MSW has a significant component of inorganic materials. Depending on the type of feedstock, the MSW co-composting facility may produce combined residuals of 25 to 40 percent by weight of the material processed. This number may be a bit misleading since moisture is added throughout the process so weight comparisons may not be completely representative of the diversion potential compared to volume reduction. The inorganic material must be disposed of in a landfill or

approved solid waste disposal facility. The final compost product is tested and sold as a soil amendment.

6.2.5 Overview of Waste-to-Energy

The WTE industry emerged in the United States in the 1970s due to several factors. The Arab Oil Embargo resulted in oil and energy prices increasing substantially. Second, there was growing recognition of the potential risks of groundwater contamination at existing unlined landfills. This led to new regulations requiring the construction of lined sanitary landfills, which increased solid waste landfilling cost. Third, WTE facilities were considered viable alternatives for waste disposal and energy production.

In 1980, less than 60 WTE facilities were operating. By 1993, the number of operating facilities reached a peak of approximately 150. From 1993 to present, the number of operating WTE facilities has declined to approximately 89. The decline was caused in part by an abundance of landfill space with lower tipping fees than WTE facilities, loss of ordinance-based flow control, and implementation of more stringent federal air quality standards. Currently, WTE facilities process approximately 12 percent of all MSW generated in the United States, according to the USEPA.

It is important to note that the last “greenfield” WTE facility utilizing mass burn technology was constructed in the United States in the early 1990s. Since that date, several WTE vendors have exited the business (Westinghouse, Foster Wheeler, and General Electric), and multiple acquisitions have taken place. Covanta Energy, Montenay Power/Veolia, and Wheelabrator Technologies represent the three primary remaining WTE vendors. Several existing facilities are proceeding with expansion, including but not limited to, Lee County, FL; Rochester, MN; Honolulu, HI; and Lancaster County Solid Waste Authority. Higher energy prices over the last two to three years have resulted in a renewed interest in WTE technologies.

A. **WTE Facility Components**. Generally, a mass burn WTE facility will consist of a large building, including an enclosed waste receiving and storage area, furnace-boiler room, central operations control center, water treatment area, turbine-generator hall, and residue storage area. An air-cooled condenser, air emissions control systems, a continuous emissions monitoring system enclosure, and stack with multiple flues will be located outdoors.

The WTE facility should be situated on a minimum of an 8- to 10-acre site surrounded by additional buffer area. The selected site should exist near a major road for ease of access, water supply source, wastewater discharge point to treat wastewater, and electrical interconnection. The design of a new WTE facility can incorporate on-site wastewater reuse.

The anticipated energy content (higher heating value) of the processible solid waste will range from 4,500 to 5,000 Btu per pound. Typically, food waste is the highest moisture-laden component with the lowest energy value of the potential processible waste stream for the WTE facility.

B. **Commercially Proven Technologies.**

1. **Mass Burn WTE Systems.** Mass burn WTE systems can be basically divided into three separate technologies: (a) modular starved air systems; (b) modular excess air systems; and (3) field-erected excess air systems.

   The modular starved air systems were historically used for small applications (under 400 TPD). These facilities would typically combine several refractory lined combustors, each rated for around 90 TPD, in the number necessary to dispose of the quantities of waste available in the area. These refractory lined combustors generally had two chambers in which the MSW was introduced and pushed through several steps during which the fuel was first dried, then combusted, and then completely burned with the ash removed into a submerged conveyor. The combustion was conducted without adequate amounts of oxygen; additional air was introduced in the secondary chamber where the combustion was fully completed. Many of these modular starved air systems were used in small applications for incineration only. If energy recovery was desired, a separate waste heat boiler was included to convert the hot gases from incineration into steam to drive a steam turbine connected to an electric generator.

   The modular excess air WTE system can be described as the rotary combustor systems currently in use in several facilities in the United States. These facilities use a rotating cylindrical combustor in combination with a waste heat boiler to create steam for electrical production. The combustors are constructed with tube material that circulates water to absorb the heat of combustion and to heat the water being used in the waste heat boiler to create the steam for use in the steam turbine generator. The MSW tumbles through the inclined combustor and falls out of the combustor onto an afterburning grate system, which allows for the complete burn-out of the MSW fuel.

The type of WTE facility most prevalent in the United States uses the field-erected excess air technology. With this technology, the incinerator and boiler are one system; the walls of the incinerator are constructed of tubing in which water circulates as part of the steam generation process. The mass burn technology typically utilizes an overhead crane to feed municipal solid waste from a pit into a chute that deposits the municipal solid waste onto an inclined surface upon which the municipal solid waste burns in the presence of more than enough air (oxygen) to achieve complete combustion. The heat generated during combustion is transferred through the water walls to create steam. In addition, the water wall boilers are typically provided with additional tubing in other sections of the boiler to create superheated steam that improves the generation of electricity and other tubes to preheat the water, which improves the efficiency of the boiler process. The super-heated steam is sent to a steam turbine connected to an electrical generator to create electric power. Some facilities use steam turbines that allow for extraction of steam at some specific pressure level to be sold to an adjacent industry that may require process steam.

2. **RDF Systems**. RDF systems have been employed as a means to increase the quality of the MSW as a fuel and to provide a means to recover materials prior to combustion. RDF systems in use today are being used in combination with field-erected water wall boilers. RDF systems can be used to prepare fuel to be used with different types of combustors, including fluid bed combustors and other industry boilers (cement kilns, pulverized coal units, etc.). On average, RDF systems have a larger design capacity than mass burn facilities. Most RDF facilities in the U.S. process 1,000 TPD or more.

   RDF systems can be arranged in several different forms. There are several systems typically used in an RDF plant, including shredders, magnets, eddy current separators, trommels, and picking stations. The combination of and order in which the systems are arranged are what differentiates one from the other. Two or three types of shredders can be employed, including slow-speed shear-type shredders, bag-breaking “flail mill”-type shredders, and size-reducing hammermill-type shredders. Magnets can be used to remove ferrous metals such as steel cans and other iron. Eddy current separators can be used to remove non-ferrous metals such as aluminum, brass, tin, etc. Trommel systems can be used to separate materials by size using a rotating cylindrical drum with sides made of screens with holes of certain size. Picking stations provide a means to pick targeted items for recovery.

In the United States, three types of RDF systems are normally employed, including the shred-and-burn system, the trammel-first systems, and the shred-first systems. All three designs use ferrous removal magnets. The shred-and-burn system in use at the SEMASS facility in Rochester, MA basically removes the non-processible waste, shreds everything else, removes ferrous metals, and burns the remainder. The trommel first system at SPSA in Portsmouth, VA and one of the Miami, Dade County, FL systems use trommels to open bags and remove glass and grit; then sends the material into another trommel to separate those items already sized appropriately for the combustor, which also concentrates the aluminum cans; then shreds the oversized material for use in the boiler. Typically magnets are used to remove ferrous metal from each stream, and eddy current separators remove aluminum prior to the size reducing shredder. The shred-first systems typically use a flail mill to open bags of MSW, then magnets and trommels remove small residues and size materials, and hammermills size the remaining materials. H-POWER in Honolulu, HI uses the shred-first system.

All of the RDF systems operating in the United States use grate-type combustion units. Typically, the boilers used in the RDF systems are very similar to those used in mass burn systems: field-erected water wall units with superheaters and economizers. The differences between mass burn and RDF combustion units are associated with the grate systems. The RDF units use a horizontal grate system; the mass burn facilities use inclined grate systems.

C. **Residuals.** Unprocessible (i.e., large, bulky) solid waste is separated in the waste receiving area for recycling or landfill disposal. Unprocessible solid waste components include demolition/renovation/construction debris, durables, household hazardous wastes, and special wastes. The remaining solid waste components are compatible with mass burn technology.

6.2.6 Overview of Bioreactor Landfills

Unlike the other alternative technologies discussed in this section, bioreactor landfill technology does not prevent the disposal of MSW in the landfill. This technology is focused on the accelerated decomposition of organic matter within the landfill waste mass. Operating a bioreactor landfill requires the managed introduction of liquid, usually leachate, into the waste mass. This is typically accomplished using vertical and/or horizontal piping systems. While the concept is similar to leachate recirculation, a true bioreactor landfill is monitored for various operational parameters (including temperature, moisture content/pore water pressure, leachate generation rate, head on the primary liner system, etc.) to optimize biological degradation of organic matter through controlled liquid addition. A bioreactor landfill is operated within a certain range of these parameters to create the proper environment for biological activity without overapplying the liquid and creating additional leachate generation. Air can also be "injected" into the waste mass to increase oxygen levels and create an aerobic bioreactor, which can further enhance biological activity. The USEPA continues to evaluate the design and operation of bioreactor landfills through both the Project XL program, which began in 1995, and through funding of demonstration projects.

A. **Potential Advantages of Bioreactor Landfills.** According to the USEPA, bioreactor landfill operations can offer several advantages when compared to standard landfill operations, including:

1. **Accelerated Waste Decomposition/Stabilization**. A bioreactor landfill operation increases the volume of waste that can be placed within a given footprint prior to closure and also results in the stabilization of readily and moderately decomposable organic matter in years (typically 5 to 10), as compared to decades for traditionally operated landfills.

2. **Increased Landfill Airspace**. As a result of the increased rate of waste decomposition, organic matter is converted to gas, and the density of the waste is increased. This results in a reported 15 to 30 percent increase in air space.

3. **Reduced Waste Toxicity and Mobility**. As a result of both aerobic and anaerobic conditions within the waste mass, the long-term toxicity and mobility of the waste is reduced.

4. **Increased Landfill Gas (LFG) Generation Rate**. For those facilities that capture and reuse landfill gas, an increased rate of LFG generation allows for more efficient collection of the energy available from the organic waste over a shorter period of time. This can decrease the overall cost to capture and reuse LFG.

5. **Decreased Leachate Disposal Cost**. If leachate is utilized as the liquid in a bioreactor landfill, the cost of leachate treatment/disposal can be reduced.

6. **Reduced Post-Closure Care**. Because more of the decomposition of the waste is completed prior to closure, post-closure settlement is reduced.

In addition to the potential advantages reported by the USEPA, other potential advantages include:

1. **Improved Leachate Quality**. By recirculating leachate through the landfill and increasing the biological activity in the waste mass, the overall quality of the leachate can be improved (i.e., the concentration of biodegradable parameters is reduced) by the time the landfill is capped.

2. **Potential Reduced Landfill Capping Requirements**. Some landfill owners have proposed that by recirculating leachate through the waste mass, the overall environmental liability (toxicity and mobility) remaining at closure is significantly reduced compared to standard operations, and therefore a formal, low permeability landfill cap should not be required. Proponents of this approach have suggested only phyto capping (trees) or no capping of managed and monitored bioreactor landfills.

B. **Potential Concerns with Bioreactor Landfills.** The USEPA also identifies several special considerations that must be examined and understood prior to implementing a bioreactor landfill operation, including:

1. Increased LFG generation.
2. Increased odors.
3. Decreased waste mass stability due to increased moisture content and waste density.
4. Decreased landfill liner system stability.
5. Increased surface (side slope) seeps.
6. Landfill fires, primarily for aerobically operated bioreactor landfills.

C. **State of Bioreactor Landfill Operations in the United States.** In conjunction with the Bioreactor Landfill Committee of the Solid Waste Association of North America (SWANA), the USEPA maintains a listing of bioreactor projects in North America. This listing includes approximately 80 projects in the U.S., 7 of which are in New York State. Few of the projects are true bioreactor operations, and many simply utilize surface application (spraying) of leachate. Many of the projects are demonstrations in various phases. All of the New York State projects ended prior to 2001, including the Broome County leachate recirculation demonstration completed in 1997. In July 2008, the Florida Department of Environmental Protection released a report summarizing bioreactor landfill demonstration projects at five landfills. The report identified findings associated with various aspects of bioreactor landfill operations, both aerobic and anaerobic. Some of the findings included:

1. **Monitoring Equipment**. Several limitations were encountered.

2. **Temperature**. Increased in areas where a significant amount of air was added. However, it was very difficult to control temperature by changing the rate of air addition.

3. **Moisture Content**. Was substantially increased.

4. **Air Addition**. Difficult to get air to deep or wet areas.

5. **Leachate Quality**. Rapid degradation of biodegradable constituents, especially under aerobic conditions. Non-biodegradable and persistent leachate constituents accumulated over time.

6. **Landfill Gas**. Air addition did not significantly impact VOCs or nitrogen oxide, but decreased hydrogen sulfide and increased carbon monoxide concentrations.

7. **Settlement**. An average 10 percent settlement that varied with the depth of waste.

To date, no formal design and operating standards have been developed by the USEPA for operation of a bioreactor landfill, although a significant amount of training and guidance is available.

D. **Applicability of Bioreactor Landfill Operation to Broome County.** Operation of the Section IV landfill as a bioreactor landfill is feasible. Prior to development of the Section IV Cell 1 design, the County evaluated their desire to operate the cell as a bioreactor landfill. While the potential bioreactor operation of Section III presented concerns due to the variety of landfill liner systems within the Section II/III footprint, the Section IV landfill consists of a state-of-the-art double composite landfill liner system. In addition, the performance of the primary liner system to date has been well within regulatory limits. While discussions have been held with Broome County regarding the potential addition of primary leachate collection piping if the County were to consider a bioreactor landfill operation, a properly operated bioreactor landfill should not produce significantly greater quantities of leachate.

E. **Bioreactor Landfill Operation Cost Impacts.** A bioreactor landfill operation at the Broome County landfill would require hauling and/or pumping of leachate from existing storage facilities (either from the leachate pretreatment facility or the new Section IV storage tanks) to the Section IV landfill. A distribution system consisting of vertical wells and/or horizontal piping would be required to introduce the leachate in a managed approach. Surface application of leachate could also be utilized depending on its impact on waste placement operations, odor generation, and worker safety. Equipment would also be required to monitor the performance of the bioreactor landfill. Additional vertical and horizontal piping systems, blowers, and monitoring systems would be required to operate the bioreactor landfill aerobically. In addition to capital costs, ongoing operation and maintenance of the system would be required.

F. **Potential Revenue Generation from a Bioreactor Landfill.** As waste will already be in place, this alternative technology does not present a real opportunity to generate additional revenue except when considering the additional volume of waste that could be placed within the landfill footprint due to accelerated waste decomposition and stabilization. This air space gain could be up to 30 percent, but would more likely be 10 to 15 percent. Waste mass settlement is also a function of the depth of the waste mass, which is a function of the geometry of the landfill footprint. The long, narrow design of the Section IV landfill will limit the overall depth of waste compared to a more square footprint. There may also be some cost avoidance related to reduced leachate hauling and treatment if the cost to pump/apply the leachate is less than the disposal cost.

6.2.7 Screening Criteria to Select Preferred Technologies

Based on the above discussion, we have identified the following as the second level screening criteria:

- Applicability to Broome County solid waste stream.
- Commercial status of technology.
- Technical, environmental, and financial risks.
- Waste diversion potential.

Table 6-1 is a matrix that summarizes the application of these criteria to each of the shortlisted alternative technologies.

6.3 GENERAL COST COMPARISON

Based on the initial evaluation of alternative technologies for downstream diversion, Broome County requested a preliminary overall comparison of costs for each technology which would allow a comparison with current waste management approaches. As each alternative technology requires a minimum waste volume for the technology to be viable, a 500 TPD facility was selected to compare costs. As bioreactor landfills do not present an opportunity for diverting waste from landfill disposal, it was excluded from further consideration. Waste-to-energy facilities typically require a minimum of 1,000 TPD to be economically viable. Since Broome County does not generate that volume of waste and is not interested in importing waste, this technology was also excluded from further consideration. The cost for each remaining alternative technology will be compared with a $50/ton landfill tipping fee which represents the expected average cost of the current landfill disposal approach over the proposed planning period.

As a majority of the alternative technologies have limited full-size facilities in operation in the Untied States, the opinion of probable costs (both capital and operations) is based on information available in literature and Stearns & Wheler GHD/ R.W. Beck files. The following sections present our general opinion of probable costs for each of the three remaining alternative technologies.

6.3.1 Anaerobic Digestion

A. **Technology Options.** Most anaerobic digestion technologies are classified as either wet or dry. This processing technology reduces the volume of solid waste and recovers energy through the process. AD systems may be classified as follows:

- wet single-step
- wet multi-step
- dry continuous
- dry sequencing batch
- dry multi-step
- percolation (dry two-step)

Presently, there are several wet and dry AD systems commercially operating in Europe that use the organic fractions of MSW as feedstock. In addition, digesters have been used in the U.S. to manage biosolids and manures for several decades. However, there are no commercially operating facilities in the U.S. using the organic fraction of the MSW as feedstock.

Wet and dry systems are not typically used for the AD of the full MSW stream, but target the OFMSW. Wet systems are primarily designed to co-digest OFMSW with a liquid substrate, such as manure or sewage sludge. Because the Broome County disposed solid waste stream includes large quantities of both organics and biosolids, we have selected the wet AD system for further review. For purposes of this evaluation, we have identified a facility sized to process 220 TPD based on our characterization of the solid waste stream.

B. **Selected Technology for Cost Comparison.** For the purposes of a cost comparison, the wet AD system technology was selected based on the following considerations:

1. **Status of Technology.** Wet AD has been used in the U.S. for decades to manage manures and sewage sludge. It is presently used in Europe and Canada to manage OFMSW. For example, since 2002, the City of Toronto has been operating an anaerobic digestion facility at its Dufferin solid waste transfer station using the BTA technology, a wet two-step process. There are several other commercially operating AD facilities in Europe that are co-digesting OFSWM (e.g., yard waste, kitchen waste, and compostable paper) with sewage sludge.

2. **Regulatory Acceptance**. Wet AD has been permitted as a management approach for biosolids in the U.S., including New York. Therefore, the technology is understood by the regulators, but its application to the organic fraction of the MSW would require additional information and analysis. The technology also fits within the State's Solid Waste Management Hierarchy to Reduce, Reuse, and Recycle.

3. **Operating Flexibility**. Wet AD co-digesting systems accept a range of OFMSW and sludges for processing. The proposed technology includes some up-front processing to remove the contaminants and optimize the process. Feedstock may include source separated organics (food waste), biosolids, non-hazardous liquid waste, paper sludge, yard waste, and non-recycled organic material such as soiled paper or cardboard. Thus, some flexibility exists in both the type of materials and the proportional mix of organics that can be processed.

4. **Landfill Preservation/Diversion Goals**. Wet AD systems accepting targeted OFSWM and sludges typically divert up to 80 percent of the materials processed from landfill disposal through volume reduction, composting of the

solids, and reuse and/or land application of the process water. Keys to maximizing landfill diversion include finding markets for the compost by-product and process water. The compost by-product can be used as soil conditioner. The process water and its constituents need to be evaluated prior to identifying reuse opportunities.

C. **Cost Considerations.** When evaluating the economic viability of alternative waste processing technologies, the basic business model holds true as for many industrial facilities. There is the need for a raw product (feedstock), preparation of the raw product (feedstock mixing and preparation), management of residual products (nonprocessibles), consistent and reliable processing methods and controls (the AD process), the marketing and distribution of the final end products (compost/biogas/process water), and applicable regulatory compliance and reporting (environmental controls).

In addition, it must also be recognized that AD facilities utilize a biological process that must be applied consistently within the system. Unlike landfills, these facilities cannot accept more waste than what they are designed to process. Landfill operators have the ability to accept a wide range of daily volumes of waste. For example, the Broome County landfill can accept 500 or 750 TPD without significant disruption to its operations. However, an anaerobic facility designed to accept 220 TPD of materials cannot accept 500 TPD of materials since the throughput volume is limited and the organics would not be adequately processed.

D. **Preliminary Cost Evaluation for Screening Purposes.** To determine if this technology is worthy of further economic evaluation, a preliminary cost review was completed based on reported costs for similar AD facilities, published articles, and technical presentations at waste conferences. However, it should be noted there are no commercially operating facilities in the U.S.

The purpose of this screening is to determine if the range of cost for an AD facility compares favorably with Broome County's existing landfill disposal cost, which is estimated at $50/ton over the planning period. This analysis is not intended to determine if an AD facility is a viable option for Broome County. The intent is to determine if this technology is potentially economically viable as an option to the County for increasing reuse and recycling opportunities and thus should be further evaluated through a more detailed cost analysis.

The following is a summary of the preliminary cost evaluation completed as part of this task based on processing 220 TPD of solid waste composed of OFMSW and wastewater sewage sludges.

1. **Facility Processing Input (Feedstock)**

   a. OFMSW – 120 TPD (42,000 tons per year [TPY]).[3]

   b. The OFMSW projected quantity includes the following segments of Broome County's MSW stream:

      - Compostable paper
      - Food waste
      - Yard waste
      - Diapers
      - Other organics

   c. WWTP Sludges – 100 TPD (35,000 TPY).

   d. Total – 220 TPD (77,000 TPY).

2. **Facility Processing Outputs**

   a. Fiber (solids from digestate for composting) – 60 TPD (21,000 TPY) .
   b. Filtrate (liquids in digestate) – 140 TPD (49,000 TPY).
   c. Preprocessing residuals for landfill disposal -10 TPD (3,500 TPY).
   d. Biogas – 3,000 cubic feet per ton of waste (70,000,000 cubic feet per year).

3. **Site Requirements**

   a. Buildings – 2 to 4 acres.
   b. Land Requirements – 7 to 10 acres.
   c. Electricity – Varies.

4. **Summary of Facility Components.** The following is a summary of the key components required:

[3] Quantities of organics composing the OFMSW were estimated using the waste characterization developed as part of the solid waste plan.

a. Waste pre-processing area, to remove materials that cannot be anaerobically digested (such as metals, glass, and concrete) to pre-process the remaining materials into a uniform feedstock and adding the sludges providing moisture to form a slurry in the digester.

b. Anaerobic digester, where large organic compounds are broken down into smaller compounds in an airtight vessel called a reactor or digester. The biogas produced by AD can be used with minimal treatment in boilers to generate heat and in reciprocating engines or turbines to generate electricity. If the gas is purified, it can be used in place of natural gas or compressed natural gas as a vehicle fuel.

c. Gas flaring, steam, and/or power generation using the digester as a fuel.

d. Emissions control on units combusting the gas produced.

e. Residue composting and beneficial use.

5. **Capital Cost Consideration**

a. Costs adjusted to reflect 2009 Cost Index.

b. Economies of scale are applicable depending on size and optimization of equipment throughput.

c. The estimated capital costs for an AD facility of 77,000 TPY are $250 to $275 per ton of annual capacity.[4]

d. Estimate for a 220 TPD MSW AD facility including (42,000 TPY MSW + 35,000 TPY sludge = 77,000 TPY) is $25,000,000 to $35,000,000.

6. **Operation and Maintenance Cost Considerations**

a. Personnel costs for 5 to 10 staff.
b. Facility operates seven days per week.

[4] This is a planning level estimate based on R.W. Beck studies conducted for King County, Washington; Hawaii County, Hawaii; and Linn County, Iowa. There is very limited publicly available data.

c. Includes utilities, materials, equipment rentals, environmental monitoring, reporting, equipment maintenance.
d. Include a capital replacement fund of $500,000 per year.
e. Electrical costs at $0.12/kw-hour.
f. Residual disposal cost of $50/ton
g. No host community fee considerations.

7. **Gross Cost on Equivalent Per Ton Basis**

a. Operating costs - $55 to $65/ton.

b. Capital cost amortized over 20 years at 4 percent interest (public finance) equals $24 to $34/ton.

c. Gross operating cost, including debt retirement: $79 to $99/ton.

8. **Potential Annual Revenue Streams**

a. Sale of biogas for direct end use or power purchase agreement using relevant electric utility renewable energy pricing – potential of $500,000 to $1,000,000 net revenue depending on selected market (energy credits and other tax credits not considered).

b. Sale of compost assumed to be offset by cost of building material and mixing/handling.

c. Total Gross Revenue Potential: $6.50 to $13.00/ton

9. **Net Cost on Equivalent Per Ton Basis.** $72 to $86/ton.

E. **Results of Preliminary Screening.** The preliminary results of the screening process for AD reflect that the gross operating costs are higher than the County's current $50/ton tip fee cost. Based on the cost analysis, AD is not competitive as an option for increasing diversion and recycling opportunities unless the potential revenue streams can be increased to address the net cost differential.

6.3.2 Gasification

A. **Technology Options**. In addition to the traditional thermal conversion technology of WTE, thermal conversion alternatives include several emerging technologies as outlined in the previous discussion. The emerging thermal conversion technologies discussed in the previous section included pyrolysis, conventional gasification, plasma arc, and advanced thermal recycling.

Pyrolysis and gasification are not new technologies, having been used in the coal industry since the early 20th Century. Plasma arc has been applied in an industrial setting to manage hazardous waste for decades. Advanced thermal recycling represents second generation combustion-to-energy technology that has recently been considered for MSW. All of these technologies have been applied in other parts of the world, such as Japan and Europe, but there are no commercially operating facilities in the U.S. However, there are operating demonstration plants and commercial facilities in the planning stage in the U.S.

Because of the lack of commercially operating facilities in the U.S., cost data is very limited. Through work that Beck has conducted for other clients, we have gathered some preliminary planning level capital and O&M cost information based on previous discussions with suppliers of various gasification technologies. It is worth noting the County would likely need to consider the import of applicable waste streams from outside the County to take advantage of the needed economies of scale for conventional gasification to be considered competitive.

For purposes of this evaluation, we have selected conventional gasification for further review because there are commercially operating facilities in Europe and demonstration facilities in North America.

B. **Selected Technology for Cost Comparison.** For the purposes of a cost comparison, conventional gasification technology was selected based on the following considerations:

1. **Proven Technology.** This emerging technology has a commercially operating status in Europe and Japan. In addition, there are demonstration facilities in the U.S. that reflect that this emerging technology offers potential. Several facilities are planned for development in the U.S. in the future and should offer a frame of reference for additional consideration.

2. **Regulatory Acceptance**. As the technology evolves, the permitting issues will be clarified. Gasification technology has been applied in other energy production settings providing relevant information for the regulators. The key issues are the air emissions and management of the slag/ash.

3. **Operating Flexibility**. Conventional gasification offers operating flexibility because it can process most all of the MSW stream with limited materials considered non-processible. Moreover, some of the other emerging technologies such as plasma arc typically require more materials pre-processing and greater energy input for application of the technology.

4. **Landfill Preservation/Diversion Goals**. For conventional gasification, up to 90 percent of the incoming waste stream may be diverted from landfill disposal. Fly ash from the emissions control system is the primary process residue that may need disposal. The slag resulting from the gasification process has beneficial reuse potential in building and road materials. Thus, Broome County could extend the life of the existing landfill while significantly increasing recycling and reuse as a management strategy.

6.3.3 Cost Considerations

A. **Preliminary Cost Evaluation for Screening Purposes.** To determine if this technology is worthy of further economic evaluation, a preliminary cost review was completed based on reported costs for similar types of conventional gasification facilities, published articles, and technical presentations at waste conferences. The purpose of this screening is to determine if the range of costs for conventional gasification compares favorably with Broome County's existing landfill disposal cost, which is estimated at $50/ton over the planning period. This analysis is not intended to determine if gasification is a viable option for Broome County. It is intended to determine if this technology is potentially economically viable as an option to the County for increasing reuse and recycling opportunities and thus should be further evaluated through a more detailed cost analysis.

The following is a summary of the preliminary cost evaluation completed as part of this task based on processing 500 TPD of MSW.

1. **Facility Processing Input (Feedstock).** MSW – 500 TPD (175,000 TPY).

2. **Facility Processing Outputs.** Conventional gasification has the potential to reduce the volume of materials received by up to 90 percent. Various

process outputs are provided below. Specific quantity estimates are not provided because of the lack of reliable materials flow data.

a. Syngas.
b. Ash/char.
c. Non-processibles.
d. Recyclable metals .

However, it is anticipated that non-processibles needing landfilling will compose approximately 5 to 10 percent of the throughputs by weight.

3. **Site Requirements**

a. Buildings – 3 to 5 acres.
b. Land Requirements – 10 to 15 acres.
c. Electricity – Varies.

4. **Summary of Facility Components.** The following is a summary of the key components required:

a. Waste pre-processing area, to remove materials that cannot be thermally degraded (such as metals, glass, and concrete) and some pre-processing of the remaining materials into a uniform feedstock.

b. Reactor/gas refining, where gasification reactions occur and the resulting product (gases, oils) is refined, as needed, to produce gas of suitable quality. The gas produced is often referred to as "synthesis gas" or "syngas," because it is predominantly a combination of methane and hydrogen.

c. Power generation or chemical production using the syngas and/or oils as a fuel or feedstock. Unrefined or minimally refined gas can be burned directly in boilers with heat recovery to produce steam for electricity generation. More refined gas can be used in reciprocating engines, gas turbines, or for chemical production.

d. Emissions control on units combusting the gas produced.

e. Ash, char, or slag handling and disposal.

5. **Capital Cost Consideration**

   a. Costs adjusted to reflect 2009 Cost Index.

   b. Economies of scale are applicable depending on size and optimization of equipment throughput.

   c. For conventional gasification facilities, planning level capital cost ranges from $150,000 to $180,000 per ton of daily capacity.

   d. Estimate for a 500 TPD MSW gasification facility is $75,000,000 to $92,500,000.

6. **Operation and Maintenance Cost Considerations**

   a. Personnel costs for 15 to 20 staff.
   b. Facility operates seven days per week.
   c. Includes utilities, materials, equipment rentals, environmental monitoring, reporting, equipment maintenance.
   d. Include a capital replacement fund of $ 500,000 per year.
   e. Electrical costs at $0.12/kw-hour.
   f. Residual disposal cost of $50/ton
   g. No host community fee considerations.

7. **Gross Cost on Equivalent Per Ton Basis**

   a. Operating and Maintenance Costs - $60 to $70/ton (based on data from demonstration facilities without facility scale-up).

   b. Capital cost amortized over 20 years at 4 percent interest (public finance) equals $32 to $38/ton.

   c. Gross operating cost, including debt retirement: $92 to $108/ton.

8. **Potential Annual Revenue Streams**

   a. Power purchase agreement with renewable energy pricing – Potential for $2,000,000 to $5,000,000 in net revenues depending on end-use markets (energy credits and other tax credits no considered).

b. Gross Total Revenue Potential: $12 to $30/ton.

9. Net Cost on Equivalent Per Ton Basis: $70 to $85/ton.

B. **Results of Preliminary Screening.** The preliminary results of the screening process for conventional gasification reflect that the gross operating costs are higher than the County's current $50/ton tip fee cost. Based on the cost analysis, conventional gasification is not competitive as an option for increasing diversion and recycling opportunities unless the potential revenue streams can be increased to address the net costs differential.

6.3.4 Enhanced MSW Composting

As part of the evaluation of alternative technologies, enhanced MSW composting included two potential management strategies that could expand the County's current yard waste composting operations and increase diversion opportunities. The first was the expansion of yard waste composting with the addition of other organics on a small-scale basis, and the second was through a large-scale commercial MSW composting facility. As a result of the Diversion Strategies Work Session held on July 14, 2009, the Broome County Division of Solid Waste recognized that an enhanced yard waste composting strategy was a potentially viable option, with relatively modest capital investment and risk, and thus should be further considered under the Local Solid Waste Management Plan. It was also agreed that while the economic advantages of MSW composting were not immediately apparent, it does offer a comparative basis to other alternative waste diversion technologies. As a next step in the evaluation process of alternative diversion technologies, a screening of cost considerations was completed to compare the County's current solid waste management operating costs with other alternative technologies, including MSW Composting.

A. **Technology Options.** There are a variety of composting processes for Municipal Solid Waste (MSW) that has been used throughout the world with varying degrees of success. These include:

- In-vessel aerated systems (containerized processes).
- Aerated static systems on pads (outdoor facilities),
- Aerated static systems with fabric covers (outdoor windrows covered with fabric).
- Rotary drum aerobic systems (fully enclosed within buildings).

All of these options apply the basic principles of composting: feedstock preparation, active maturation of the compost (mixing with the addition of air and water), curing, storage, residuals disposal, and compost marketing and sales. However, large-scale MSW composting results in material handling challenges and associated environmental mitigation challenges that are not as easily managed as some of the less automated compost technologies. Therefore, for the purposes of this evaluation, the rotary drum composting technology (large-scale composting) will be evaluated since there is a similar recently developed project in New York State that is currently operating in Delaware County, NY.

B. **Selected Technology for Cost Comparison.** For the purposes of a cost comparison, the rotary drum composting technology was selected based upon the following considerations:

1. **Proven Technology**. Although rotary drum composting has been utilized dating back to the early 1960s, its success was often dependent on the cost for alternative local disposal options, such as landfilling. Where facilities needed to compete on a "tip fee basis" against relatively low landfill cost, the success rate was poor since capital investments and operating controls relating to compost quality and odor management were less than adequate. Over the past 20 years, owners and operators of MSW composting facilities have made proper capital investments, and a number of successful projects are currently in operation. The compost process works and is technically and economically manageable. Today there are approximately a dozen MSW Composting projects operating in the United States, with a number of additional facilities in Europe and Australia.

2. **Regulatory Acceptance**. The rotary drum composting process has been successfully permitted in New York State through the NYSDEC. While the details of each project are unique in terms of site access, environmental sensitivities, public considerations, access, etc., the 6 NYCRR Part 360 Solid Waste Regulations are clear with respect to permitting requirements. Thus, the time needed to receive a permit is reasonable and can be significantly less than a new landfill permit. The technology also fits within the State's Solid Waste Management Hierarchy to Reduce, Reuse, and Recycle.

3. **Operating Flexibility**. MSW composting facilities can accept a wide range of feedstock without disrupting the composting process. Feedstock could include MSW, source separated organics (food waste), biosolids, non-

hazardous liquid waste, paper sludge, yard waste, and non-recycled organic material such as soiled paper or cardboard. The technology does not require pre-sorting and can integrate effectively with existing recycling programs and strategies. It also allows operators to maximize their recycling revenue by focusing on high-value recyclables while capturing a significant volume of organic materials for reuse.

4. **Landfill Preservation/Diversion Goals**. For MSW co-composting facilities (MSW and biosolids), less than 30 percent of the incoming waste stream is sent to the landfill after processing (the inorganic fraction). The material is also inert, resulting from the removal of organics, and thus reduces the amount of contaminants within the landfill leachate. This means that Broome County could extend the life of the existing landfill by a factor of three while significantly increasing recycling and reuse as a management strategy.

C. **Cost Considerations.** When evaluating the economic viability of alternative waste processing technologies, the basic business model holds true as for many industrial facilities. There is the need for a raw product (feedstock), preparation of the raw product (feedstock mixing and preparation), management of residual products (inorganics), consistent and reliable processing methods and controls (the compost process), the marketing and distribution of the final end product (soil amendment/ compost), and applicable regulatory compliance and reporting (environmental controls). The primary difference with MSW composting facilities is that most of the revenue generation occurs through the acceptance of the raw product (feedstock) with limited revenue resulting from the final product. The paradigm shift in this business model leads to an important consideration for these facilities – revenue generation from multiple types of feedstock versus a consistent raw product. This offers both opportunities and challenges for MSW composting facilities. However, operating costs and the establishment of “tip fees” are usually based on a variety of feedstock and estimates of volume processed on an annual basis. Therefore, the greater variety of feedstock that can be processed provides for greater opportunities for revenue.

In addition, it must also be recognized that MSW composting facilities utilize a biological process that must be applied consistently from day to day. Unlike landfills, these facilities cannot accept more waste than what they are designed to process. Landfill operators have the ability to accept a wide range of daily volumes of waste. For example, the Broome County landfill can take 500 or 750 TPD without significant disruption to its operations. However, an MSW composting facility designed to accept

500 TPD of MSW cannot accept 750 TPD of MSW since the throughput volume is limited and the organics would not be adequately processed.

D. **Preliminary Cost Evaluation for Screening Purposes.** To determine if this technology is worthy of further economic evaluation, a preliminary cost review was completed based on reported costs for similar MSW compost facilities, published articles, and technical presentations at waste conferences. The purpose of this screening is to determine if the range of cost for an MSW composting facility compares favorably with Broome County's existing landfill disposal cost, which is estimated at $50/ton over the planning period. This analysis is not intended to determine if MSW composting is a viable option for Broome County; it is simply intended to determine if this technology is potentially economically viable as an option to the County for increasing reuse and recycling opportunities and thus should be further evaluated through a more detailed cost analysis.

The following is a summary of the preliminary cost evaluation completed as part of this task based on a "prototype facility" processing 500 TPD of MSW.

1. **Facility Processing Input (Feedstock)**

   a. MSW – 500 TPD (175,000 TPY).
   b. WWTP Sludges – 100 TPD (35,000 TPY).
   c. Liquid Waste – 100 TPD (35,000 TPY).

2. **Facility Processing Outputs**

   a. Compost – 125 to 150 TPD (50,000 TPY).
   b. Residuals for Landfill Disposal – 150 TPD (50,000 TPY).
   c. Recyclable Metals – 10 TPD (3500 TPY).
   d. Waste Liquids – 0.

3. **Site Requirements**

   a. Buildings – 6 to 8 acres.
   b. Land Requirements 13 to 15 acres.
   c. Electricity – 1.0 to 1.3 MW.

4. **Summary of Facility Components**

   a. Fully enclosed waste receiving area with three days storage for MSW.
   b. Sludge receiving area.
   c. Operator controls and automated instrumentation systems.
   d. Waste feeding systems.
   e. Rotary drum for waste processing.
   f. Conveyance and transfer systems.
   g. Active compost aeration system (windrows, concrete wall, aeration systems, mixing equipment, and support systems),
   h. Compost refining systems and equipment.
   i. Curing and storage area
   j. Air handling and odor control systems, including dust collection and odor treatment.
   k. Post-sorting area for capture of recyclable metals.
   l. Building and support systems.
   m. Site access and site stormwater management features.

5. **Capital Cost Consideration**

   a. Cost adjusted to reflect 2009 Cost Index.

   b. Economy of scale is noted incrementally depending on size and optimization of equipment throughput.

   c. For larger MSW composting facilities, capital cost ranges from $280 to $300/ton of annual capacity (for small facilities it increases to $450 to $550/ton).

   d. Estimate for a 500 TPD MSW compost facility including sludge processing (175,000 TPY MSW + 35,000 TPY sludge = 210,000 TPY) is $58,000,000 to $63,000,000.

6. **Operation and Maintenance Cost Considerations**

   a. Personnel costs for 25 to 30 people.
   b. Facility operates seven days per week.
   c. Includes utilities, materials, equipment rentals, environmental monitoring, reporting, and equipment maintenance.
   d. Include a capital replacement fund of $200,000 per year.

e. Electrical costs at $0.12/kw-hour.
f. Residual disposal cost of $50/ton.
g. No host community fee considerations.

7. **Gross Cost on Equivalent per Ton Basis**

a. Capital cost amortized over 20 years at 4 percent interest (public finance).

b. Residual value for facility at the end of the 20-year finance period of 35 percent.

c. Estimated gross cost on an annual basis: $10,500,00 to $11,500,000.

d. Estimated annual processing fees for privatized operator: $3,000,000 to $3,500,000 (before taxes).

e. Gross operating cost, including debt retirement: $64 to $72/ton.

8. **Potential Annual Revenue Streams**

a. Compost Sale: Assumes 30 percent of incoming waste stream at $3 to $10/ton = $262,500.

b. Total Gross Revenue Potential: $1 to $3/ton.

9. Net Cost on Equivalent Per Ton Basis: **$63 to $69/ton**

D. **Results of Preliminary Screening Process.** The preliminary results of the screening process for MSW composting show that gross operating costs are approximately 20 percent higher than the County's projected $50/ton tip fee cost, but are competitive with tipping fees in other portions of the Northeast United States that range between $65 and $80 per ton. As an option for increasing diversion and recycling opportunities, MSW composting appears to offer some potential, but not without significant capital investment. As a future consideration, MSW composting may be a reasonable alternative and worthy of additional evaluation in terms of specific site considerations and site suitability, costs, integration of existing County programs, comparative long-term economic value, landfill life considerations, and risk assessment. However, given the County's past and present capital investments, personnel experience, and operations success related to solid waste landfill disposal, a phased organics diversion and recycling strategy would integrate more effectively with the County's existing programs.

6.4 Conclusion and Recommendations

Considering a variety of outputs from the alternative technology evaluation process, including:

- required tonnage
- required feedstocks
- applicability to the waste stream
- diversion potential
- environmental considerations
- residuals management
- commercial viability
- anticipated costs

it appears that organics processing through enhanced composting presents the best technological, economical, and environmental option for increasing downstream waste diversion for Broome County. Anaerobic and thermal conversion technologies do not appear as viable or cost effective. However, this evaluation of alternative technologies, including the general cost comparison, was originally developed as a potentially significant downstream diversion approach. As the actual evaluation progressed and further discussions/work sessions were held, it became evident that a major program change from the current landfill approach, which is currently more cost effective, was not likely. As a result, a more modest, sequenced, and scalable approach was considered for Broome County. An approach that focuses on organics would satisfy both the County's interest in increasing recycling and diversion and NYSDEC's interest in organics diversion.

In keeping with enhanced composting as the preferred technology, this approach would most likely begin with expansion of the existing yard waste composting program. The first step in expanding the existing program would be the addition of food waste (pre-consumer) or biosolids. The addition of pre-consumer food waste from institutions (universities, prisons) and commercial enterprises (grocery stores, processors) typically represents the least contaminated (and therefore most cost effective) source of food waste for composting. Collection of pre-consumer food waste would also require the least change to current collection practices. In addition, the County has had some initial discussions related to the economic viability of a County-wide biosolids management facility.

The volume of food waste or biosolids that could be diverted will be a function of the volume of bulking agent (brush/yard/wood waste) that is available. Based on approximately 450 tons of yard waste disposal per year, approximately 300 tons of food waste or biosolids could be processed annually without importing bulking material. This tonnage would be appropriate for an initial demonstration project. In order to expand processing capacity, Broome County could integrate biosolids disposal with wood waste disposal for interested municipalities.

Typically, a biosolids composting facility would be enclosed to minimize management of odor and other environmental impacts (such as leachate). Low volume food waste composting would not typically require completely enclosed facilities. However, the Federal Aviation Administration has expressed their concern with composting facilities and the potential to attract vectors compared to current open landfilling. Considering the processing capacity available with current wood waste tonnage, vector concerns, and other food waste/biosolids composting facilities in the region, an initial, outdoor, demonstration composting facility may be an appropriate first step in pursuing additional downstream organics diversion. A project of this nature would be pursued to demonstrate required mix ratios, processing options, processing times, finished product quality, the potential for vector attraction, and required environmental impact management.

For a demonstration project, a “low tech” approach to material processing could be used that would utilize the County’s existing equipment. Broome County currently owns a tub grinder, windrow turner, and screen. This equipment, along with a front-end loader, could be adequate to operate a static, turned windrow demonstration facility depending on the nature of the food waste. As part of the demonstration, Broome County could also employ a forced aeration static pile processing approach by adding blowers and piping, in lieu of turning windrows, to compare the two processes. Biosolids and food waste could be composted separately and together to evaluate individual and combined processing details. If this first step of enhanced composting shows promise, the next step in expanding organics diversion could be to construct a larger, enclosed composting facility that utilizes more process controls and automation. The nature of that facility (size, feedstock, processing capacity, processing approach, type of enclosure, etc.) would be determined as part of the demonstration project.

Further expansion of enhanced composting as an alternative technology would require the diversion of more organic waste from the MSW stream. Inclusion of source separated organic waste is one option for capturing organic material. However, during evaluation of upstream diversion opportunities (via the issue papers), an organic waste diversion or green bin approach did not receive a high ranking. As a result, processing the MSW stream may present a more cost-effective approach for significant capturing and diverting organics from the landfill.

Based on the above discussion, we have identified a "Phased Organics Diversion Strategy" that begins with the County's existing yard waste composting program (the baseline) and builds upon the program as follows:

- A demonstration project that utilizes a forced aeration composting method for processing yard waste and food waste or biosolids.

- A full-scale (outdoor) forced aeration composting operation to process 100 percent of the County's existing yard waste (as currently delivered to the site) and food waste or biosolids.

- A fully enclosed composting facility to process 100 percent of the County's existing biosolids that is expandable for processing additional organic feedstock.

Table 6-2 presents a summary of the incremental costs associated with the proposed Phased Organics Diversion Strategy.

TABLE 6-1

ALTERNATIVE SOLID WASTE REDUCTION TECHNOLOGIES MATRIX

TECHNOLOGY	APPLICABILITY TO BROOME COUNTY WASTE STREAM	COMMERCIAL STATUS	RISKS (I.E., TECHNOLOGY, ENVIRONMENTAL, FINANCIAL)	WASTE DIVERSION POTENTIAL
Anaerobic Digestion (AD)	The overall waste stream is composed of nearly 70 percent of organics including, but not limited to, food waste, yard waste, paper, and wood. This estimate excludes the yard waste that is separated from the mixed refuse by homeowners and businesses. AD can be applied to this fraction of the waste stream to convert organics into biogas and digestate (i.e., solid residues).	A few pilot facilities using MSW as feedstock have operated in the U.S. in the past. The wastewater treatment industry has used AD to manage biosolids and generate biogas for decades. There are more than 100 commercially operating facilities using the organic fraction of the MSW stream and/or organic industrial wastes located in Europe, with a few in other locations, including Canada.	Technology risks may include inadequate materials processing because of an underperforming digestion process caused by contaminated feedstock, inadequate moisture content, etc. Environmental risks may include odor from pre-processing and/or digestion activities; exceeding air emissions limits when using the biogas as a fuel; and the inability to site a facility due to perceived threats to water, air, and property values. Financial risks may include lack of markets for biogas and/or residues and failure to receive adequate quantities of materials to ensure needed economies of scale.	Volume reduction is projected up to 75 percent assuming the pre-processing of the feedstock to remove non-organics and the beneficial reuse of digestate. Without beneficial use of the digestate, the potential volume reduction is projected to be approximately 50 to 60 percent.

TABLE 6-1 (continued)

TECHNOLOGY	APPLICABILITY TO BROOME COUNTY WASTE STREAM	COMMERCIAL STATUS	RISKS (I.E., TECHNOLOGY, ENVIRONMENTAL, FINANCIAL)	WASTE DIVERSION POTENTIAL
Pyrolysis/ Gasification	This technology process converts the carbon-based portion of the waste stream into a syngas that can be used to generate electricity or fuels. The organic content, which is carbon- based, composes approximately 70 percent of the waste stream. The carbon content of the overall waste stream would exceed this value.	There are a handful of commercially operating gasification plants operating worldwide using MSW as feedstock. A small number of pilot facilities reportedly are operating or have operated in the U.S. using pre-processed MSW as feedstock to produce syngas. Operating data is very limited for the application of this technology to MSW; therefore, this technology is not considered fully commercialized. The technology has been used for other types of feedstock, such as coal and uniform types of biomass. Plasma arc thermal gasification, a variation of conventional gasification, has reportedly been used in Japan to manage pre-processed MSW and other types of homogeneous solid wastes, such as auto shredder fluff in commercially proven settings.	Technology risks may include inadequate materials processing because of underperforming gasification process due to lack of uniform feedstock and/or issues associated with scaling up demonstration projects. Environmental risks may include odor at the pre-processing stage; air emissions when using the syngas as a fuel in a boiler; disposal of residues (i.e., char, silica, slag, and ash); and inability to site a facility due to perceived threats to water, air, and property values. Financial risks may include lack of markets for sales of syngas and uncertain capital and operating costs due to lack of full-scale projects with MSW as the feedstock.	Volume reduction for pyrolysis/ gasification can reach up to 90 percent with limited pre-processing. However, limited operating data using MSW as feedstock exists to confirm this projection.

TABLE 6-1 (continued)

TECHNOLOGY	APPLICABILITY TO BROOME COUNTY WASTE STREAM	COMMERCIAL STATUS	RISKS (I.E., TECHNOLOGY, ENVIRONMENTAL, FINANCIAL)	WASTE DIVERSION POTENTIAL
Waste-to-Energy (WTE)	The overall waste stream is composed of approximately 85 percent combustible materials by weight.	MSW combustion is a fully commercialized processing technology with nearly 90 WTE projects (mass burn and RDF) operating in the U.S. alone. Many others are operating throughout the world. Most of the facilities in the U.S. are sized to process, on average, approximately 1,000 tons per day. Some smaller WTE facilities of less than 250 TPD (i.e., limited economies of scale) are operating in the U.S, but in many instances struggle to remain economically competitive with landfill disposal options. In the last decade, many of these smaller WTE facilities have had to be retrofitted for additional air pollution control equipment, which has dramatically increased overall costs.	Technology risks may include inefficient energy production due to waste variability, as well as excessive unscheduled maintenance. Environmental risks may include odor at tipping floor/pre-processing stage; exceeding of air emissions limits (including dioxins and furans); metals in ash; and inability to site a facility due to perceived threats to water, air, and property values. Financial risks may include large capital costs, variable operating costs, and variability in energy sales.	Volume reduction for WTE facilities is 75 to 80 percent, depending on the type of technology and system used.

TABLE 6-1 (continued)

TECHNOLOGY	APPLICABILITY TO BROOME COUNTY WASTE STREAM	COMMERCIAL STATUS	RISKS (I.E., TECHNOLOGY, ENVIRONMENTAL, FINANCIAL)	WASTE DIVERSION POTENTIAL
Enhanced Composting	**A. Expanded Organics Composting with the Existing Yard Waste Composting Operations**			
	◗ Readily available wastewater sludges ◗ Institutional food waste is available ◗ Potential partnering opportunities with SUNY Binghamton or other schools and institutions	◗ The Northeast U.S. is primarily focused on yard waste, but communities are recently adding other source-separated organics, such as food waste (e.g., OCRRA). ◗ The western region of the U.S. is very active, with nearly 70 food waste composting facilities spread throughout 6 states.	◗ Outdoor odor management ◗ Reliability of consistent feed stock ◗ Public perception of dangers of biosolids ◗ Risk of compost sales	◗ Over 90 percent of the material processed, but at lower volumes
	B. MSW Composting			
	◗ Single stream process to convert organic content of MSW to compost ◗ Integrates easily with existing recycling and collection programs ◗ Eligible for Carbon Credits *Other:* New York State is considering incentives for removing organics from landfills (Europe has already implemented organics waste bans to landfills).	◗ 13 operating facilities in the U.S. ◗ One operating facility in New York State (fully permitted through NYSDEC regulations)	◗ Odor control management ◗ Worker health and safety ◗ Siting challenges at the landfill site with the FAA ◗ Perceptions of compost quality and available markets ◗ Capital reinvested over the long term	◗ 60 to 75 percent of the incoming MSW; high volume processing

TABLE 6-1 (continued)

TECHNOLOGY	APPLICABILITY TO BROOME COUNTY WASTE STREAM	COMMERCIAL STATUS	RISKS (I.E., TECHNOLOGY, ENVIRONMENTAL, FINANCIAL)	WASTE DIVERSION POTENTIAL
Bioreactor Landfills	Applies to waste already in place. Applicable to Section IV landfill cells. Previous leachate recirculation demonstration in Section II/III landfill. Increased landfill gas generation rate may not directly benefit the County.	Majority of current projects are in the pilot/ demonstration stage. Long-term cost/benefit still being evaluated.	Risks are primarily operational and include increased cost compared to current operations, increased odors, decreased stability, increased surface seeps, and potential for fires (aerobic operation).	None, but can increase air space by 10 to 30 percent, probably closer to 10 to 15 percent.

TABLE 6-2

INCREMENTAL COST SUMMARY FOR PHASED ORGANICS DIVERSION STRATEGY

PROGRAM ELEMENT DESCRIPTION	ORGANIC FEEDSTOCK TYPE AND VOLUME	INCREMENTAL CAPITAL COST INVESTMENT (△$)	INCREMENTAL OPERATION & MAINTENANCE COST (△$)	EQUIVALENT ANNUAL INCREMENTAL COST (△$/YEAR)	EQUIVALENT ANNUAL INCREMENTAL PROCESSING COST (△$/TON)
1. Existing Program: Outdoor composting of yard waste	Yard waste 450 tons/year	$0	Included within existing landfill operations cost.	N/A	N/A
2. Demonstration Project: Yard waste plus food waste or biosolids	Yard waste 300 CY (135 tons) Food waste or biosolids 100 CY (60-80 tons)	Temporary pad with blowers and air distribution system - approximately $30,000	$5,000/year	$35,000(1)	$167
3. Forced Aeration Outdoor Composting: 100 percent of existing yard waste plus food waste or biosolids	Yard waste 1,000 CY (450 tons) Food waste or biosolids 330 CY (300 tons)	Site development, pad, equipment, utilities, blowers, and air distribution system - approximately $250,000	$20,000/year	$45,000(2)	$70
4. Enclosed Composting Facility for 100 percent of County biosolids (with expandability to other feedstock)	Biosolids 20,000 tons Wood chips or sawdust 10,500 tons	Buildings, roadways, utilities, processing equipment, bulking agent, odor controls, etc. - approximately $8,000,000	$600,000/year	$1,200,000(3)	$60 (biosolids portion only)

(1) Assumes no financing and only a one-year demonstration period.
(2) Assumes 10-year financing at 5 percent interest.
(3) Assumes 20-year financing at 4 percent interest.

7.0 ENHANCEMENTS TO INTEGRATED SYSTEM

7.1 INTRODUCTION

The Broome County Division of Solid Waste Management is responsible for planning, developing, implementing, and sustaining public solid waste management programs and facilities on behalf of the County. These responsibilities also include education and public outreach efforts in order to encourage, support, and foster participation by the public with respect to reducing, reusing, and recycling portions of the existing solid waste stream. Historically, the County's solid waste programs have relied on both public and private participation to manage a variety of waste streams and recyclable products. These efforts have resulted in current recycling rates between 48 and 50 percent.

It is also the Division's mission to "provide our constituency (residents and businesses) with a comprehensive program for managing solid waste, which is consistent with New York State's Hierarchy for solid waste management, in an economically sound and environmentally safe manner." To this end, implementation efforts under the most recent Local Solid Waste Management Plan have focused on the following:

- Safe and reliable disposal of MSW.
- Recyclables acceptance and processing through contracts with private companies.
- Continued efforts with local municipalities and private haulers for residential MSW and recyclables transfer stations.
- Yard waste composting in support of the State's ban on yard waste disposal to the landfill.
- Periodic household hazardous waste collection for residents and small businesses.
- Periodic electronics recycling for residents and small businesses.
- Development of guidelines and educational materials in support of the County's programs, including a web site.
- Public outreach and assistance to businesses and institutions to assist in setting up recycling programs.

- Purchasing and distributing recycling yellow bin containers.

- Assistance with backyard composting, including compost bins for sale and distribution.

- Beneficially reusing “auto fluff” at the landfill as daily cover.

- Tracking and monitoring of recycling participation through mailers and telephone surveys.

As discussed in Chapter 4, Broome County has a variety of existing solid waste management facilities that are owned and operated by both public and private ventures. In addition, the County has taken steps to support State and Federal efforts to decrease toxins in the landfill and divert beneficially reusable materials or products from the landfill. These actions include the following:

- Per the federal Universal Waste regulations (40 CFR Part 273), wastes with toxic substances as defined in the Resource Conservation and Recovery Act (RCRA), Subtitle C are not permitted at the Broome County landfill.

- Supported New York State legislation to ban the sale of all products containing mercury.

- Supported New York State legislation to require all wireless telephone companies to take back cell phones from any supplier.

- Supported past and present Bottle Bill Legislation.

- Adopted local laws to ban yard waste from the landfill.

- Backyard composting is supported by the County by supplying educational materials and working with the Cornell Cooperative Extension (CCE) for outreach activities.

- The County encourages residents to engage in grasscycling and leaving grass clippings on the lawn.

- Promoting food donations to various locations around the County to help feed those in need and to divert organics from the landfill.

These programs are considered "upstream diversion activities" because they focus on preventing material from reaching the landfill. "Downstream diversion activities" are dedicated to processing, recycling, and marketing material brought to the landfill. Broome County is currently participating in the following downstream diversion programs:

- The Broome County landfill has a household hazardous waste (HHW) and an E-waste collection site where residents are able to drop off their materials on specified days each month year round. These wastes are processed by private companies.

- As mentioned above, banned yard waste is accepted by the county for composting at the Broome County landfill. The compost is available at no charge to Broome County residents while supplies last.

7.2 SELECTION OF PROGRAM EXPANSION OPTIONS FOR THE INTEGRATED SYSTEM

Given the County's existing programs, past and current investments, and future opportunities, the Division completed a series of team work sessions that evaluated past, present, and future solid waste management program elements and potential areas for improvement. In addition, New York State is currently developing draft guidelines for Local Solid Waste Management Plans based on a proposed policy framework that could also include increased requirements for organics diversion. As a baseline, the Division selected 2007 as a representative year to examine current operations, waste generation volumes, and recycling rates (2008 was considered to be impacted by economic slowdown and reduced waste volumes). Table 3-1 presents a summary of the estimated waste composition for the MSW that is delivered to the landfill and the reported recycling efforts that resulted in a County-wide recycling rate of 48 percent for 2007.

To increase recycling efforts, the Division was interested in further examination of upstream diversion opportunities (capture, control, and processing of recycling streams prior to disposal) and downstream diversion opportunities (alternative disposal and diversion through waste conversion technologies).

The following topics were selected for further consideration under upstream diversion opportunities:

1. Environmentally Preferable Purchasing (EPP) Practices & Recycled Content - Policy that encourages communities to purchase materials and services that offer specific environmental benefits.

2. Increase CII&M Recycling Participation – A target strategy directed at the largest generators or under-served portion of the County with respect to recycling efforts.

3. C&D Recycling – Source separation of demolition debris to remove reusable and recyclable products.

4. Use of Alternative Daily Cover (ADC) Materials at the Landfill – To beneficially reuse alternative materials in lieu of soils.

5. Franchising Collection Services – An option to further capture recyclables under a consistent collection system with uniform rate structures for customers.

6. Establishment of Collection Districts – An option that would allow the County to contract collection services by district in order to provide "best price" to customers and to specify collection and recycling requirements uniformly across the districts.

7. Expand the Existing Household Hazardous Waste (HHW) and Electronics Recycling – In consideration of growing demands for electronics disposal.

8. Pursue Zero Waste Options – A management philosophy that looks at materials and products from a cradle-to-grave approach to encourage 100 percent reuse.

9. Organics Diversion – Efforts to divert organics from the landfill through the participation of residents, businesses, and institutions.

10. Single Stream Recycling Collection Methods Bins Versus Carts – Consideration of larger recycling containers under a co-mingle collection system that could increase the participation and volume of recyclable products.

Issue Papers were then developed for each of the 10 topics listed above and are presented in Appendix B.

For downstream diversion opportunities, the following technologies were considered during an evaluation of alternative technologies:

1. Anaerobic digestion.

2. Thermal technologies, including gasification, pyrolysis, and plasma technologies.

3. Enhanced composting, including MSW composting.

4. Waste–to-energy.

5. Bioreactor landfill methods.

An evaluation of alternative technologies was then developed for each of the five technologies listed above and is presented in Chapter 6.

7.2.1 Selection Process

After the Issue Papers were developed, reviewed, and finalized, the Division of Solid Waste met to identify applicable ranking criteria and establish priorities within the Local Solid Waste Management Plan for implementation of upstream diversion strategies. It was determined that 11 specific evaluation criteria could be applied to the topics being considered, including:

1. The ability to extend the life of the landfill and optimize investments.
2. Promotion of financial stability over the life of the plan.
3. Life cycle cost considerations.
4. Potential environmental protection and mitigation opportunities.
5. Potential energy efficiency and carbon footprint reduction.
6. Impacts to existing public infrastructure (roads, bridges, etc.).
7. Support to standardized and efficient waste programs.
8. Practicality of implementation and enforcement considerations.
9. Technical and commercial viability.
10. Integration synergies with existing programs. and,
11. Flexibility to respond to markets and opportunities.

Based on the Issue Papers, facility assessments, ranking criteria, legal and institutional considerations, preliminary costs, project goals, and local considerations, the solid waste management team met to apply a weighting factor on a scale of 1 to 5 to each of the evaluation criteria. The results are summarized in Table 7-1. Like many solid waste managers across the country, the Broome County Division of Solid Waste believes that recycling and diversion activities are extremely important and thus the "spread" of the scores listed on the table is relatively small (a 3.5-point spread).

TABLE 7-1

SUMMARY OF RANKING AND WEIGHTING CRITERIA FOR UPSTREAM DIVERSION STRATEGIES

IP #	ISSUE PAPER TOPIC	SCORE	IMPLEMENTATION PERIOD
1	Environmentally preferable purchasing (EPP) and recycled content procurement policies	31.0	Years 10-20
2	CII&M recycling	31.5	Years 1-20
3	C&D debris recycling	28.0	Years 5-10
4	Alternative daily cover	29.0	Years 1-20
5	Franchising	30.8	Years 10-20
6	Collection (hauling) districts	30.8	Years 10-20
7	HHW and electronics recycling	29.5	Years 1-5
8	Zero waste	25.5	Years 10-20
9	Organics composting	28.5	Years 1-5
10	Residential recycling curbside bins and carts	29.0	Years 10-15

The team also recognized, however, that program changes take time to implement as well as time to grow participation. Therefore, the anticipated timing of implementation for these programs in order to prioritize efforts was further examined; in particular, which programs could more easily be integrated with current programs and which programs would require further evaluation, significant policy changes, or revisions to local laws prior to implementation. It was also determined that alternative daily cover options are evaluated on a continuous basis as part of the landfill options and do not require separate upstream diversion focus. The Division selected the following options for immediate consideration under the Local Solid Waste Management Plan (the next five-year horizon): (1) CII&M recycling; (2) HHW and electronics recycling; (3) C&D debris recycling; and (4) organics diversion.

Based on the results of the evaluation of alternative technologies, including preliminary cost assessments, the Division selected "enhanced composting" for the preferred downstream diversion opportunity as an extension of the existing yard waste composting efforts. This will allow the County to potentially compost wastewater treatment plant sludges currently being disposed of in the County landfill and could ultimately lead to a County-wide biosolids or food waste composting facility at the landfill.

7.2.2 Upstream Diversion Options

A. **CII&M Recycling.** This program expansion will focus on recycling collection programs at commercial and industrial sites; institutional facilities (i.e., schools, universities, hospitals, prisons, etc.); and multi-family buildings of five or more families. It is estimated that this program could encompass 6,000 to 7,000 building units. The potential to increase recycling participation is significant depending on the amount of staff time and funds that are dedicated to these efforts. Some of the challenges and program implementation needs are summarized in Table 7-2 (more detailed discussions are presented in Issue Paper No. 1 in Appendix B).

TABLE 7-2

SUMMARY OF INITIAL PROGRAM CHALLENGES FOR INCREASING CII&M RECYCLING RATES

CHALLENGE	PROGRAM IMPLEMENTATION ACTIVITIES	IMPLEMENTATION NEEDS
Lack of space in apartments, offices, and buildings for containers	Establish a CII&M building ordinance requiring recyclables storage in or near the building with individual containers available to transport materials to the central location	Dedicated staff time to work with Building Code Officer
High resident, manager, and building owner turnover rate	Track recycling programs for participation, educational and collaborative opportunities for each building	Dedicated staff time to outreach
Small incentive for building occupants to recycle	Survey building occupants to determine appropriate methods to encourage recycling in that building	Dedicated staff time to outreach
Ineffective recycling and waste education	Improve and advertise the county's solid waste website and information; produce and handout simple and innovative educational materials; provide buildings with appropriate signage	Dedicated staff time to outreach and educational materials
Lack of recycling regulations enforcement	Periodically monitor and analyze recycling data for a statistically significant number of buildings	Dedicated staff time and tracking software

B. **HHW and Electronics Recycling.** This initiative involves expansion of the County's existing HHW and E-waste program. HHWs are household products that contain corrosive, toxic, flammable, or reactive ingredients, warranting their diversion from the landfill, transfer stations, and other waste disposal sites in order to protect ground and surface waters from accidental release. E-wastes and HHW currently comprise about 1 percent of the MSW stream by volume and have high potential for harmful toxins to enter the surrounding groundwater. Regulations are already in place banning HHW from landfills, but this waste stream is not yet fully captured. Issues and methods to increase diversion are shown in Table 7-3.

TABLE 7-3

SUMMARY OF INITIAL PROGRAM CHALLENGES FOR
INCREASING HHW AND E-WASTE PARTICIPATION

CHALLENGE	PROGRAM IMPLEMENTATION ACTIVITIES	IMPLEMENTATION NEEDS
Limited hours of operation of HHW facility because of required staff involvement	Expand the County's HHW facility hours of operation and explore opening satellite collection sites, curbside pick up or a mobile collection unit	Dedicated staff time to increase hours of drop off locations
Low public and Small Business participation rates	Increase educational activities and encourage product stewardship programs	Dedicated staff time for outreach and educational materials
Small quantity and types of materials collected or managed at the facilities	Work with NYSDEC to find businesses that accept or have a demand for various HHW and E-Waste and work to expand facilities to store these products	Dedicated staff time for outreach and storage area
Large amount of usable products going to the landfill	Explore opening a reuse center for certain electronic items	Dedicated staff time to operate re-use center and storage area

C. **C&D Debris Recycling.** This program would encourage separation of C&D debris for recycling or reuse at the job site of a construction, demolition, or remodeling project. As more buildings are built to achieve LEED[5] accreditation, deconstruction verses demolition will increase since one of the LEED accreditation points involves utilization of recycled or reused construction materials. Table 7-4 highlights the issues and potential activities associated with C&D debris recycling.

[5] LEED (Leadership in Energy and Environmental Design): According to the U.S. Green Building Council website: LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

TABLE 7-4

SUMMARY OF INITIAL PROGRAM CHALLENGES FOR IMPLEMENTATION OF C&D DEBRIS RECYCLING (UPSTREAM)

CHALLENGE	PROGRAM IMPLEMENTATION ACTIVITIES	IMPLEMENTATION NEEDS
Small incentive to spend extra to save material	Increase public and construction workers' education and awareness of LEED certification and the benefits of green building. Promote public recognition programs for those that participate.	Dedicated staff time for outreach
More time and effort needed for deconstruction verses demolition	Increase public and construction workers' education; offer guidance or incentives for C&D recycling such as preferred disposal rates for non-recycled C&D after separation has occurred or for site MSW	Dedicated staff time for outreach and program cost for incentives (lost revenue)

D. **Organics Diversion.** This program would involve expansion of the current organics (yard waste, food scraps, wood waste) diversion program, including backyard composting, grasscycling, food donations, and small-scale vermicomposting (worm composting in containers). The primary issue associated with upstream diversion of organics is described in Table 7-5.

TABLE 7-5

SUMMARY OF INITIAL PROGRAM CHALLENGES FOR ENCOURAGING UPSTREAM DIVERSION OF ORGANICS

CHALLENGE	PROGRAM IMPLEMENTATION ACTIVITIES	IMPLEMENTATION NEEDS
Educating the public	Have an organics diversion team work with outreach groups to develop a comprehensive program to educate food waste generators and the general public	Dedicated staff time for outreach and educational materials

7.2.3 Downstream Diversion Options

A. **C&D Debris Recycling.** This program expansion opportunity is targeted for implementation in 5 to 10 years and would involve diverting C&D debris from the landfill by processing material on site. In 2007, the landfill accepted over 22,400 tons of C&D debris, of which 70 percent consisted of highly marketable materials (Tier 1 recyclables). Additional information is presented in Issue Paper No. 3 in Appendix B. Public, private or dual ownership is a possibility with this option. Table 7-6 identifies challenges that will need to be addressed prior to implementation of a C&D processing facility.

TABLE 7-6

SUMMARY OF INITIAL PROGRAM CHALLENGES FOR IMPLEMENTING DOWNSTREAM C&D RECYCLING

CHALLENGE	PROGRAM IMPLEMENTATION ACTIVITIES	IMPLEMENTATION NEEDS
Determination of waste composition of C&D debris	Identify space at the landfill to complete a C&D composition demonstration study, including rental of appropriate processing equipment. Explore opportunities for beneficial reuse of non-recycled materials as daily cover or bulking agents for compost operations.	Storage and processing equipment, staff time, and maintenance
Daily value variation of recyclable materials	Conduct a market assessment for materials as well as the site's potential recovery of recyclable materials	Dedicated staff time for research

B. **Organics Diversion.** Choosing the best downstream diversion activity involved considering a variety of outputs from the alternative technology evaluation process, including:

- required tonnage
- required feedstocks
- applicability to the waste stream
- diversion potential
- environmental considerations
- residuals management
- commercial viability
- anticipated costs

It appears that organics processing through enhanced composting presents the best technological, economical, and environmental option for increasing downstream waste diversion for Broome County. Anaerobic and thermal conversion technologies do not appear as viable or cost effective. However, this evaluation of alternative technologies, including the general cost comparison, was originally developed as a potentially significant downstream diversion approach. As the actual evaluation progressed and further discussions/work sessions were held, it became evident that a major program change from the current, more cost-effective landfill approach was not likely. As a result, a more modest, sequenced, and scalable approach was considered for Broome County. An approach that focuses on organics would satisfy both the County's interest in increasing recycling and diversion and NYSDEC's interest in organics diversion.

In keeping with enhanced composting as the preferred technology, this approach would begin with expansion of the existing yard waste composting program. The first step in expanding the existing program would be the addition of food waste (pre-consumer) or biosolids. The addition of pre-consumer food waste from institutions (universities, prisons) and commercial enterprises (grocery stores, processors) typically represents the least contaminated (and therefore most cost-effective) source of food waste for composting. Collection of pre-consumer food waste would also require the least change to current collection practices. In addition, the County has had some initial discussions related to the economic viability of a County-wide biosolids management facility.

The volume of food waste or biosolids that could be diverted will be a function of the available volume of bulking agent (brush/yard/wood waste). Based on approximately 450 tons of yard waste disposed per year, approximately 300 tons of food waste or biosolids could be processed annually without importing bulking material. This tonnage would be appropriate for an initial demonstration project. To expand processing capacity, Broome County could integrate biosolids disposal with wood waste disposal for interested municipalities.

Typically, a biosolids composting facility would be enclosed to minimize management of odor and other environmental impacts (such as leachate). Low volume food waste composting would not typically require completely enclosed facilities. However, the Federal Aviation Administration has expressed their concern with composting facilities and the potential to attract vectors. Considering the processing capacity available with current wood waste tonnage, vector concerns, and other food waste/biosolids composting facilities in the region, an initial outdoor demonstration composting facility may be an appropriate first step in pursuing additional downstream organics diversion. A project of this nature would be pursued to demonstrate required mix ratios, processing options, processing times, finished product quality, the potential for vector attraction, and required environmental impact management.

For a demonstration project, a "low tech" approach to material processing could utilize the County's existing equipment. Broome County currently owns a tub grinder, windrow turner, and screen. This equipment, in addition to a front-end loader, could be adequate to operate a static, turned windrow demonstration facility depending on the nature of the food waste. As part of the demonstration, Broome County could also employ a forced aeration static pile processing approach by adding blowers and piping, in lieu of turning windrows, to compare the two processes. Biosolids and food waste could be composted separately and together to evaluate individual and combined processing details. The next step in expanding organics diversion would then be to construct a larger, enclosed composting facility that utilizes more process controls and automation. The nature of that facility (size, feedstock, processing capacity, processing approach, type of enclosure, etc.) would be determined as part of the demonstration project.

Further expansion of enhanced composting as an alternative technology would require the diversion of more organic waste from the MSW stream. Inclusion of source-separated organic waste is one option for capturing organic material. However, during evaluation of upstream diversion opportunities (via the issue papers), an organic waste diversion or green bin approach did not receive a high ranking. As a result, processing the MSW stream may ultimately present a more cost-effective approach for significant capture and diversion of organics from the landfill than source separation methods.

Based on the above discussion, a phased organics diversion strategy was recommended that begins with the County's existing yard waste composting program (the baseline) and builds upon the program as follows:

- A demonstration project that utilizes a forced aeration composting method for processing yard waste and food waste or biosolids.

- A full-scale (outdoor) forced aeration composting operation to process 100 percent of the County's existing yard waste (as currently delivered to the site) and food waste or biosolids.

- A fully enclosed composting facility to process 100 percent of the County's existing biosolids that is expandable for processing additional organic feedstock.

7.3 ELEMENTS RELYING ON PRIVATE SECTOR

Broome County currently has five private companies that collect, separate, and market recyclables:

1. WM Recycle America in Binghamton, NY. This facility accepts recyclable materials co-mingled (single-stream) and transfers the materials to their materials recovery facility (MRF) in Syracuse where the loads are sorted, processed, and marketed. The County has a contract with WM Recycle

America for recyclable materials processing; however, haulers and municipalities are not mandated to use this MRF.

2. Broome Recycling, Inc. in Binghamton, NY. This facility accepts recyclable materials in two streams (fiber and containers) and processes/markets the material at its Binghamton location.

3. A&W Recycling in Chenango Bridge, NY. This facility accepts materials in two streams (fiber and containers) and processes/markets the material at its Chenango Bridge location.

4. Taylor Garbage & Recycling in Owego, NY (Tioga County). This facility accepts recyclable materials in two streams (fiber and containers) and processes/markets the material at its Owego location.

5. Empire Recycling Corporation in Johnson City, NY. This facility is a branch of Empire Recycling's main facility in Utica. They accept scrap paper and shredded paper exclusively from commercial accounts. The materials are baled and marketed to end users from the Johnson City location.

WM Recycle America currently receives and processes approximately 65 percent of all the recyclables collected within Broome County (100 percent of what the Division of Solid Waste manages), and Broome Recycling and A&W Recycling collects and processes the remaining 35 percent. In support of the County's expanded efforts to collect additional recyclables from CII&M units, WM Recycle America has reported that they have sufficient processing capacity to accept 100 percent of the County's co-mingled recyclables. If 100 percent of the processing capacity of the existing MRF is met, the County will procure additional processing capacity from other private operators.

7.4 PLAN IF PRIVATE SECTOR IS UNABLE TO FUNCTION

Currently, Broome County has an agreement with WM Recycle America to manage curbside recyclables and have the capacity to take all the recyclable materials produced in Broome County if the four other private companies are unable to perform. If WM Recycle America stops collecting and processing recyclables in Broome County, the County's waste haulers will continue to pick up the curbside recyclables and the landfill site will act as a temporary transfer station for recyclables. The County will then transport the materials to the nearest recycling facility that processes single-stream recyclables until another private organization is found to manage the recyclable materials.

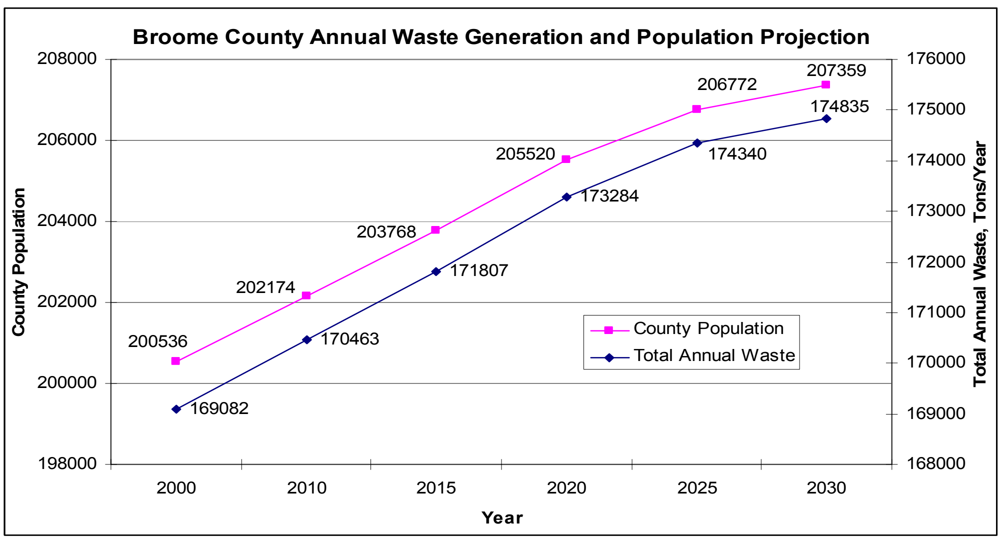
7.5 CERTIFICATION OF DISPOSAL CAPACITY

7.5.1 Solid Waste Generation – 20-Year Projection

Broome County has projected a population increase of 2.56 percent over the next 20 years. The 20-year population projection is more fully described in Chapter 5. For each increase in population, there is an associated increase in waste generated per year. Recently, the USEPA estimated the average waste generation rate in the United States at 4.62 lbs/person-day. Using the USEPA waste generation rate, the projected population and annual waste generation in Broome County is shown in Figure 7-1.

FIGURE 7-1

BROOME COUNTY ANNUAL WASTE GENERATION AND POPULATION PROJECTION



Broome County has completed permitting activities associated with the next 100-acre landfill expansion. The first cell in Section IV was recently opened and 12 additional cells are planned for the remainder of Section IV. Given the air space capacity (volume available for solid waste disposal) of the landfill, the anticipated waste generation per year, an average waste density of 1,700 lbs. per cubic yard based on historical data at the landfill, and consideration of daily cover and interim cover material, Section IV is expected to have a lifespan of over 40 years.

7.5.2 Locally Available Disposal Options Outside of the Planning Unit

There are currently three landfills outside of Broome County within a 75-mile radius that accept MSW from outside of their individual planning units. The landfills include the Town of Chenango (40 miles, 1.25 hours driving), the County of Chemung (59 miles, 1.2 hours driving), and the City of Auburn (75 miles, 1.75 hours driving).

Although there are landfills available outside of the County, there are no plans or intentions to use them in the next 20 years. In fact, these landfills currently provide market competition for MSW and C&D with the Broome County landfill and potentially have a negative impact to Broome County's revenue generation and subsequent funding of solid waste management programs. Although the County has successfully competed with these facilities on an economic basis in the past, recent economic conditions have resulted in lower than market rates for various waste products, and some waste from private haulers has left the County in light of more favorable tipping fees outside of the County. Control of Broome County-generated waste and related revenue is critically important to the County in terms of expanding and funding additional solid waste management programs (refer to discussion related to flow control in Chapter 9).

7.5.3 Disposal Cost Summary

Broome County currently offers renewable commercial permits on an annual basis that are prorated monthly from the beginning of July through the following June. There is a $55 application fee and an annual fee for vehicles of $22 and $5.50 for trailers or roll-off containers. Tipping fees depend on the type of waste for disposal, ranging from $20/ton to drop off yard waste to $100/ton for materials containing asbestos, with MSW rates currently set at $40/ton. Appendix C includes the Broome County Landfill Information Guide, including the tipping fees for various materials accepted at the landfill.

The competing landfills around Broome County have similar tipping fees and are summarized in the table below.

LANDFILL	DISTANCE	TRAVEL TIME	TIPPING FEE
Chenango	40 miles	1.25 hours	$55/ton
Chemung	59 miles	1.20 hours	$40/ton
Auburn	75 miles	1.75 hours	$50/ton plus gate rate
Broome	-	-	$40/ton

In comparison, Broome County offers a price-competitive tipping fee and is significantly less than the reported Northeast average of nearly $70/ton.

7.6 SPECIFIC, MEASURABLE, ATTAINABLE, REALISTIC, TIME-BOUND (S.M.A.R.T.) GOALS

As summarized in and discussed in Chapter 3, Table 3-4 presents the estimated "baseline composition" of waste generated and managed within the County and compares it to recycling and diversion capture rates for the year 2007. The following observations were noted:

1. There is a very high capture rate of metals within the waste stream (approximately 90 percent). This is likely due to the market value of metals during 2007. However; like other commodities, the value of metals is prone to significant price fluctuations.

2. The remaining "yellow bin" type recyclable materials, including paper, plastic, glass, and co-mingled materials, are being captured at about a 40 percent rate. These numbers support the County's desire to pursue targeted commercial, institutional, industrial, and multi-family recycling (CII&M) recycling efforts to increase the capture of these materials.

3. Food waste and yard waste currently account for 9 percent of the total waste stream (although other organics such as paper could also be considered as organic waste) and offer opportunity for diversion through private and public composting efforts.

4. Sludges from wastewater treatment facilities are organics that can also be composted for reuse as a solid amendment. Although composting of sludges (biosolids) by local municipalities has occurred in the past, it has grown burdensome in some cases and the County is evaluating potential coordination efforts for a central composting facility. The volume of sludges produced in the County on an annual basis is over 15,000 wet tons with a potential for higher production in the future.

5. C&D debris volumes fluctuate from year to year but contribute to approximately 15 percent of the total waste stream on an average annual basis. This is clearly a source that can be targeted for diversion potential and beneficial reuse of products, but also comes with program management challenges.

6. HHW and E-waste does not comprise a large portion of the waste, but it is a waste stream that should be kept out of the landfill. Current public

participation with the HHW and E-waste is relatively low and the County has targeted this waste for increased participation and diversion opportunities.

7. The County currently takes significant advantage of alternative daily cover materials for the landfill in lieu of purchasing soil materials. Although these efforts fall under the State's Beneficial Reuse Program, it is not considered a recycling or diversion program since these materials are ultimately placed in the landfill.

The NYSDEC has offered guidance to solid waste planning units to set diversion rates on a per capita basis. Based on 2007 numbers, the County currently captures and diverts approximately 220,000 tons of materials per year as shown on Table 3-4. Based on an estimated 2007 population of 200,000, Broome County has a per capita diversion rate of 5.9 lbs. diverted/capita-day. A reasonable goal over the next 20-year planning period is to increase the diversion rate per capita by 25 percent, to 7.4 lbs/capita-day. When compared to the 2007 diversion rates, it is approximately equivalent to an additional 55,000 tons of waste diverted on an annual basis.

To determine whether this goal is reasonably attainable, the 2007 waste characteristics were examined and the following targets were set for the primary diversion actions selected for upstream and downstream activities:

1. Increase recycling participation by 10 percent by targeting CII&M building units. This would result in the additional capture of 19,000 tons of recyclables per year by the end of the planning period.

2. Develop capture and processing strategies for approximately one third of the current C&D debris waste stream. This would result in the diversion and reuse of 20,000 tons of C&D per year by the end of the planning period.

3. Increase HHW and E-waste diversion to 35 percent (on a tonnage basis) in order to capture approximately 1,000 tons of these waste products per year by the end of the planning period.

4. Implement a phased program to expand the existing composting operations to include biosolids and food waste. Approximately 15,000 tons of organics could by composted and diverted on an annual basis by the end of the planning period.

Increasing the per capita diversion goal to 1.6 lbs. would result in additional diversion of 55,000 tons when using the baseline waste generation for 2007, or a 60 percent overall diversion rate compared to the current 48 percent.

7.7 CARBON REDUCTION CONSIDERATIONS

To quantify the carbon effects of the diversion programs identified above, the USEPA Waste Reduction Model (WARM) was used. WARM was created by the USEPA to help estimate greenhouse gas (GHG) emission reductions resulting from various waste management practices by calculating GHG emissions in metric tons of carbon or carbon dioxide equivalents for baseline and alternative waste management practices.

The USEPA WARM was used because it provides GHG emission calculations based on the County's specific waste characterization and operations. The baseline carbon emissions were calculated using tonnages of materials in the solid waste characterization described in Table 3-1 and 3-2, including landfilled waste and designated recycled or composted material. Broome County-defined waste categories were allocated to the most appropriate categories within the model. Broome County landfill operations are represented by designating landfill gas recovery for energy production and an estimated landfill gas collection system efficiency of 75 percent.

The upstream diversion activities and the resulting estimated diversion over the planning period are shown below:

UPSTREAM DIVERSION ACTIVITY	ADDITIONAL DIVERSION
CII&M recycling	10 percent of available recyclables to 1,000 tons
HHW and E-waste recycling	35 percent increase for an increase of 19,000 tons
Organics diversion	15,000 tons of biosolids and food wastes
C&D debris recycling	30 percent of wood and C&D debris in MSW for an increase of 20,000 tons

Carbon emissions based on the waste stream at the end of the planning period were calculated using the material tonnages after the diverted material was subtracted from the baseline landfilled tonnage and added to the recycled or composted material tonnage. A summary of the results of the WARM model are included in Appendix D.

The results of the model show a carbon equivalent emissions savings of approximately 10,300 metric tons. This is equivalent to removing almost 1,900 passenger cars from the roadway a year. The model also calculates an energy savings of approximately

104,000 million BTU, or almost 18,000 barrels of oil a year. Output from the model is provided in Appendix D.

8.0 IMPLEMENTATION SCHEDULE

8.1 PROGRAM PROCEDURES

8.1.1 Plan and Scope of Operation

A primary objective of the enhancements to the current Solid Waste Management Program is to increase diversion from the landfill by increasing recycling efforts for commercial, industrial, institutional, and multi-family units; increase HHW and E-waste collection; decrease C&D debris and organic material from the MSW stream; as well as process C&D debris and compost some organics at the landfill.

8.1.2 Collection, Processing and Storage Procedures

At this time, the County intends to continue with the existing collection, processing, and storage procedures described in Chapter 4. There are recyclables drop-off bins and storage areas for HHW and E-wastes located at the landfill, but private companies transport, process, and dispose of the recyclable material entering the landfill. All non-hazardous commercial, industrial, institutional, and residential recyclables are collected and processed by the private sector.

8.1.3 Market Agreements

There are no existing market agreements at this time and no agreements are anticipated during this planning period. All recycled material is processed and sold through the private sector.

8.1.4 Funding Sources

The County's existing and future solid waste management programs will continue to be self funded from revenue generated through permits, licenses, and tipping fees at the landfill for various waste products. Capital investments are funded through capital reserves (through a dedicated enterprise fund) and revenue bonds. As previously described, there are no tipping fees or user fees charged for residential or commercial recyclables.

A. **Waste Revenue**. The tipping fees from commercial and residential haulers support most of the educational activities, equipment, and O&M costs. As of December 2008, the majority of landfill fees were collected from commercial permits from eight private waste haulers and four municipalities. Some revenue was collected for household hazardous waste and the sale of scrap and excess material.

B. **Other Revenue**. New York State grants have been used to fund a portion of the recycling efforts under the Solid Waste Management Program. The specific grant programs that have been used include:

- The New York State Shared Municipal Services Incentive (SMSI) Grant Program
- The NYSDEC Municipal Waste Reduction and Recycling Program (MWR&R) for Capital Projects and Recycling Coordinators
- The NYSDEC Household Hazardous Waste State Assistance Program

8.1.5 Entity Responsible for Program Operation and Management

Broome County is responsible for program management regarding both solid waste and recyclable materials. Their primary operations program relates to past, present, and future landfilling actions (waste disposal). The operation of the recyclable program is divided between the private sector and the County, with private companies collecting, processing, marketing, and disposing of products; while the County is responsible for recycling outreach and education activities.

8.1.6 Implementation of Potential Staff

Potential staff increases to implement program modifications are summarized as follows.

A. **CII&M Recycling Initiative.**

- One full-time Recycling Assistant - Immediate.
- Part-time Summer Intern to assist Recycling Coordinator – As program expands.

B. **C&D Debris Recycling Initiative**

- Utilize existing landfill operators for C&D characterization – Years 2-4.

- Complete market assessment with existing staff - Years 1-2.
- Investigate private operator interest with existing staff - Years 3-5.
- Procure private operators if applicable – Years 5-10.
- Hire County operators if C&D processing is implemented with County staff – Years 5-10.

C. **HHW and Electronics Recycling Initiative (E-Waste)**

- Extend current hours of operations at the existing drop-off centers using existing staff – Immediate.
- Add one laborer at the landfill to manage the collection program as it expands – Years 1-2.
- Investigate the benefits of private management of these facilities using existing staff – Years 1-3.

D. **Enhanced Composting Initiative**

- Utilize existing operators to complete a demonstration project as previously described – Years 1-2.
- Increase landfill operations staff by one operator and one laborer – Years 2-4.
- Staff full-scale facility for target capture of organics (three to five people) – Years 5-10.

8.2 IMPLEMENTATION SCHEDULE

8.2.1 Program Schedule and Milestones

The NYSDEC has offered guidance to solid waste planning units to set diversion rates on a per capita basis. Based on 2007 numbers, the County currently captures and diverts approximately 220,000 tons of materials per year as shown on Table 3-4. Based on an estimated 2007 population of 200,000, Broome County has a per capita diversion rate of 5.9 lbs. diverted/capita-day. A reasonable goal over the next 20-year planning period is to increase the diversion rate per capita by 25 percent, to 7.4 lbs/capita-day.

When compared to the 2007 diversion rates, it is approximately equivalent to an additional 55,000 tons of waste diverted on an annual basis.

To determine whether this goal is reasonably attainable, the 2007 waste characteristics were examined and the following targets were set for the primary diversion actions selected for upstream and downstream activities:

- Increase recycling participation by 10 percent by targeting CII&M building units. This would result in the additional capture of 19,000 tons of recyclables per year by the end of the planning period.

- Develop capture and processing strategies for approximately one third of the current C&D debris waste stream. This would result in the diversion and reuse of 20,000 tons of C&D per year by the end of the planning period.

- Increase HHW and E-waste diversion to 35 percent (on a tonnage basis) in order to capture approximately 1,000 tons of these waste products per year by the end of the planning period.

- Implement a phased program to expand the existing composting operations to include biosolids and food waste. Approximately 15,000 tons of organics could by composted and diverted on an annual basis by the end of the planning period.

Increasing the per capita diversion goal to 1.6 lbs. would result in additional diversion of 55,000 tons when using the baseline waste generation for 2007, or a 60 percent overall diversion rate compared to the current 48 percent. A summary of the specific measures and milestones to achieve these goals is summarized in Table 8-1.

8.2.2 Existing Facility Closure Schedule

There are no facilities scheduled for closure or replacement. All operating facilities are currently permitted and are not forced by a government agency to close.

8.2.3 Economic Development Schedule

No economic development schedule is required because all recycled material is handled by private companies. Recyclable material stored at the County is collected by WM Recycle America.

8.2.4 Educational Schedule

The County's existing education schedule is presented in Table 8-2. Outreach activities will be expanded to include proposed program enhancements as they are implemented.

8.3 INTERIM MANAGEMENT PLAN

An interim management plan is required by the NYSDEC when a large solid waste program change is offered and significant transitional steps are necessary as part of the implementation process. The recommended program enhancements under this Local Solid Waste Management Plan do not require major changes under the existing program, so an interim management plan is not necessary.

TABLE 8-1

SUMMARY OF BROOME COUNTY SOLID WASTE PROGRAM ENHANCEMENTS KEY MEASURABLES AND MILESTONES

UPSTREAM DIVERSION GOALS	MEASURABLES	MILESTONES	TIMEFRAME
CII&M recycling	Quantify number of CII&M building	Establish a communication system with the County Building Code Officer	By Year 1
		Work with tax information to building a database of existing CII&M buildings in the County	By Year 2
	Establish a baseline participation rate	Develop and distribute survey to all building units	By Year 2
		Determine estimates of participation rates based on survey results	By Year 2
	Education and outreach to the public	Develop and distribute educational material to participants	By Year 2
		Revise County website and offer more information and outside links	By Year 3 and annually thereafter
	Track participation rates and trends	Conduct a survey of occupants in a statistically representative sample of buildings regarding recycling participation	By Year 3 and annually thereafter
	Track tonnages of recyclables collected in Broome County with private haulers		By Year 3 and annually thereafter
HHW and electronics (E-waste) recycling	Quantify number of HHW and E-waste collectors	Work with tax information to building a data base of existing electronic stores who could accept E-waste	By Year 2
		Conduct research to find businesses who accept HHW or E-waste	By Year 3
	Count existing County participants who self deliver	Develop and distribute educational material to public forums, collection centers, and all County residents.	By Year 3
	Measure increases in tonnage received and number of participants	Increase collection center hours for HHW and E-waste	By Year 1
		Increase storage at collection centers to double current capacity.	By Year 2

UPSTREAM DIVERSION GOALS	MEASURABLES	MILESTONES	TIMEFRAME
HHW and electronics (E-waste) recycling (continued)	Determine results of program expansion efforts	Track tonnages of HHW and E-waste collected in Broome County using County collection centers and private collectors	By Year 3 and annually thereafter
		Determine estimates of participation rates based on tracking results	By Year 3 and annually thereafter
C&D debris recycling	Quantify C&D composition through a waste characterization process	Establish a communication system with the County Building Code Officer and Green Building Council member	By Year 2
		Conduct research to create database of local businesses who reuse building material	By Year 3
		Update educational materials with reuse list, LEED and construction regulations	By Year 4 and annually thereafter
	Implement tip fee incentives and record participation	Develop and distribute educational material to public forums, collection centers, and all County residents.	By Year 4 and annually thereafter
Organics diversion	Identify number of compost bins sold to date	Determine local organizations who promote and work with residents on composting.	By Year 2
		Establish a communication system with the identified organizations.	By Year 2
	Track purchase of County compost bins	Update educational materials with available compost assistance and resources	By Year 3 and annually thereafter
	Track businesses and institutions who develop organic diversion programs	Develop and distribute educational material to public forums, collection centers, and all County residents.	By Year 3 and annually thereafter

DOWNSTREAM DIVERSION GOALS	MEASURABLES	MILESTONES	TIMEFRAME
C&D debris recycling	Track tonnage of C&D debris passing scalehouse and entering landfill	Designate an area at landfill for temporary storage and processing of C&D material	By Year 1
	Based on the database of C&D debris recyclers, track tonnage of C&D diverted from landfill	Work with haulers to separate C&D debris from MSW upon delivery	By Year 2
	Determine estimates of diversion rates based on tracking results	Conduct pilot C&D debris processing program at landfill	By Year 3
		Conduct market research to determine potential value of reusable materials	By Year 4
		Determine appropriate management strategy - publicly or privately owned	By Year 5
Organics diversion	Estimate feedstock and tonnages of organics available in County	Track tonnage of yard waste entering landfill at scalehouse	By Year 1 and daily thereafter
		Conduct survey of commercial, industrial, and institutional centers who process food for types and amounts	By Year 2
		Determine amount of biosolids produced in County by contacting WWTPs	By Year 2
	Determine amount of organics that could be composted at existing facilities	Conduct survey to WWTPs and food processing facilities in County to determine interest in composting at landfill	By Year 2
		Calculate feasibility of composting organics identified in survey at landfill in regard to land and bulking agents available	By Year 3
		Research permitting requirements for a biosolids and food composting facility at the landfill	By Year 3
	Measure volume of organics composting	Construct a demonstration biosolids and food composting facility	By Year 4
		Determine feasibility of full-scale operation	By Year 5

TABLE 8-2

BROOME COUNTY EDUCATION SCHEDULE

MONTH	PROGRAM	OUTREACH
January- February	HHW and electronics recycling	Advertisement in newspaper. Outlines accepted materials and collection days for the year, press release, posting on County website, printed schedules and submitted to free news outlet (community calendar).
March-April	Recycling, waste reduction	Advertisement in newspaper to promote recycling/provide tips, posted on County website, press release, and printed guide.
March-April	Backyard composting	Sell bins at discounted rate, press release, posted on County website, posters hung, promoted at farmers markets and special events.
April	Earth Fest	Community event - display table and disbursement of informational guides.
April-May	Farmer markets	Participate in a few and promote composting, recycling, HHW & electronics recycling.
May-July	Grass recycling	Radio advertisements (one week in May, one week in July), press release, posted on the County website (composting page), printed brochure.
May-October	Electronics collections offsite	Advertisements in newspaper, press release, letter to area clerk offices, posted on County website, posters, submitted to free news outlet (community calendar)
November-December	Waste reduction/holiday tips, buy recycled, recycling	Advertisement in newspaper, press release, posted on County website.
November-December	Christmas tree recycling	Press release, posted on County website, submitted to free press outlets.
Year-round	Recycling programs, landfill tours	Conduct year round specific school and community group programs regarding recycling, HHW, electronics, composting. Promoted through direct contact with teachers and the County website.

9.0 LEGAL AND INSTITUTIONAL CONSIDERATIONS

9.1 REVENUE GENERATION AND PROGRAM FUNDING

Control of Broome County-generated waste and revenue from waste disposal tipping fees is critically important to the County in terms of expanding and funding additional solid waste management programs. Although the public is not charged for processing recyclables, there are a variety of costs to the Division of Solid Waste for managing recyclables. These include costs for contract services with a private MRF for processing recyclables; cost for purchasing and distribution of recycling containers; cost for contracting for disposal of HHW; staff cost associated with coordination and permitting local haulers; staff time for public outreach and education activities; and administrative costs for managing and reporting on the overall solid waste management program. All of these activities rely on revenue from tipping fees at the landfill or through annual subsidies from the New York State Recycling Grants Program. To sustain existing and expanded programs, the County must rely on consistent levels of revenue generation from tipping fees. Therefore, the Division made a critical examination of recent flow control legislation in New York State and its applicability to Broome County, particularly in light of the potential expansion of the proposed recycling and diversion programs.

The County's existing and future solid waste management programs will continue to be self funded from revenue generated through permits, licenses, and tipping fees at the landfill. Capital investments are funded through capital reserves (through a dedicated enterprise fund) and revenue bonds. As previously described, there are no tipping fees or user fees charged for residential or commercial recyclables.

9.1.1 Waste Revenue

The tipping fees from commercial or residential haulers help pay for most of the educational activities, equipment and O&M costs. As of December 2008, the majority of landfill fees were collected from commercial permits from eight private waste haulers and four municipalities. Some revenue was collected for HHW and the sale of scrap and excess material.

9.1.2 Other Revenue

New York State grants have been used to fund a portion of the recycling efforts under the Solid Waste Management Program. The specific grant programs that have been used include:

- The New York State Shared Municipal Services Incentive (SMSI) Grant Program.

- The NYSDEC Municipal Waste Reduction and Recycling Program (MWR&R) for Capital Projects and Recycling Coordinators.

- The NYSDEC Household Hazardous Waste State Assistance Program.

Approximately 4 percent of the program cost is funded through State grants.

9.2 LEGAL/INSTITUTIONAL ANALYSIS

Broome County is considering implementing flow control regulations to address its solid waste management needs. The County requested that Pannone, Lopes, Devereaux, West, LLC (New York, NY) complete an analysis of the various issues, benefits, and drawbacks of flow control in the event it decides to implement such regulations. Accordingly, the following is a discussion of flow control, considerations associated with implementation of flow control regulations, and issues to consider going forward. Also included in Appendix E is information regarding the legal history of flow control, economic flow control, and a summary of the flow control law of Madison County, NY (a community with similar solid waste programs).

9.2.1 Flow Control - Overview

Flow control refers to the ability of local governments and agencies to mandate -- through laws or other regulations -- that all locally-generated solid waste be delivered to designated solid waste management facilities. Until the United States Supreme Court's recent decision in United Haulers Association, Inc. et al v. Oneida-Herkimer Solid Waste Management Authority, et al., 127 S.Ct. 1786 (2007), the prevailing view was that most flow control laws were unconstitutional because such laws imposed an impermissible burden on interstate commerce. That view had been endorsed by the Supreme Court's opinion in C&A Carbone, Inc. v. Town of Clarkstown, 511 U.S. 383 (1994). In United Haulers, the Supreme Court held that it is legally permissible for a local government to require that MSW be processed at a designated publicly-owned and operated solid waste management facility. Accordingly, municipalities throughout the country have started enacting their own flow control regulations.

9.2.2 Flow Control – Benefits

Flow control is an essential tool, without which municipalities may find it more difficult to fulfill their responsibilities to plan for the management of MSW. Flow control is necessary to ensure the financing of existing facilities within the municipalities and to meet the responsibilities of municipalities to sustain old disposal sites. Municipalities are also obligated to provide and/or fund all supplementary waste management services, such as HHW collection, curbside recycling programs, and community education programs. Flow control is essential to keep municipalities from going bankrupt trying to fulfill these obligations; in addition to covering the costs of meeting regulatory requirements, planning, and public participation in decision-making activities. Flow control provides for various economic benefits such as economies of scale in operation of solid waste management facilities. Greater throughput allows for a decrease in per ton costs for disposal at facilities, and recyclables revenue can increase.

Aside from ensuring the financial viability of MSW management systems, flow control measures provide municipalities with greater control and oversight of the solid waste generated within their jurisdictions. Flow control measures therefore allow municipalities to better protect the health, safety, and welfare of their citizens. By thoroughly regulating disposal of solid waste through flow control measures, municipalities can ensure that solid waste is disposed of in a safe and environmentally sound manner. Flow control measures also serve to protect natural resources by allowing municipalities to designate disposal sites in specific areas that must meet certain environmental standards. Such measures additionally provide municipalities with sufficient revenue to pursue alternative technological solid waste disposal methods that would otherwise be unattractive to private entities due to their prohibitive costs.

Of the many laudable goals that may be achieved through the adoption and enforcement of flow control measures, an increased rate of recycling is perhaps the most significant, given current environmental concerns. By allowing municipalities to control and inspect all the solid waste generated within their jurisdictions, flow control measures permit municipalities to implement recycling programs that would otherwise be unmanageable. For example, flow control measures increase the rate of recycling by: (1) creating incentives for citizens to recycle (flow control measures are often drafted to exempt from tipping fee requirements disposal of recyclable materials, thus encouraging citizens to separate their recyclables from their solid waste); and (2) allowing municipalities to better enforce their recycling laws by requiring all solid waste to be delivered to designated publicly-owned solid waste management facilities.

Flow control measures and their resulting increased rate of recycling allow municipalities to better conserve their resources and protect the local environment.

9.2.3 Flow Control – Issues

One important issue to consider is how to monitor waste collectors and haulers to ensure they take solid waste and recyclables to designated publicly-owned solid waste management facilities. Like other municipalities, Broome County must also consider whether and to what extent a flow control law could conflict with an existing law, such as a provision of health code.

Consideration must also be given to a flow control law's impact on existing solid waste collection contracts. If a collection contract specifies that solid waste collected in a municipality must be taken to a transfer station or other privately-owned solid waste facility, the likely impact by a flow control law is that the waste may be redirected to a publicly-owned solid waste facility. The impact to the hauler, if any, would likely result from a higher tip fee at the publicly-owned solid waste facility, and an increase in transportation costs if the publicly-owned facility is farther than the facility designated in the contract. While the hauler is unlikely to prevail on a constitutional challenge to the flow control law, presumably it would seek to pass these increased costs on to the municipality.

9.2.4 Flow Control – Implementation

As explained by the Supreme Court in the United Haulers decision, local governments' authority to enact flow control is derived from their police power. It is therefore essential for municipal governments interested in enacting legally sustainable flow control laws to demonstrate the relationship between the proposed flow control regime and the health, safety and welfare of their citizenry. Accordingly, it is recommended that a findings statement should be prepared that establishes the public policy basis for restructuring the municipality's solid waste management system. The findings statement should discuss the legitimate governmental objectives that will be achieved through the implementation of flow control. Furthermore, the findings statement should, to the extent possible, provide persuasive evidence of community support for the creation and development of an integrated public solid waste management system. Additional items that may be appropriate for inclusion in the findings statement are:

- A technical description of the proposed integrated system and an examination of how such a system would operate to the benefit of the public.

- A technical assessment of existing publicly-owned solid waste management facilities and a discussion of their proposed role in an integrated waste management system.

- Evaluation of the perceived benefits of a public system as compared to waste management services provided by the private sector.

- Discussion of public health and environmental benefits of an integrated public system.

- Perceived economic benefits of an integrated system to the public.

- A clear presentation of the reasons why flow control would be good for the current and future needs of the County.

- A draft of amended flow control legislation.

This Local Solid Waste Management Plan Update identifies the County's current and future solid waste management needs. The County must also consider its policy with respect to recyclable materials and whether such materials would continue to be disposed of at private facilities. The County should also consider potential political issues involved with the implementation of flow control regulations and the impact of such regulations on the private solid waste industry.

It appears that the authority to implement flow control measures is contained in the Broome County Solid Waste Code. Section 179-14 (B)(1) provides:

> "The County Executive (Executive) or his designee, which designee must be an officer or agent of the county, is hereby authorized and directed to designate, by written statement, from time to time, one or more solid waste management - resource recovery facilities to be used for the disposal of solid waste generated, originated or brought within the County of Broome, which designation may include a determination that a particular solid waste management - resource recovery facility shall be the only facility used for the disposal of solid waste generated, originated or brought within all of, or a described area within, the County of Broome or by a particular person or persons. Such written designation of a facility shall be filed with the Clerk of the Broome County Legislature and shall become effective within 60 days of filing, unless rescinded or modified by appropriate resolution of the Broome County Legislature."

9.3 SUMMARY OF PROPOSED ACTIONS TO MODIFY LOCAL LAWS

The following is a summary of the proposed 2010 revisions to the Broome County Local Solid Waste Management Laws, Chapter 179. Changes or additions are shown as bold and deletions are shown in italics.

§179-9 A(5) Commencing April 1, 2000 the following charges shall apply at the hazardous waste facility located at the (*Delete: Nanticoke*) **Broome County** Landfill:

§179-25. (B) PARTICIPATING HAULER- An authorized agent of the County that utilizes the (*Delete: Nanticoke*) **Broome County** Landfill exclusively for the disposal of solid waste it collects.

§179-26 (B) Materials the must be source separated include paper, **corrugated cardboard,** glass, metals, plastics, leaves, yard wastes, tires, batteries (wet and dry cell) and household hazardous waste. **A detailed published list of materials to be accepted will be on file with the Broome County Legislature.**

§179-26 **(E) All municipal and private haulers are prohibited from co-mingling source separated recyclables with solid waste.**

§179-28 (B) The owner and/or manager of every multifamily apartment building or condominium within the county shall provide and maintain, in a neat and sanitary condition, recycling dropoffs to receive all recyclable materials, generated by residents of the building or complex. **Recycling drop-offs must be placed adjacent to each solid waste collection point.** In cases where a condominium association exists, the condominium association shall be responsible for provision and maintenance of the recycling dropoff(s). It shall be the tenant's responsibility to separate designated recyclable materials from the solid waste and deposit the recyclables in the dropoff(s), in the manner prescribed by facility management.

§179-29 **Residential/**Commercial (insitutuional) and industrial waste and recyclables.

A. All **residential** (*Delete: commercial/industrial/institutional*) solid waste collected by either municipal or private haulers shall be source-separated and delivered to an appropriate facility for disposition, as may be designed by the county.

B. All commercial/industrial/institutional) solid waste collected by either municipal or private haulers shall be source-separated and delivered to an appropriate facility for disposition, as may be designed by the county.

C. All recyclable …….. Only the lettering from B to C changed.

§179-32. Solid waste disposal on public property.
C.(1) **All municipal** parks (*delete:may, in lieu of*) **must** provid**e** separate public receptacles for recyclables collection and arrange transportation of all recyclable materials to a material recovery facility (*delete: require that park patrons take their recyclable materials with them upon leaving the park. The municipalities shall post signs at all park entrances advising the public of the rule. Park patrons shall be responsible for removing recyclables from the park and disposing of them*) in accordance with §179-21 of this article.

***Any section of the local law that referred to fines will be updated to reflect any fines collected shall be split 50/50 with the municipality in which the violation occurred and with Broome County.**

9.4 COORDINATION WITH OUTSIDE JURISDICTIONS

9.4.1 Participation with Outside Jurisdictions

Currently, Broome County works cooperatively with Tioga County to collect and store HHW and electronics for processing at a private facility. The drop-off facility is located at the Broome County landfill. Residents from both Broome and Tioga Counties may drop off HHW materials at no charge without an appointment on the days that the HHW collection drop-off facility is open. Commercial hazardous waste is accepted for a fee and by appointment only. Small businesses in Broome and Tioga Counties may participate after they have completed a permit process and have registered with the County. In accordance with Broome County Local Law, no outside waste is accepted at the landfill.

10.0 INTERIM SOLID WASTE MANAGEMENT MEASURES

An interim management plan is required by the NYSDEC when a large solid waste program change is offered and significant transitional steps are necessary as part of the implementation process. The recommended program enhancements under this local Solid Waste Management Plan do not require major changes under the existing program, so an interim management plan is not necessary. Goals will be tracked as summarized on Table 8-1.

10.1 SOLID WASTE PROGRAM FUNDING

Until flow control legislation is fully assessed and acted upon, tipping fees and other fees will be set to be competitive with other New York State landfills. Program enhancements during the first five years of the Plan will be funded through modest rate increases. In order to fund additional program enhancements for the remainder of the planning period, modifications to local law to enact flow control may be necessary or adjustments to future enhancements may be needed. Thus, the dynamics of this Plan will continuously be evolving over the planning period.

11.0 EXPORT CERTIFICATION OF CAPACITY

An export certification of capacity is not required since the County does not export any MSW for disposal. However, if there is an emergency, there are currently three landfills outside of Broome County within a 75-mile radius that accept MSW from outside of their individual planning units. The landfills include the Town of Chenango (40 miles, 1.25 hours driving), the County of Chemung (59 miles, 1.2 hours driving), and the City of Auburn (75 miles, 1.75 hours driving).

Although there are landfills available outside of the County, there are no plans or intentions to use them in the next 20 years. In fact, these landfills currently provide market competition for MSW and C&D with the Broome County landfill and potentially have a negative impact to Broome County's revenue generation and subsequent funding of solid waste management programs. Although the County has successfully competed with these facilities on an economic basis in the past, recent economic conditions have resulted in lower than market rates for various waste products, and some waste from private haulers has left the County in light of more favorable tipping fees outside of the County. Control of Broome County generated waste and related revenue is critically important to the County in terms of expanding and funding additional solid waste management programs.

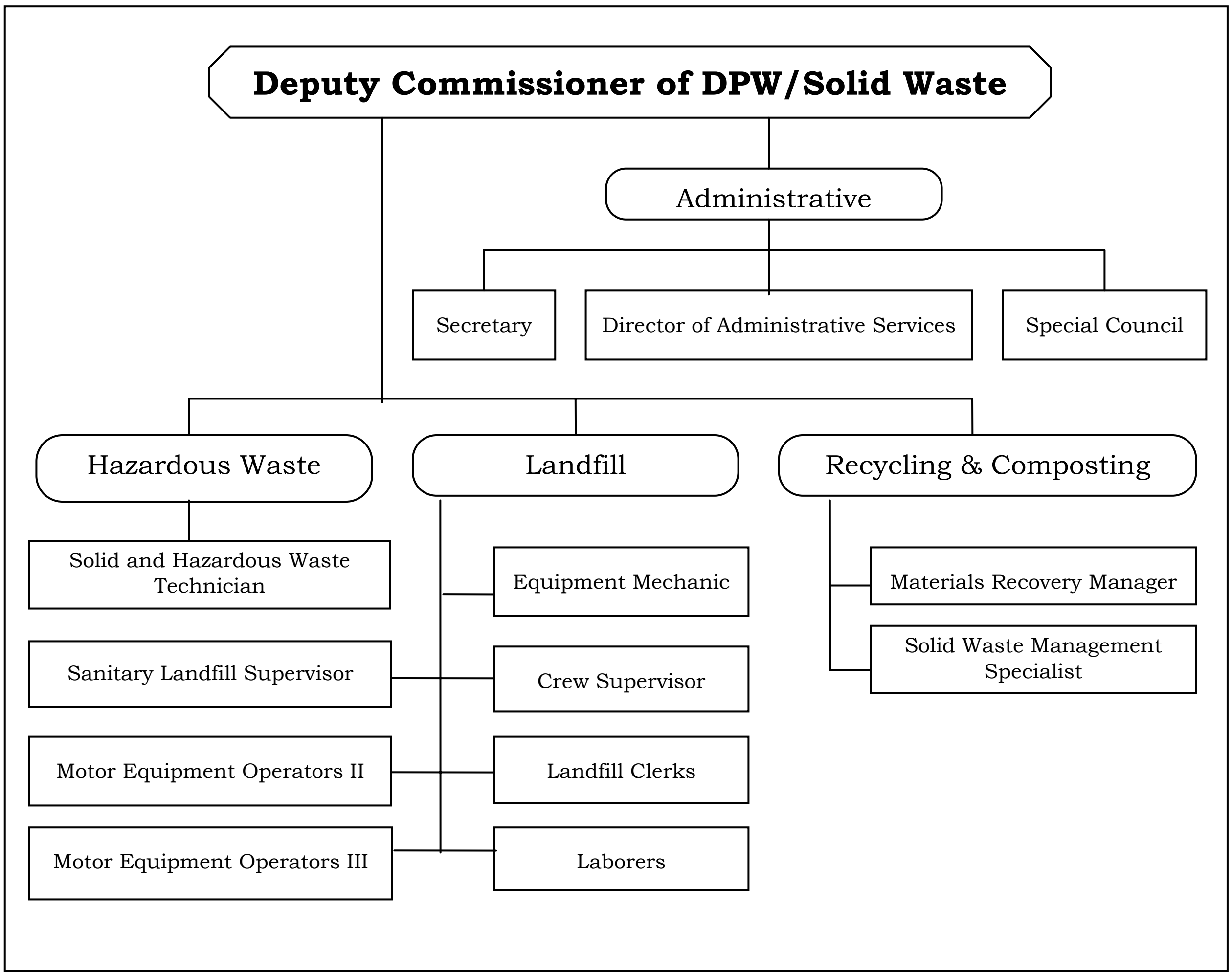
12.0 ADMINISTRATIVE STRUCTURE AND FINANCIAL MECHANISMS

12.1 CURRENT STRUCTURE

Figure 12-1 presents a graphical representation of Broome County's current administrative and management structure. No organizational changes are anticipated under this plan; however, additional staff is likely over the planning period.

FIGURE 12-1

BROOME COUNTY SOLID WASTE MANAGEMENT



12.2 COST ANALYSIS

The following discussion is offered to demonstrate the County's commitment to implementing and financially supporting existing solid waste management programs, ongoing landfilling operations, and proposed program enhancements to increase overall recycling and landfill diversion rates within the County, including public outreach and education participation. As summarized in Chapter 7, the County has identified specific program goals to increase recycling and diversion rates from 48 percent in 2007 to 60 percent in 2020 (based on increasing per capita participation rates by 25 percent).

12.2.1 Current Operating Costs

The Division of Solid Waste is responsible for managing operating costs as well as for collecting revenue through various fees. The solid waste management program is self funded and has relied on revenue bonds to finance significant capital investments. Debt service is retired through revenue generated from tipping fees, and no general funds are used to financially support this debt (no ad valorem taxes). In addition, New York State grants have provided some financial support to recycling programs in recent years (about 4 percent of the total revenue is 2008). Additional revenue collected beyond operating expenses is held in a reserve fund dedicated to future solid waste program investments. In 2008, the Division operating expenses totalled approximately $9 million and costs were generally allocated as follows:

Debt service payments	$3.2 million
Landfill operations	$4.8 million
Recycling program	$1.0 million
Total	$9.0 million

In 2008, revenue collected was approximately $9.8 million and was generally allocated as follows:

Revenue from fees	$8.6 million
Interest, earnings, and miscellaneous	$0.8 million
State Grants	$0.4 million
Total	$9.8 million

Please note that these summaries only reflect operating expenses and revenue and do not include financial assurance requirements, Enterprise Fund balance, asset value, or other financial numbers the County is obligated to manage in accordance with generally accepted public accounting standards.

12.2.2 Cost Projections for Planning Purposes

The primary purpose of the Local Solid Waste Management Plan Update is to set the stage for the next 20-year planning horizon for solid waste programs within Broome County. Although the Plan has targeted continued landfilling operations and program enhancements to increase recycling and diversion rates, it must also provide flexibility in anticipation of changing regulations, new technologies, public interest, changing environmental attitudes, and economic influences. In other words, it is likely that this Plan will continue to undergo revisions during the 20-year planning period. However, in support of future decision-making efforts, cost projections were developed over the next 20 years to estimate the level of financial support that will be required to continue landfilling operations and to implement program enhancements related to upstream diversion efforts. These are not intended to be future budget projections; rather, they are planning estimates for future program costs given specific volumes of wastes and anticipated events and milestones over the next 20 years.

Current operating expenses are supported through current revenue (fees), and the following projections focus on potential incremental cost increases.

12.2.3 Landfill Disposal Cost Section

Landfill disposal represents the current primary downstream waste management approach. Broome County has invested significant capital in developing the Section IV landfill and infrastructure during the past 10 years. Section IV Cell 1 was opened in August 2009. In light of this past investment and in review of future options, landfill disposal will continue as a significant waste management approach during the planning period as other solid waste program enhancements are developed.

To evaluate the capital investment for design, construction, and closure of future cells in Section IV, the overall capacity analysis performed for Section IV was updated based on recent operational data. The new analysis also detailed the development schedule and cost by individual cell for the duration of the planning period. From the *Engineering Report and Leachate Management Plan (Volume II)* of the 2001 Section IV Permit Application Package, the total airspace available below the proposed cap for all of Section IV was 12.4 million cubic yards (CY). For the original capacity analysis in 2001, the following parameters were used:

Annual disposal.. 114,000 tons (includes waste, daily cover material, roadways)
Average waste density...................................... 1,100 lb/CY
Annual airspace consumption........................... 207,000 CY

Intermediate cover .... 1 foot
Life of Section IV.. 60 years

For the current SWMP process, the parameters were modified as follows:

Annual disposal... 240,000 tons (waste and daily cover as ADC)
Average waste density..................................... 1,700 lb/CY
Annual airspace consumption........................... 282,000 CY
Additional daily cover/roadways........................ 5 percent
Intermediate cover .... 1 foot
Life of Section IV.. 41 years (from August 2009)

While the annual disposal more than doubled, the increased density and overall reduction in daily cover volume only resulted in a 30 percent decrease in landfill capacity. The parameters used to estimate the remaining life of Section IV should be revised as better data specific to operations in Section IV become available and to reflect actual annual disposal rates. While the overall capacity of each of the 15 cells conceptually designed for Section IV can be estimated from the permit drawings, the actual capacity in each cell based on operations will be less, as an individual cell may not be completely filled until the next cell is constructed.

A more detailed evaluation of Cells 1 to 3 was completed to better determine the useful life of each of these cells. Based on discussions with site personnel, the evaluation limited waste placement in each cell to provide a minimum 200-foot wide level working surface (thereby limiting the waste height). For the remaining cells (4 to 13), the specific capacity and life of each was based on its relative capacity. A more detailed analysis of Cells 4 to 13 was not warranted, as more accurate operational data will become available, future cell development may not follow the original pattern due to the construction of the new Section IV landfill entrance, and the bedrock profile in future cells may change the cell design and capacity.

The following assumptions were made in creating a development schedule:

1. Construction of a new landfill cell is required the year before existing capacity is exhausted unless a given cell provides capacity through October of a given year.

2. Design of a new cell is undertaken the year prior to construction.

3. Construction of partial closures is performed in the year following the use of existing capacity, except for Cell 5 where partial closure is delayed until the capacity in Cell 6 is exhausted.

4. Design of partial closures is undertaken the year prior to construction.

A summary of capital costs for design, new cell construction, and partial closure of cells for Section IV is provided in Table 12-1. From the detailed capacity analysis, Cells 1 to 8 will be needed during the 20-year planning period. The design of Cell 9 will be completed in year 2030 in order for construction to be completed in 2031 and have additional airspace available by late 2031. Capital expenditures were based on the following costs (2010 dollars):

New cell construction..$500,000/acre
Partial cell closure $100,000/acre
Design ....10 percent of construction cost

The area of each partial closure was estimated and may vary. We also note that based on the limited capacity of Cell 5 (the first cell on the western portion of Section IV), Broome County may wish to consider building Cells 5 and 6 (under the original development plan) or Cells 5 and 11 (under an optional development plan) at the same time to preclude new cell construction in consecutive years.

The capital costs presented in Table 12-1 are intended for planning purposes. Some capital projects are relatively minor and may not be financed, while other capital projects are more significant and will likely be financed. As such, the debt service on capital costs for landfill disposal have not been projected. As presented in Section 12.2.1, debt service payments in 2008 were $3.2 million. Annual debt service payments typically vary between $3.0 and $3.5 million.

Ongoing O&M costs for the entire landfill site are also presented in Table 12-1. For those landfill cells south of Dunham Hill Road (old landfill/Section I and Sections II/III), active waste placement will be completed and post-closure O&M will be implemented. The annual O&M cost for these cells is based on the financial assurance calculations presented in the O&M Manual for the 2010 final closure plan for Sections II/III. Variations in annual cost are related to projected reductions in leachate generation rates and environmental monitoring during the planning period. After Year 15 (2025), the 30-year post-closure period under 6 NYCRR Part 360 regulations for the old landfill/Section I footprint expires.

Normally, the post-closure costs for a given footprint would be eliminated after 30 years. However, based on the nature of the environmental monitoring network and the leachate collection and removal system, it is likely that a portion of the current O&M program will be continued after the initial post-closure period. Therefore, 60 percent of the costs associated with post-closure monitoring for that footprint is continued through the end of the planning period.

12.2.4 Program Enhancement Cost Projections

To estimate future program costs associated with each recommended program enhancement, the individual program elements were evaluated separately using today's costs and then projecting the cost over the 20-year planning period (at an increase of 3 percent per year). For capital cost investments, estimates were projected to the year when the capital investment is anticipated. Table 12-2 summarizes potential operating costs for these programs. The first page of the table represents operating costs and the second page represents capital investments.

The following presents a summary of the parameters used for the cost projections.

A. **Increase Commercial, Institutional, Industrial, and Multi-Family Recycling Efforts.**

Annual Cost Considerations:

- Staff time..One person
- Outreach efforts ....Mailers and information
- Recycling bin replacement......................25 percent of total
- Recyclables processing cost...................Δ increase of 1,000 TPY

Capital Cost (2011):

- New recycling bins 10,000

B. **Alternative Daily Cover.** Additional costs were not considered under this program enhancement since the County implemented this management option within their 2009 operating budget.

C. **Increase Household Hazardous Waste and Electronic Waste Recycling Efforts.**

Annual Cost Considerations:

- Staff time..Two People
- Processing cost ....\$0.06/pd for E-waste
  \$0.60/pd for HHW
- Education and outreach ....Flyers, presentations, meetings

Capital Cost (2011):...New storage center

D. **Increase Organics Diversion.**

Annual Cost Considerations:

- Demonstration project............................2014
- Forced aeration pad O&M.......................Beginning in 2016
- Compost facility O&M ....Beginning in 2025

Capital Cost Considerations:

- Demonstration project............................2013
- Forced aeration pad O&M.......................2015
- Compost facility O&M 2020

E. **Implement Construction and Demolition Debris Recycling.**

Annual Cost Considerations: ....O&M Cost for processing equipment and personnel (2015)

Capital Cost Considerations: ....Equipment (2015)

- Grinder; front-end loader, excavator with grapple, skid steer loader, roll-off containers, tractor trailer (transfer)

As summarized on Table 12-2, the projected additional operating cost and annual debt retirement costs for capital investments will grow from approximately $250,000 in 2011 to over $4,000,000 in 2030. Potentially significant incremental cost increases during the 20-year planning period are summarized as follows:

PLANNING YEAR	INCREMENTAL COST INCREASE (COST PLUS DEBT RETIREMENT)	PERCENT INCREASE FROM 2008 OPERATING BUDGET OF $9 MILLION
2011	$250,000	<3 percent
2015	$1,200,000	13 percent
2020	$3,540,000	39 percent
2030	$4,380,000	49 percent

To support these program enhancements, the County may need to increase revenue generation by nearly 50 percent by the end of the 20-year planning period, depending upon mechanisms for financing capital expenditures.

12.2.5 Summary of Cost Implications

Broome County has made a significant investment in long-term landfill disposal of solid waste. The solid waste program is a well-managed combination of public and private parties and is self sustaining using a competitive tipping fee that secures a majority of the local waste stream. Moving forward during the planning period, the County proposes program enhancements to increase diversion from the landfill. The nature, timing, cost, and rate of cost increase of these enhancements have been projected for planning purposes and should be reviewed and updated. For the solid waste management program to remain self sustaining, the County may need to consider appropriate mechanisms (such as tipping fee increases, flow control, etc.) if needed to generate sufficient revenue for continued operational and debt service (capital) costs.

TABLE 12-1

CAPITAL AND O&M COSTS FOR LANDFILL DISPOSAL OVER THE PLANNING PERIOD

Planning Year	Calendar Year	Description	Landfill Footprint (Acres)	Capital Cost: Design	Capital Cost: New Cell	Capital Cost: Partial Closure	Capital Cost: Total	O&M Cost: Old Landfill/ Sections I, II, and III	O&M Cost: Section IV	Total Annual Cost
1	2011	Final Closure Section II / III	16.0			$1,854,000	$5,768,000	$1,171,110	$3,708,000	$10,647,110
		Construct Cell 2	7.6		$3,914,000					
2	2012	Design partial closure of Cell 1	5.0	$53,045			$53,045	$1,206,243	$3,819,240	$5,078,528
3	2013	Partial closure of Cell 1	5.0			$546,364	$934,282	$1,242,431	$3,933,817	$6,110,529
		Design Cell 3	7.1	$387,918						
4	2014	Construct Cell 3	7.1		$3,939,281		$3,939,281	$1,279,704	$4,051,832	$9,270,816
5	2015	Design partial closure of Cell 1, 2	8.0	$92,742			$92,742	$1,318,095	$4,173,387	$5,584,223
6	2016	Partial closure of Cells 1, 2	8.0			$955,242	$1,456,744	$1,140,320	$4,298,588	$6,895,652
		Design Cell 4	8.4	$501,502						
7	2017	Design partial closure of Cells 1, 2, 3	8.0	$98,390			$5,263,860	$1,174,530	$4,427,546	$10,865,936
		Construct Cell 4	8.4		$5,165,470					
8	2018	Partial closure of Cells 1, 2, 3	8.0			$1,013,416	$1,013,416	$1,209,765	$4,560,372	$6,783,554
9	2019	Design Cell 5	6.5	$424,051			$424,051	$1,246,058	$4,697,183	$6,367,293
10	2020	Design partial closure of Cells 2, 3, 4	14.0	$188,148			$4,965,771	$1,283,440	$4,838,099	$11,087,310
		Construct Cell 5	6.5		$4,367,728					
		Design Cell 6	6.1	$409,894						
11	2021	Partial closure of Cells 2, 3, 4	14.0			$1,937,927	$6,159,841	$1,259,653	$4,983,242	$12,402,735
		Construct Cell 6	6.1		$4,221,913					
12	2022	Design Cell 7	7.1	$506,145			$506,145	$1,297,442	$5,132,739	$6,936,327
13	2023	Construct Cell 7	7.1		$5,213,295		$5,213,295	$1,336,366	$5,286,721	$11,836,382
14	2024	Design partial closure of Cells 5, 6	5.0	$75,629			$75,629	$1,376,457	$5,445,323	$6,897,409
15	2025	Partial closure of Cells 5, 6	5.0			$778,984	$778,984	$1,417,750	$5,608,683	$7,805,417
16	2026	Design Cell 8	7.1	$569,671			$569,671	$899,259	$5,776,943	$7,245,873
17	2027	Design partial closure of Cells 5, 6, 7	8.0	$132,228			$5,999,837	$954,024	$5,950,251	$12,904,112
		Construct Cell 8	7.1		$5,867,609					
18	2028	Partial closure of Cells 5, 6, 7	8.0			$1,361,946	$1,361,946	$982,644	$6,128,759	$8,473,350
19	2029						$-	$982,644	$6,312,622	$7,295,266
20	2030	Design Cell 9	6.9	$623,108			$ 731,475	$1,042,487	$6,502,000	$8,275,963
		Design partial closure of Cells 6, 7, 8	6.0	$108,367						

Notes:

Based on an annual rate increase of 3%.
New Cell: Based on $500,000/acre.
Partial Closure: Based on $100,000/acre.

Design: Based on 10% of construction cost.
O&M: Based on Section II/III Final Closure Plan financial assurance calculations.
O&M Section IV: Based on County's long-term maintenance calculations.

TABLE 12-2

POTENTIAL OPERATING COSTS FOR BROOME COUNTY'S SOLID WASTE MANAGEMENT PLAN UPSTREAM DIVERSION PROGRAM ELEMENTS

Planning Year	Calendar Year	Selected Upstream Diversion Program Elements				Total Annual Operating Cost
		CII&M[(1)]	HHW/Electronics[(2)]	Organics Diversion	C&D[(3)]	
Estimated Cost in 2010 $		$79,200	$160,000	Varies	$395,000	
1	2011	$62,200	$164,000	$ -		$ 227,000
2	2012	$97,700	$169,000	$ 5,300		$ 272,000
3	2013	$115,000	$174,000	$ 5,500		$ 295,000
4	2014	$133,000	$180,000	$22,500		$ 335,000
5	2015	$152,000	$185,000	$23,200	$458,000	$ 818,000
6	2016	$172,000	$191,000	$788,000	$472,000	$ 1,622,000
7	2017	$193,000	$196,000	$812,000	$486,000	$ 1,687,000
8	2018	$215,000	$202,000	$836,000	$500,000	$ 1,754,000
9	2019	$239,000	$208,000	$861,000	$515,000	$ 1,824,000
10	2020	$263,000	$215,000	$887,000	$531,000	$ 1,896,000
11	2021	$289,000	$221,000	$914,000	$547,000	$ 1,971,000
12	2022	$316,000	$228,000	$941,000	$563,000	$ 2,048,000
13	2023	$345,000	$234,000	$969,000	$580,000	$ 2,129,000
14	2024	$375,000	$241,000	$998,000	$598,000	$ 2,212,000
15	2025	$406,000	$249,000	$1,028,000	$615,000	$ 2,299,000
16	2026	$439,000	$256,000	$1,059,000	$634,000	$ 2,389,000
17	2027	$474,000	$264,000	$1,091,000	$653,000	$ 2,482,000
18	2028	$510,000	$272,000	$1,124,000	$673,000	$ 2,578,000
19	2029	$548,000	$280,000	$1,157,000	$693,000	$ 2,678,000
20	2030	$588,000	$288,000	$1,192,000	$713,000	$ 2,782,000

(1) CII&M = Commercial, institutional, and multi-family recycling.
(2) HHW/Electronics = Household hazardous waste and electronics recycling.
(3) C&D = Construction and demolition debris recycling.

TABLE 12-2 (continued)

Planning Year	Calendar Year	Selected Upstream Diversion Program Elements				Estimated Capital Outlay	Equivalent Annual Debt Retirement
		CII&M	HHW/Electronics	Organics Diversion	C&D		
Estimated Cost in 2010 $		$75,000	$100,000	Varies	$2,294,000		
1	2011	$77,300	$103,000	$ -	$ -	$180,000	$21,800
2	2012	$ -	$ -	$ -	$ -	$ -	$22,400
3	2013	$ -	$ -	$31,800	$ -	$31,800	$23,100
4	2014	$ -	$ -	$ -	$ -	$ -	$23,800
5	2015	$ -	$ -	$281,000	$2,659,000	$2,941,000	$390,000
6	2016	$ -	$ -	$ -	$ -	$ -	$402,000
7	2017	$ -	$ -	$ -	$ -	$ -	$414,000
8	2018	$ -	$ -	$ -	$ -	$ -	$426,000
9	2019	$ -	$ -	$ -	$ -	$ -	$439,000
10	2020	$ -	$ -	$9,552,000	$ -	$9,552,000	$1,640,000
11	2021	$ -	$ -	$ -	$ -	$ -	$1,660,000
12	2022	$ -	$ -	$ -	$ -	$ -	$1,710,000
13	2023	$ -	$ -	$ -	$ -	$ -	$1,762,000
14	2024	$ -	$ -	$ -	$ -	$ -	$1,814,000
15	2025	$ -	$ -	$ -	$ -	$ -	$1,377,000
16	2026	$ -	$ -	$ -	$ -	$ -	$1,419,000
17	2027	$ -	$ -	$ -	$ -	$ -	$1,461,000
18	2028	$ -	$ -	$ -	$ -	$ -	$1,505,000
19	2029	$ -	$ -	$ -	$ -	$ -	$1,550,000
20	2030	$ -	$ -	$ -	$ -	$ -	$1,597,000

(1) CII&M = Commercial, institutional, and multi-family recycling.
(2) HHW/Electronics = Household hazardous waste and electronics recycling.
(3) C&D = Construction and demolition debris recycling.

Based on an annual interest rate of 3%.
All future costs based on (F/P,i%,n), or (1+i%)^n
Equivalent annual debt requirements based on (A/P,i%,n), or [i(1+i)^n]/[(1+i)^n -1] with interest at 5% for 10 years of financing.

13.0 FUTURE ACTIONS TO FURTHER THE SWM HIERARCHY

13.1 SCOPE OF EXISTING RECYCLABLES RECOVERY PROGRAMS

The existing recyclables recovery programs are described in Chapters 3 and 4 of this document as well as R.W. Beck's Recyclable Materials Characterization Study (Appendix A). All residential and commercial recycling is coordinated and processed by private companies, but the County records and reports recycled material tonnages to the State. The County will store HHW and E-waste at the landfill for private businesses, but does not process any material. As shown in Table 3-1, the County achieved a diversion rate of 48 percent in 2007 by recycling tires, HHW and E-wastes, and residential and commercial recyclables; and by composting yard wastes and biosolids.

13.2 FACILITY SIZING

The implementation of the priority programs presented under this Local Solid Waste Management Plan Update requires minimum capital investment for new facilities. The upstream and downstream diversion programs will be implemented using existing infrastructure; expansion of program features; and continued investment in landfill disposal. However; the HHW and E-waste drop-off and storage center at the County landfill will be expanded to accommodate increases in material resulting from extended hours of operation and potential increased public participation rate. The current composting facility will initially be expanded as part of a demonstration project using the existing area and equipment. Development of a full scale composting facility is not anticipated during the first ten years of the plan and actual sizing of this facility is dependent upon the results of the demonstration project, available feedstock, and discussions with the FAA (with respect to proximity of the airport). C&D debris will continue to be disposed in the landfill until a final decision is reached regarding processing and recovery of recyclables based on demonstration projects or private participation. The CII&M program will require additional processing of recyclables under the County's existing contract or through multiple processing contracts. No new facilities are anticipated.

13.3 RECYCLING PROGRAM ENHANCEMENT

As described in Chapter 7, the County will pursue four upstream diversion activities (i.e., activities that promote reducing, recycling, and reusing products before reaching the County's landfill). The following describes the four upstream diversion activities.

A. **Commercial, Industrial, Institutional and Multi-family Recycling.** This program expansion will focus on recycling collection programs at commercial and industrial sites; institutional facilities (i.e., schools, universities, hospitals, prisons, etc.); and multi-family residential units of five or more families. It is estimated that this program could encompass 6,000 to 7,000 building units. The potential to increase recycling participation is significant depending on the amount of staff time and funds that are dedicated to these efforts.

B. **HHW and Electronics Recycling.** This initiative involves expansion of the County's existing HHW and E-waste Program. HHWs are household products that contain corrosive, toxic, flammable, or reactive ingredients, warranting their diversion from the landfill, transfer stations, and other waste disposal sites in order to protect ground and surface waters from accidental release. E-wastes and HHW currently comprise about 1 percent of the MSW stream by volume and have high potential for harmful toxins to enter the surrounding groundwater. Regulations are already in place banning HHW from landfills, but this waste stream is not yet fully captured.

C. **Construction and Demolition (C&D) Debris Recycling.** This program would encourage separation of C&D debris for recycling or reuse at the job site of a construction, demolition, or remodeling project. As more buildings are built to achieve LEED[6] accreditation, deconstruction verses demolition will increase since one of the LEED accreditation points involves utilization of recycled or reused construction materials. In addition, the County will consider reduced landfill tip fee rates for those businesses or construction contractors that can document and certify that C&D recycling was completed on site as part of the construction process. This incentive will provide an offset to the additional costs to residents or businesses for deconstruction and on-site recycling efforts.

D. **Organics Diversion.** This program will encourage private participation to increase diversion of organics (yard waste, food scraps, wood waste) from the landfill, including backyard composting, grasscycling, food donations, and small-scale vermicomposting (worm composting in containers). These activities include continuation of the sale of backyard composting containers as well as public outreach, educational materials, and guidance to commercial and institutional establishments regarding organics diversion and on-site composting practices.

[6] LEED (Leadership in Energy and Environmental Design): According to the U.S. Green Building Council website**:** LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

13.4 PROCUREMENT PRACTICES FOR PRODUCTS WITH RECYCLED CONTENT

Although the Broome County Division of Solid Waste utilizes products with recycled content and encourages the use of recycled products for all county departments, there currently are no local procurement laws that specifically mandate the use of products with recycled content. The County supports extended producer responsibility, an environmental policy approach requiring producers to accept responsibility for recycling, reusing, or disposing of their own products. This policy approach encourages products to be made with materials that are easily recycled, potentially increasing the County's landfill diversion rate and reducing the amount of hazardous substances entering the landfill.