Broward County

SOLID WASTE AND RECYCLING ISSUES STUDY

Interim Final Report

August 22, 2018

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Interim Final Report

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Broward County

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ACRONYMS AND ABBREVIATIONS

BEBR	Bureau of Economic and Business Research
Board	Resource Recovery Board
BW	Bulky Waste
C&D	Construction and Demolition
Carbone	United States Supreme Court decision in C&A Carbone, Inc. vs. Town of Clarkstown 511 U.S. 383 (1994)
CY	Calendar Year
ENR	Engineering News-Record's
F.S.	Florida Statute
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
Former District	Solid Waste Disposal District
LOS	Level of Service
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MWP	Mixed Waste Processing
No America	North America
NPV	Net Present Value
OCC	Old Corrugated Containers (or Old Corrugated Cardboard)
OP	Organics Processing
Park	Tradewinds Park
PAYT	Pay As You Throw
PET	Polyethylene Terephthalate
POV	Personally Occupied Vehicle
R&R	Repair and Replacement
SE USA	Southeast United States
Site	Alpha 250 Site
Study Report	Solid Waste and Recycling Issues Study Report
SWRS	Solid Waste and Recycling Services
System	Resource Recover System

tpd	Tons per day
tph	Tons per hour
tpy	Tons per year
United Haulers	Supreme Court ruling, United Haulers Association Inc. v. Oneida-Herkimer Solid Waste Management Authority, 550 U.S. 330 (2007)
Working Group	Solid Waste Working Group
Workshop	Interim Governance Workshop with the Working Group on February 28, 2018
WSB	Wheelabrator South Broward
WTE	Waste-to-Energy
YT	Yard Trash
ZBA	City of Pompano Beach Zoning Board of Appeals
Zoning Code	City of Pompano Beach Planning and Zoning Code

EXECUTIVE SUMMARY

The Arcadis Team, consisting of Arcadis, U.S., Inc., Kessler Consulting, Inc., Total Municipal Solutions, L.L.C, and GMAC Consulting, L.L.C., was selected to prepare this Solid Waste and Recycling Issues Study Report (Study Report). The goals of the Study Report were to evaluate and provide recommendations regarding the following:

1. How a 75 percent County-wide recycling goal may be reached.
2. Whether retaining public ownership of Alpha 250 would facilitate the meeting of that recycling goal or would provide other benefits in connection with solid waste disposal within Broward County.
3. General solid waste disposal issues as determined by the Working Group which may include options regarding flow control and potential governance or contractual structures for collaborative management of solid waste disposal.

The following summarizes the findings of the Study Report and recommended next steps.

Reaching A 75 Percent County-Wide Recycling Goal

The Arcadis Team reviewed a wide array of existing data and information to estimate the overall composition of waste generated within Broward County. Population and solid waste quantity projections were modeled to estimate the quantity of solid waste generated throughout the 20-year and 40-year project planning periods, extending to year 2060. These solid waste composition and quantity estimates were then used to identify and evaluate waste diversion alternatives and options needed to assist Broward County in achieving the State's 75 percent recycling goal by 2020.

Short-term, mid-term, and long-term approaches were evaluated for increasing the County's recycling rate which were then prioritized based on options of greatest interest to the Working Group. Three scenarios were developed that could assist the County in achieving the 75 percent recycling goal. All three scenarios assume that short-term strategies and actions, outlined in Table ES-1 below, would be implemented, which include the following:

- Increased source-separation of recyclables through enhanced programs and mandates;
- Increased bulky waste, yard trash, and C&D debris recycling by requiring processing prior to disposal; and
- Establishing minimum recycling standards for processing facilities.

Table ES-1: Common Short-Term Strategies and Actions for all Scenarios

		Policies	Programs	Facilities
SHORT-TERM – 2018-2020	C&D, Bulky Waste & Yard Trash	Require C&D debris, bulky waste & mixed bulky waste/yard trash to be processed prior to disposal Set minimum C&D recycling rate (linked to permits & fees) Set minimum recycling rate for processing facilities	Develop implementation program, including standards, reporting, monitoring & enforcement Provide technical assistance during implementation	Utilize existing facilities in near-term Construct C&D/bulky waste processing facilities as needed Construct yard trash processing facilities
	Commercial Recycling	Require new multi-family and commercial developments to provide adequate space for recycling Require multi-family complexes and commercial businesses to establish comprehensive recycling programs	Develop implementation program, including standards, reporting, monitoring & enforcement Provide technical assistance during implementation	Utilize existing facilities in near-term Construct single stream MRF
	Residential Recycling	Maintain existing processing contracts; limit term to keep options open Direct (some or all) recyclables to publicly owned MRF upon completion	Comprehensive & coordinated marketing campaign Evaluate Pay As You Throw (PAYT) on case-by-case basis	Utilize existing facilities in near-term Construct single stream MRF

	Policies	Programs	Facilities
Energy Credits	Maintain existing disposal contracts; limit term to keep options open Commit to directing waste to regional WTE facility upon expiration	Not Applicable	Evaluate feasibility of purchasing or entering into long-term WTE contract with Wheelabrator South Based on waste commitment, evaluate need for additional WTE capacity

The three scenarios differ in how mixed residential and commercial waste that is not source-separated for recycling would be managed and include processing at a combination of the following six types of solid waste processing facilities:

- Materials Recycling Facility (MRF): receives, separates and prepares recyclable materials for marketing to end-user manufacturers.
- Combined Bulky Waste (BW)/Yard Trash (YT)/Construction & Demolition Debris (C&D) Processing Facility – receives and processes bulk waste, which includes waste types that are too large to be accepted by the regular waste collection; yard trash, which is vegetative matter resulting from landscaping maintenance or land clearing operations; and construction and demolition debris, which includes the discarded materials from construction/demolition activities.
- Yard Trash (YT) Processing Facility: receives vegetative matter resulting from landscaping maintenance or land clearing operations and is processed into a size-reduced, usable material or is composted.
- Mixed Waste Processing (MWP) Facility: receives a mixed solid waste stream, separates designated recyclable materials through a combination of manual and mechanical sorting.
- Organics Processing (OP) Facility (excludes Yard Trash) – receives organic solid waste stream that is processed using a composting technology, such as physical turning, windrowing, aeration, or other mechanical handling of organic matter.
- Waste-to-Energy (WTE) Facility – receives solid waste which is combusted to generate electricity.

A summary description of how each of the scenarios will process the solid waste stream that is not captured and processed through the Common Element short term strategies and actions is summarized below.

Scenario A - Mixed waste would be processed at a MWP Facility. Recyclables would be recovered and marketed and wet organics would be recovered and processed. Residuals would go to WTE.

Scenario B - Mixed waste would be processed at a MWP Facility. Recyclables would be recovered and marketed; residuals would go to WTE.

Scenario C - Mixed waste would go to WTE.

Projection models of these scenarios indicate the potential for the County to attain a 64 percent recycling rate by 2020 and to approach or achieve 75 percent recycling by 2025 should the proposed policies, programs, and facilities described in the Study Report be fully and effectively implemented.

Alpha 250 Site Evaluation

The Arcadis Team evaluated the Alpha 250 site to determine if it could be utilized for construction of one of the six types of solid waste processing facilities that would assist the County in achieving the 75 percent recycling goal. A preliminary review of the evaluation criteria of the Alpha 250 site indicated that there are no constraints or limitations precluding the North Alpha 250 Site from being a viable location for the development of some of the proposed facilities that would enable the County to attain the 75 percent recycling goal.

Retaining the North Alpha 250 Site in public ownership for solid waste purposes is recommended. However, additional investigations, such as geotechnical and environmental, must be conducted at the Site and investigation of the constraints and limitations checklist would need to be revisited in consideration of the conceptual design of the selected facility(ies) to be developed.

Alternatives and Options for the Future of Solid Waste Management

Recommended Governance Structure – Independent Special District

Based on the feedback received during the Study kick-off meeting, the Interim Governance Workshop, as well as review of historical documentation, reports and existing hauling and processing contracts, the Arcadis Team recommends that the Working Group and County move towards creating an independent special district. This form of governance structure was selected as it provides a mechanism that does not allow a large City or the County to control the district. An independent solid waste district creates a collaborative governance structure, enabling both the County and Cities to participate in policy decisions.

Recommended Public/Private Ownership Options

Broward County and participating Cities have developed publicly owned and operated facilities as well as signed disposal agreements with private entities serving as both owner and operator. However, since the dissolution of the former System left the County and Cities with the majority of in-County processing and disposal options controlled by the private sector, the Arcadis Team recommends developing the selected solid waste processing facilities through a public/private partnership ownership option. This will provide for public ownership of the solid waste facility(ies) constructed and financed by the New District, provide more control and input into the daily operations and maintenance activities of the facility(ies), as well as provide the opportunity to negotiate the terms of the operating agreement with the selected private entity.

Conceptual-Level Cost Estimate

The Arcadis Team prepared conceptual construction cost estimates for the construction of the facilities required to meet the 75 percent recycling goal. To assist the Working Group and County with evaluating the relative financial impact of each facility, a conceptual-level construction cost estimate for the common system elements (i.e. MRF, Combined BW/YT/C&D Facility and YT Facility), and for each of the three proposed solid waste flow scenarios identified, including MWP, wet organic, and WTE facilities over the short, mid, and long-term planning periods, were developed and are summarized in Table ES-2.

Table ES-2 Conceptual-Level Construction Cost Estimates for Recommended Facilities/Processing Lines

Scenario [1]	2025 Est. Facility Cost (2020 dollars)	2040 Est. Facility Cost (2020 dollars)	2060 Est. Facility Cost (2020 dollars)
Scenario A[2]			
Assuming 4th WTE Unit @ South Broward	$ 329,000,000	$ 332,000,000	$ 549,000,000
Assuming New WTE Facility	$ 1,004,000,000	$ 1,007,000,000	$ 1,269,000,000
Scenario B			
Assuming 4th WTE Unit @ South Broward	$ 457,000,000	$ 460,000,000	$ 497,000,000
Assuming New WTE Facility	$ 1,222,000,000	$ 1,225,000,000	$ 1,262,000,000
Scenario C[3]			
Assuming 4th WTE Unit @ South Broward	$ 285,000,000	$ 288,000,000	$ 308,000,000
Assuming New WTE Facility	$ 1,050,000,000	$ 1,053,000,000	$ 1,388,000,000

Note 1: Scenario costs also include the estimated construction cost for the common element facilities.

Note 2: System waste can be processed within the existing capacity of WSB in the short and mid-term planning period, 2025 and 2040, assuming capacity at WSB will be reserved for system-supplied waste. Therefore the estimated construction cost associated with the addition of a 4th 750 tpd processing line at WSB is only noted in the long-term planning period of 2060 for Scenario A.

Note 3: For the mid and long-term planning period of 2040 and 2060 for Scenario C, a 2nd 750 tpd processing line is required but is not possible due to the existing design of WSB. Therefore the estimated construction cost assumes one processing line.

The MRF, Combined BW/YT/C&D Facility, YT Facility and MWP Facility provide for operational flexibilities, as they could be operated on a two shift-per-day basis, which would maximize waste processed, minimize the number of facilities and/or processing lines required and potentially decrease the conceptual level construction cost estimates.

Also note that while construction cost is a major contributor to the overall cost of a facility, there are other costs to consider that are not included in this analysis. Cost considerations do not include annual operating fees, operations and maintenance, pass through, residue transport and disposal, metals recovered transport, purchase of land, financing, engineering, legal, permitting and procurement. Additionally, revenue generation opportunities are also present for each type of facility that is incorporated into the proposed solid waste system.

Once a scenario, or part thereof is selected, a full net present value (NPV) analysis and feasibility study for each facility selected should be conducted, including a detailed construction cost estimate, estimate of the additional costs noted above, as well as estimate the revenue that could be generated by the selected facility(ies).

1 PROJECT INTRODUCTION

Broward County entered into an Interlocal Agreement (ILA) in 1987 with 26 of 31 municipal cities, which created the Resource Recovery Board (Board) and Resource Recovery System (System). The ILA expired in 2013, leaving all parties individually responsible to administer contracts for the disposal of their solid waste streams, or enter into a new agreement under new conditions. Legal action ensued after the ILA expiration to liquidate assets gained and distribute funds. On April 7, 2015, Broward County and the Board/System settling parties entered into a settlement agreement, which resolved litigation over the distribution of assets and liabilities resulting from the expiration of the ILA. The settlement agreement included a process for the sale of the Alpha 250 Site, with net proceeds from the sale to be distributed to the cities that are party to the litigation.

On June 14, 2016, the first amendment to the settlement agreement was entered, which delayed the sale of the Alpha 250 site. The purpose of the delay was to allow the cities and Broward County to perform a study of various solid waste and recycling issues. Specifically, the first amendment stipulated that the study evaluate and provide recommendations regarding the following:

1. How a 75 percent County-wide recycling goal may be reached.
2. Whether retaining public ownership of Alpha 250 would facilitate the meeting of that recycling goal or would provide other benefits in connection with solid waste disposal within Broward County.
3. General solid waste disposal issues as determined by the Working Group which may include options regarding flow control and potential governance or contractual structures for collaborative management of solid waste disposal.

A Solid Waste Working Group (Working Group) was then formed, consisting of three members selected by the mayors of cities which are parties to the settlement agreement and three Broward County staff members selected by the Broward County Administrator. The Working Group created a base scope of work consisting of twelve tasks that became the Solid Waste and Recycling Issues Study and would provide the Working Group with the information needed to evaluate the three issues identified above. The Working Group presented the final scope of work to Broward County Procurement, which after approval from the Broward County Commission, issued solicitation request R2113804P1 in March 2017.

Arcadis, U.S., Inc., Kessler Consulting, Inc., Total Municipal Solutions, L.L.C, and GMAC Consulting, L.L.C., collectively referred to as the Arcadis Team, responded to the solicitation and were selected in June 2017. The Arcadis Team commenced work on this effort in October 2017, when notice to proceed was given. The project kickoff meeting was held in December 2017 with the Solid Waste Quantity and Solid Waste Composition White Papers issued to the County and Working Group in January 2018. The data collected as part of the development of the Solid Waste Quantity and Composition White Papers was then utilized to develop the Alternatives and Options for Improvement to Achieve Recycling Goals (Alternatives and Options White Paper) and was issued to the County and Working Group in May 2018. The Alternatives and Options White Paper answered the Working Group’s first question, demonstrating how the 75 percent County-wide recycling goal might be achieved through the implementation of policies, programs and solid waste processing and disposal facilities. A Technical Memorandum was then developed and issued in June 2018 to address the questions associated with retaining the Alpha 250 Site in public ownership, how to address general solid waste disposal issues identified by the Working Group and provide construction cost estimates for the facilities identified in the Alternatives and Options White Paper. This Solid Waste and Recycling Issues Study Report (Study Report) documents the findings of this effort. The following sections summarize the findings of the Solid Waste and Recycling Issues Study.

2 SOLID WASTE COMPOSITION ESTIMATE

To identify the policies, programs and facilities that could assist Broward County in reaching the State 75 percent recycling goal, the Arcadis Team first estimated the current composition of solid waste disposed and recycled (referred to collectively as solid waste generated) within Broward County. This analysis enabled the Arcadis Team to identify the types and quantities of materials currently disposed that could potentially be recycled. The following subsections detail the methodology associated with developing the solid waste composition estimate as well as the findings.

2.1 Solid Waste Composition Estimate Methodology

2.1.1 Step 1 – Evaluate County Data

The Arcadis Team reviewed a wide array of data and information provided by the County and the City of Coconut Creek. The primary information used in this analysis included the following:

- Annual reports to the Florida Department of Environmental Protection (FDEP), focusing primarily on 2014-2016;
- Backup information and documentation from the 2014, 2015 and 2016 annual reports, including certified and non-certified recycling tonnage, construction and demolition (C&D) debris reports, County's MSW Management Worksheets, and facility reports; and
- Tonnage clarifications provided by Broward County Solid Waste and Recycling Services (SWRS) staff.

Based on this data, the Arcadis Team compiled the following information for each of the three years:

- Types and quantities of materials recycled; and
- Quantities of solid waste disposed, broken down by Class I solid waste, bulky waste, C&D debris, and yard trash.

Since a clear distinction could not always be made between bulky waste and C&D debris, for the purposes of this Study Report, an assumption was made after discussion with SWRS staff that landfilled waste listed as C&D debris or yard trash would be included as such, and all other landfilled Class III waste would be considered bulky waste. **Table 1** provides a summary of the quantities of solid waste recycled and disposed during 2014-2016 and the averages of the three years of data.

The Arcadis Team then evaluated the data to develop a reasonable set of tonnage data to which waste composition assumptions would be applied. As can be seen in **Table 1**, a significant reduction in the quantities of certified recycled C&D debris and land clearing debris occurred over the course of the three years. Review of facility data revealed that the decrease in C&D debris recycling (from 932,500 tons in

2014 to 259,862 tons in 2016) was closely aligned with the decrease in C&D debris recycling reported by the Sun Recycling facilities (from 906,797 tons in 2014 to 254,078 tons in 2016). Likewise, the decrease in land clearing debris recycling (from 164,363 tons in 2014 to 0 tons in 2016) was closely aligned with the decrease in land clearing debris recycling reported by the Sun Recycling facilities (from 145,743 tons in 2014 to 0 tons in 2016). These reductions coincided with a change in ownership of the Sun Recycling facilities and were, therefore, not considered an anomaly. To more closely reflect current waste generation and management practices, the 2016 tonnage data was weighted more heavily when developing tonnage data for composition analysis purposes.

Table 1: Broward County Solid Waste Recycled and Disposed, 2014-2016 (tons/year)

	2014	2015	2016	Average	Tonnage for Analysis Purposes
Certified Recycled	293,915	395,293	330,981	363,137	340,000
Non-Certified Recycled	92,459	362,674	610,399	486,537	600,000
Certified C&D Debris Recycled	932,500	630,730	259,862	445,296	270,000
Certified Land Clearing Debris Recycled	164,363	143,840	0	71,920	0
Cover Material	83,161	46,640	5,692	26,166	20,000
Total Recycled	**1,566,398**	**1,579,177**	**1,206,934**	**1,393,055**	**1,230,000**
Class I Waste Disposed	1,448,181	1,369,733	1,282,311	1,326,022	1,300,000
Bulky Waste Disposed	139,805	405,109	223,653	314,381	270,000
C&D Debris Disposed	438,464	316,537	770,296	543,417	700,000
Yard Trash Disposed	7,410	24,441	115,498	69,970	100,000
Total Disposed	**2,033,859**	**2,115,820**	**2,391,758**	**2,253,789**	**2,370,000**
Total Generated	**3,600,257**	**3,694,997**	**3,598,692**	**3,646,844**	**3,600,000**

Note 1: Certified Recycled, Certified C&D Debris Recycled, and Certified Land Clearing Debris Recycled are recyclables reported in FDEP's certified recycling reports.
Note 2: Non-Certified Recycled is additional recycled materials identified by County staff that were not included in FDEP's certified recycling reports.
Note 3: Cover Material is material used as alternative landfill cover considered by FDEP to be recycling.
Note 4: Class I Waste Disposed is solid waste that contains putrescible materials likely to cause leachate in a landfill and that was disposed in a waste-to-energy facility or Class I landfill.
Note 5: Bulky Waste Disposed is solid waste that is bulky in size, does not contain putrescible materials, and was disposed in a Class III landfill.
Note 6: C&D Debris Disposed is C&D debris disposed in a Class III landfill.
Note 7: Yard Trash Disposed is yard trash disposed in a Class III landfill.

2.1.2 Step 2 – Assess Recent Waste Composition Studies

The Arcadis Team compiled and evaluated recent waste composition studies conducted for urban Florida counties and cities. The Arcadis Team then focused on studies conducted within the last five years for large counties or communities with waste management programs similar to programs in Broward County. The following waste composition studies were included in the final analysis:

- Hillsborough County (2015)
- Pinellas County (2014)

- Miami-Dade County (2010)
- City of Oakland Park (2015)
- City of Coral Springs (2011)
- City of Tampa (2017)

Miami-Dade County, Hillsborough County, and Pinellas County were selected based on population and similarities in use of combustion. The City of Tampa also uses waste-to-energy technology and was conducted recently, therefore it was included. The City of Oakland Park and City of Coral Springs studies were also included because they are located within Broward County. Although two of the studies above are more than five years old, they were included for the reasons mentioned above. Additionally, comparison of results from the older studies with the more recent studies did not indicate that they were outdated or not worthy of inclusion.

The material composition data from these six studies was then averaged, and the averages were applied to the tonnage of Class I waste disposed. **Table 2** provides the results of this analysis.

Table 2: Estimated Average Composition of Broward County Class I Waste Disposed

Material Category	Estimated Class I Waste Disposed (percent by weight)	Estimated Class I Waste Disposed (tons)
Newspaper	2.1%	27,300
Corrugated Cardboard	7.9%	102,700
Office Paper	1.8%	23,400
Aseptic Cartons	0.3%	3,900
Mixed Paper	6.7%	87,100
#1 PET Bottles	1.8%	23,400
#2 HDPE Containers	1.0%	13,000
Other #1-#7 Plastic Containers	1.6%	20,800
Glass Containers	3.8%	49,400
Steel Cans	1.1%	14,300
Aluminum Cans	0.6%	7,800
Recyclable Paper and Containers	**28.7%**	**373,100**
Yard Trash	9.5%	123,500
Food Waste	14.9%	193,700
Compostable Paper	8.2%	106,600
Potential Compostables	**32.6%**	**423,800**
Bulky Rigid Plastics	1.6%	20,800
Other Ferrous	1.0%	13,000
Other Non-Ferrous	0.5%	6,500
White Goods	0.6%	7,800
Electronics	1.8%	23,400
Textiles	4.2%	54,600
Other Potential Recyclables	**9.7%**	**126,100**
Other Plastics	8.7%	113,100
C&D Debris	8.8%	114,400

Material Category	Estimated Class I Waste Disposed (percent by weight)	Estimated Class I Waste Disposed (tons)
Other Materials	11.5%	149,500
All Other Materials	**29.0%**	**377,000**
Total	**100.0%**	**1,300,000**

2.1.3 Step 3 – Assess Recent Audits of Bulky Waste and C&D Debris

The composition of bulky waste can be highly variable over time and based on the source and location. Because of the bulky nature of these materials, they are typically characterized using a visual audit procedure rather than manual sorting. To develop an estimate of the composition of Broward County's bulky waste, the Arcadis Team compiled and evaluated recent bulky waste visual audits conducted in other Florida jurisdictions.

The following bulky waste visual audits were included in the final analysis:

- Pinellas County (2014)
- Polk County (2011)
- City of Oakland Park (2015)

The material composition data from these three studies was averaged and the averages were applied to the estimated tonnage of bulky waste disposed. **Table 3** provides the results of this analysis.

Table 3: Estimated Average Composition of Broward County Bulky Waste Disposed

Material Category	Estimated Bulky Waste Disposed (percent by weight)	Estimated Bulky Waste Disposed (tons)
Corrugated Cardboard	1%	2,326
Other Paper	1%	1,568
Ferrous Metals	2%	5,407
Non-Ferrous Metals	1%	1,499
Plastics	2%	5,475
Furniture/Mattresses	8%	21,508
Electronics	3%	7,740
Yard Trash	20%	52,730
Treated Wood	16%	43,848
Untreated Wood	11%	30,838
Carpet and Padding	2%	5,912
Drywall	15%	40,439
Concrete	3%	8,939
Rock/Gravel/Grit	8%	20,799
Other C&D Debris	1%	3,800
Other Materials	6%	17,172
Total	**100%**	**270,000**

As with bulky waste, the composition of C&D debris can be highly variable. The composition can vary depending on whether it is a construction or demolition project and whether it is a residential building, commercial building, road, bridge, or other type of construction project, see Figures 1 and 2, respectively. Sufficient information regarding the C&D debris disposed in Broward County was not available to make these types of distinctions.

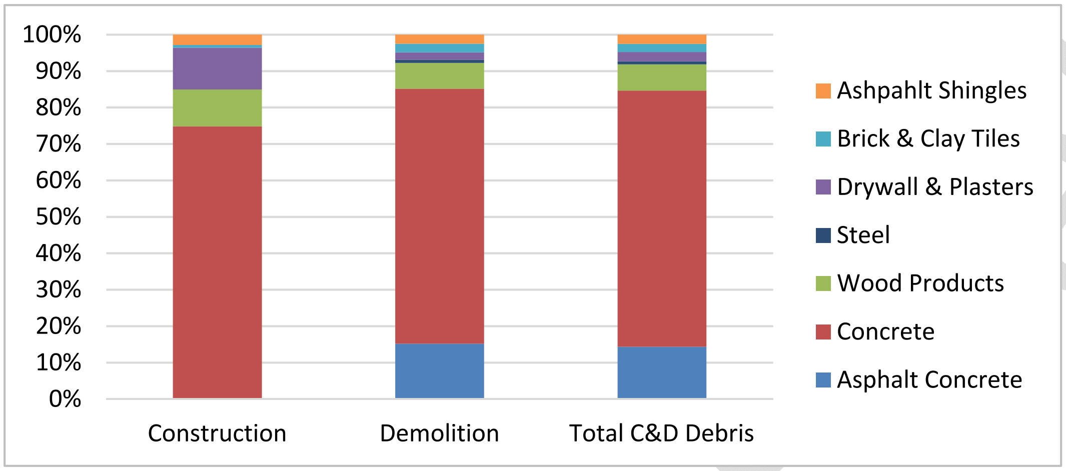


Figure 1: C&D Debris Generated by Material and Activity in the U.S. (percent by weight)
Source: US EPA, Construction and Demolition Debris Generation in the United States, 2014, December 2016.

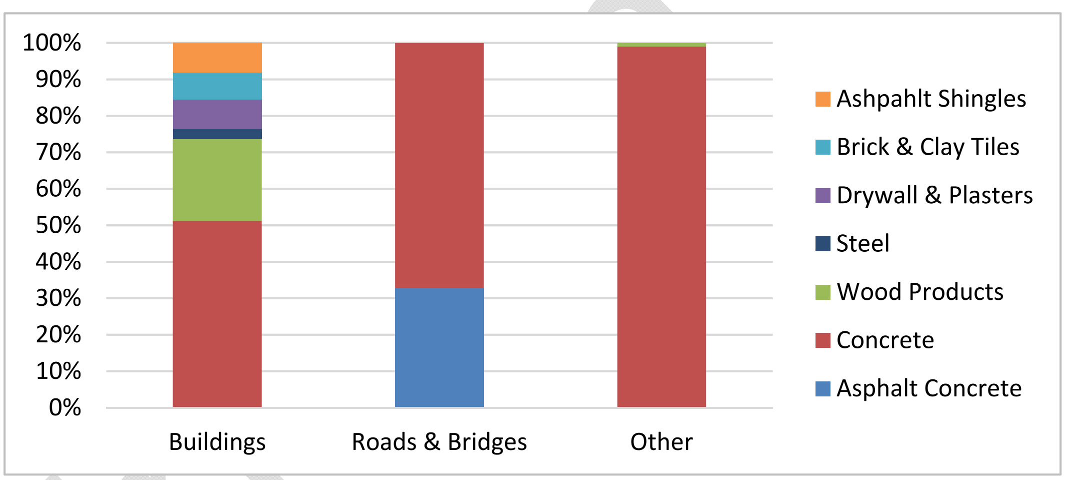


Figure 2: C&D Debris Generated by Material and Source in the U.S. (percent by weight)
Source: US EPA, Construction and Demolition Debris Generation in the United States, 2014, December 2016.

To develop a reasonable estimate of the composition of C&D debris disposed in Broward County, total C&D debris composition data in **Figure 1** was adjusted to account for the following:

1. Inclusion of land clearing debris and the exclusion of most asphalt as part of the C&D stream in Florida.
2. Current recycling activities in the County.

Table 4 provides an estimate of the composition of C&D debris disposed in Broward County.

Table 4: Estimated Average Composition of Broward County C&D Debris Disposed

Material Category	Estimated C&D Debris Disposed (percent by weight)	Estimated C&D Debris Disposed (tons)
Concrete	72%	504,000
Wood Products	8%	56,000
Drywall & Plasters	3%	21,000
Brick & Clay Tiles	3%	21,000
Asphalt Shingles	3%	21,000
Steel	1%	7,000
Land Clearing Debris	10%	70,000
Total Generated	**100%**	**700,000**

2.2 Solid Waste Composition Estimate Results and Findings

The results of the methodology outlined above were then combined to estimate the overall composition of waste recycled and disposed (collectively referred to as waste generated) within Broward County.

2.2.1 Composition of Solid Waste Generated

FDEP requires counties to report waste composition based on 18 material categories. **Table 5** and **Figure 3** provide the estimated composition, as developed through this analysis and broken down by FDEP's 18 categories, of the solid waste generated in Broward County. For comparison purposes only, **Exhibit A** compares the estimated composition resulting from this analysis with the composition as reported by the County in its 2016 annual report to FDEP.

Table 5: Estimated Average Composition of Solid Waste Generated in Broward County (percent by weight)

FDEP Categories	Estimated Composition of Waste Generated
Newspaper	1%
Glass	3%
Aluminum cans	0.4%
Plastic bottles	1%
Steel cans	1%
Corrugated cardboard	6%
Office paper	1%
Yard trash	10%
Other plastics	5%
Ferrous metals	5%
White goods	1%

FDEP Categories	Estimated Composition of Waste Generated
Non-ferrous metals	1%
Other paper	7%
Textiles	2%
C&D debris	44%
Food	5%
Miscellaneous	7%
Tires	0.1%
Total	**100%**

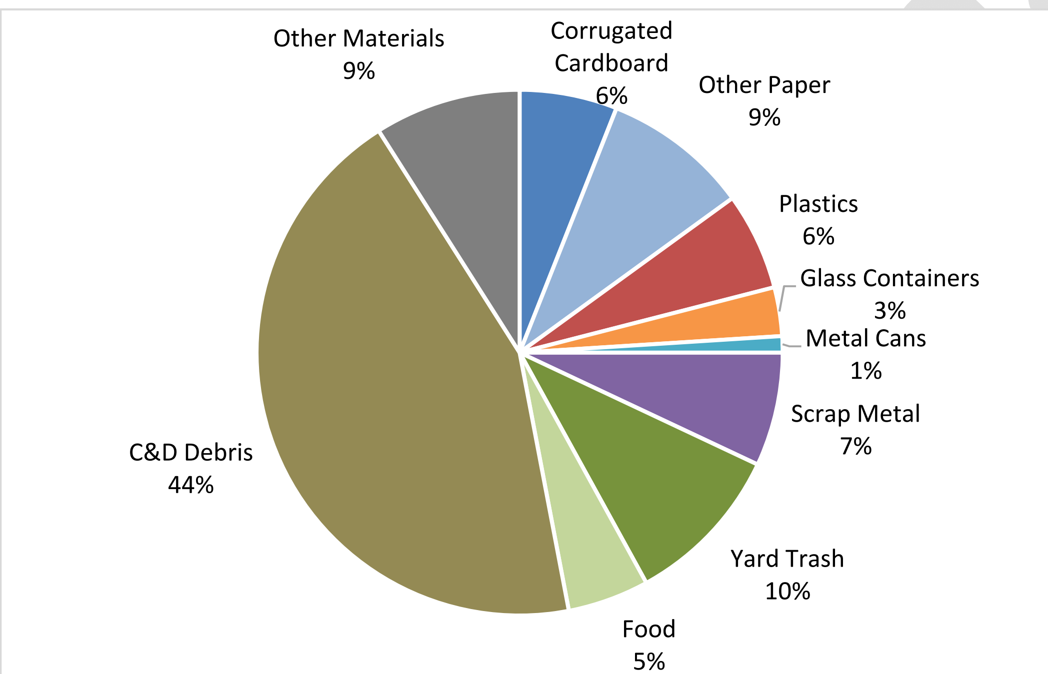


Figure 3: Estimated Average Composition of Solid Waste Generated in Broward County (percent by weight)

2.2.2 Composition of Materials Recycled

Figure 4 provides an estimated breakdown by type of Broward County materials recycled and **Figure 5** compares the estimated quantities of these materials recycled versus disposed.

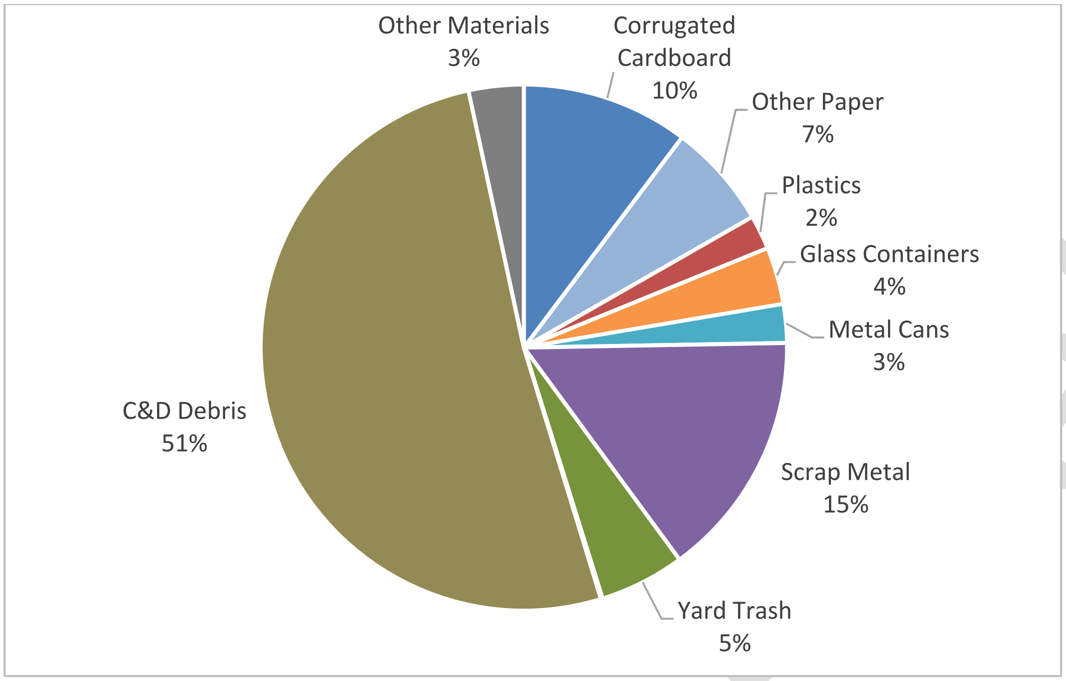


Figure 4: Estimated Average Composition of Broward County Materials Recycled (percent by weight)

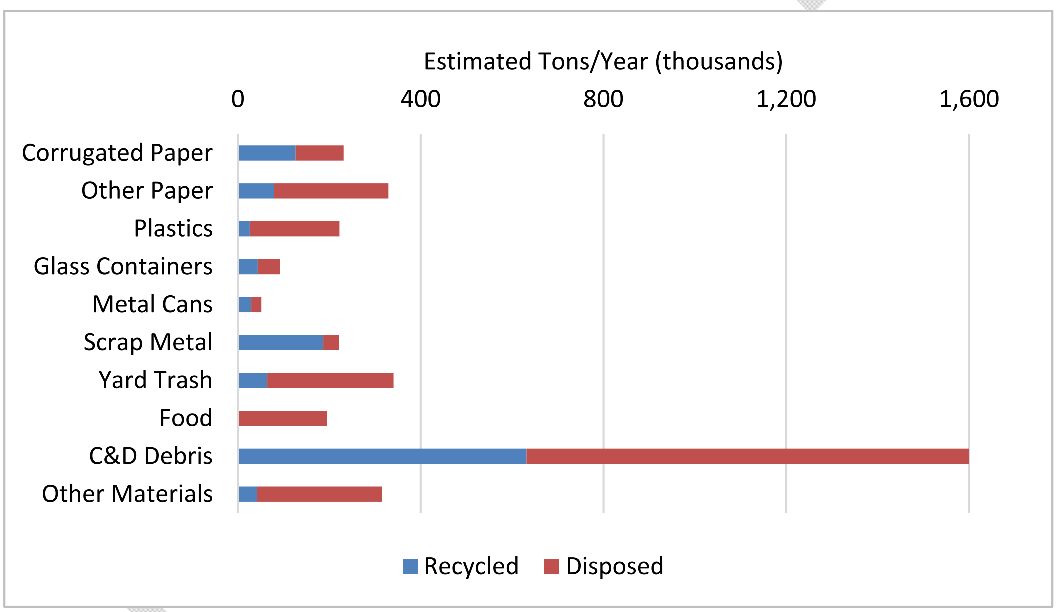


Figure 5: Comparison of Estimated Quantities of Broward County Materials Recycled versus Disposed

2.2.3 Composition of Solid Waste Disposed

Figure 6 provides the estimated composition of Broward County waste disposed. Materials are grouped based on source and the potential for recycling.

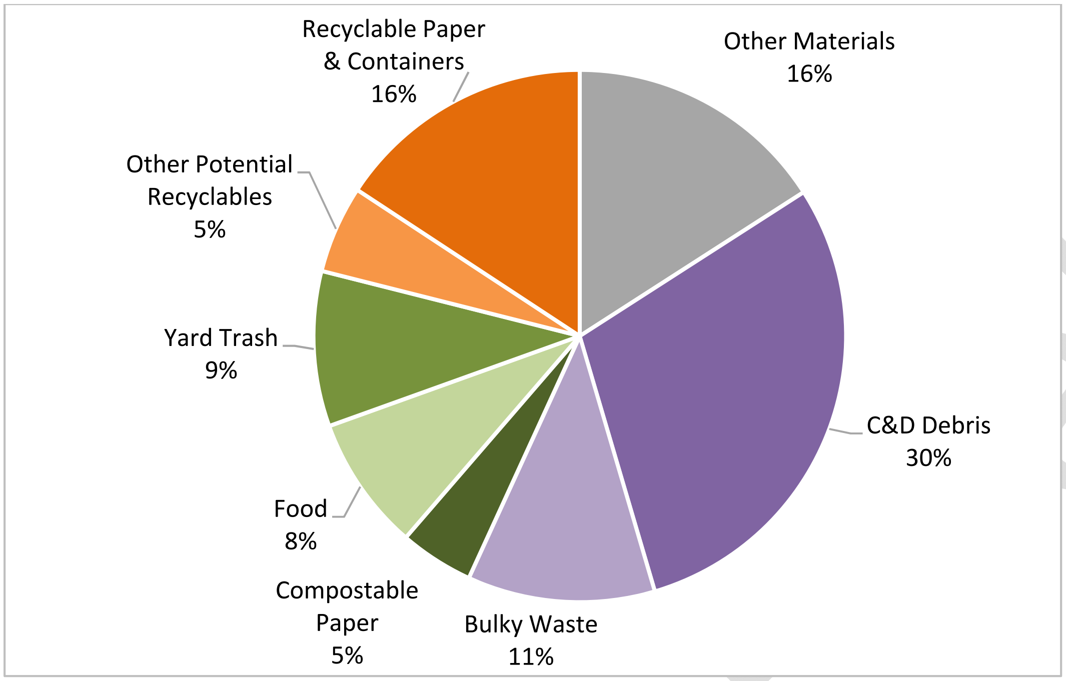


Figure 6: Estimated Average Composition of Broward County Waste Disposed (percent by weight)

Note 1: Other Potential Recyclables includes textiles, bulky rigid plastics, other ferrous and non-ferrous, white goods, and electronics.

In conclusion, this analysis provides a reasonable estimate of the composition of solid waste currently generated in Broward County for use in the strategic planning purposes of this study. It was based on available Broward County data and waste stream compositions in other Florida communities. Further confirmation of estimated tonnages may be warranted prior to investment in future facilities and infrastructure.

3 SOLID WASTE QUANTITY ESTIMATE

The Arcadis Team developed population and solid waste quantity projections to estimate the quantity of solid waste generated throughout the 20-year and 40-year project planning periods, which correlates to years 2037 and 2057, respectively. However, the projections developed were extended to year 2060 since projections typically fall into 5-year increments.

This information was then used to identify seven (7) geographic zones which were used to assess the capacity of Broward County's existing waste management system, to evaluate potential locations for solid waste facilities, and to serve as a baseline scenario for various system changes that could potentially improve waste reduction and recycling programs. The following subsections detail the methodology associated with developing the population and solid waste quantity estimates as well as the findings.

3.1 Solid Waste Quantity Estimate Methodology

3.1.1 Step 1 – Population Growth Projections

Waste projections are in part based on population growth. The Arcadis Team reviewed and assessed existing population studies, which included the following:

- 2014 Traffic Analysis and Zones and Municipal Forecasts Updates published by the Broward County Planning and Redevelopment Division;
- Preliminary results of the 2018 Traffic Analysis and Zones and Municipal Forecasts Updates (2018 TAZ) published by the Broward County Planning and Redevelopment Division;
- 2009 Broward County Population published by the Broward County Planning and Redevelopment Division; and
- Bureau of Economic and Business Research (BEBR) population projections published in 2012 and 2017.

Because the 2018 TAZ provided the most current population projections, it was selected to estimate future population projections. The 2018 TAZ provides population estimates for years 2015 through 2045. To forecast to year 2060, the Arcadis Team performed a linear trend assessment of both the TAZ population projections and the corresponding average annual percent growth rates. It was determined the forecast for years 2045 through 2060 would be based on the average annual percent growth rate linear trend, which resulted in a total estimated population of 2,279,042 in year 2060. The results of this assessment are provided graphically in **Figure 7**. The 2016 BEBR projections are also shown for reference purposes.

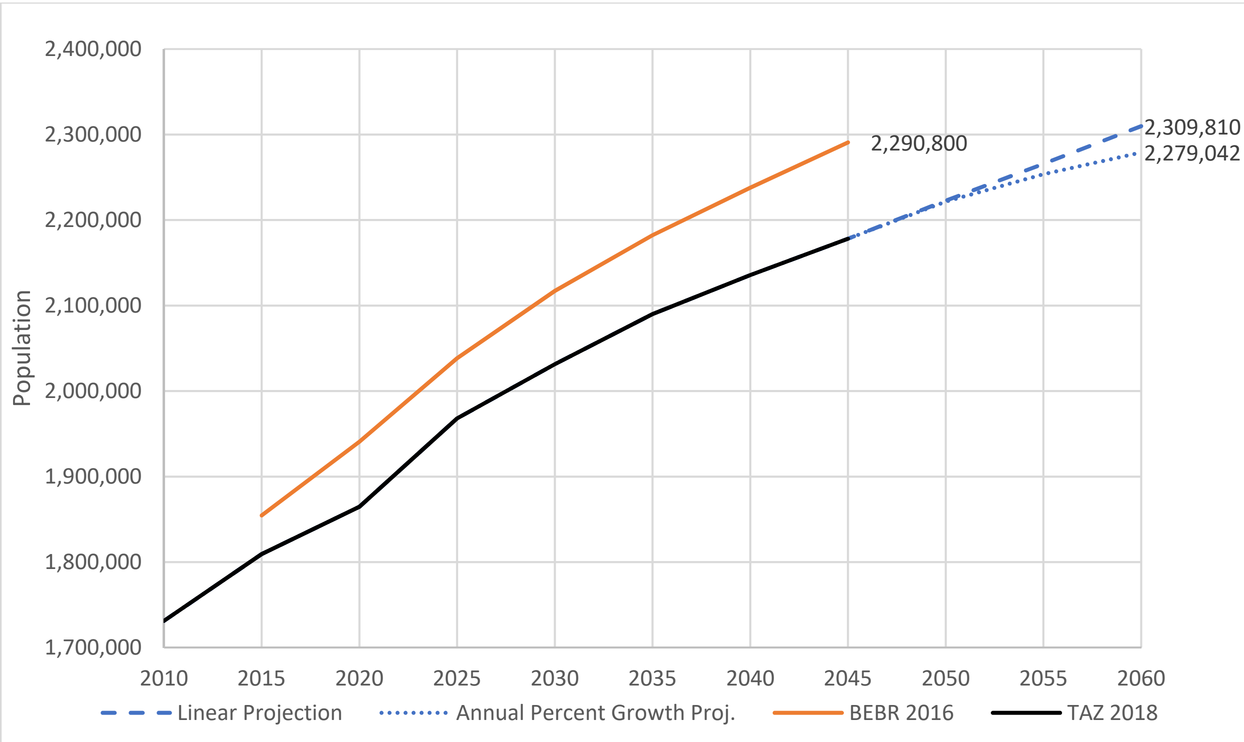


Figure 7: Total Population Projections for Broward County

The County was then divided into seven geographic zones, which were determined based on municipality boundaries and major roadways as well as balancing the current population of the municipalities as published in the 2018 TAZ within each geographic zone. **Figure 8** provides the boundaries of the seven geographic zones and the municipalities that are located within each zone.

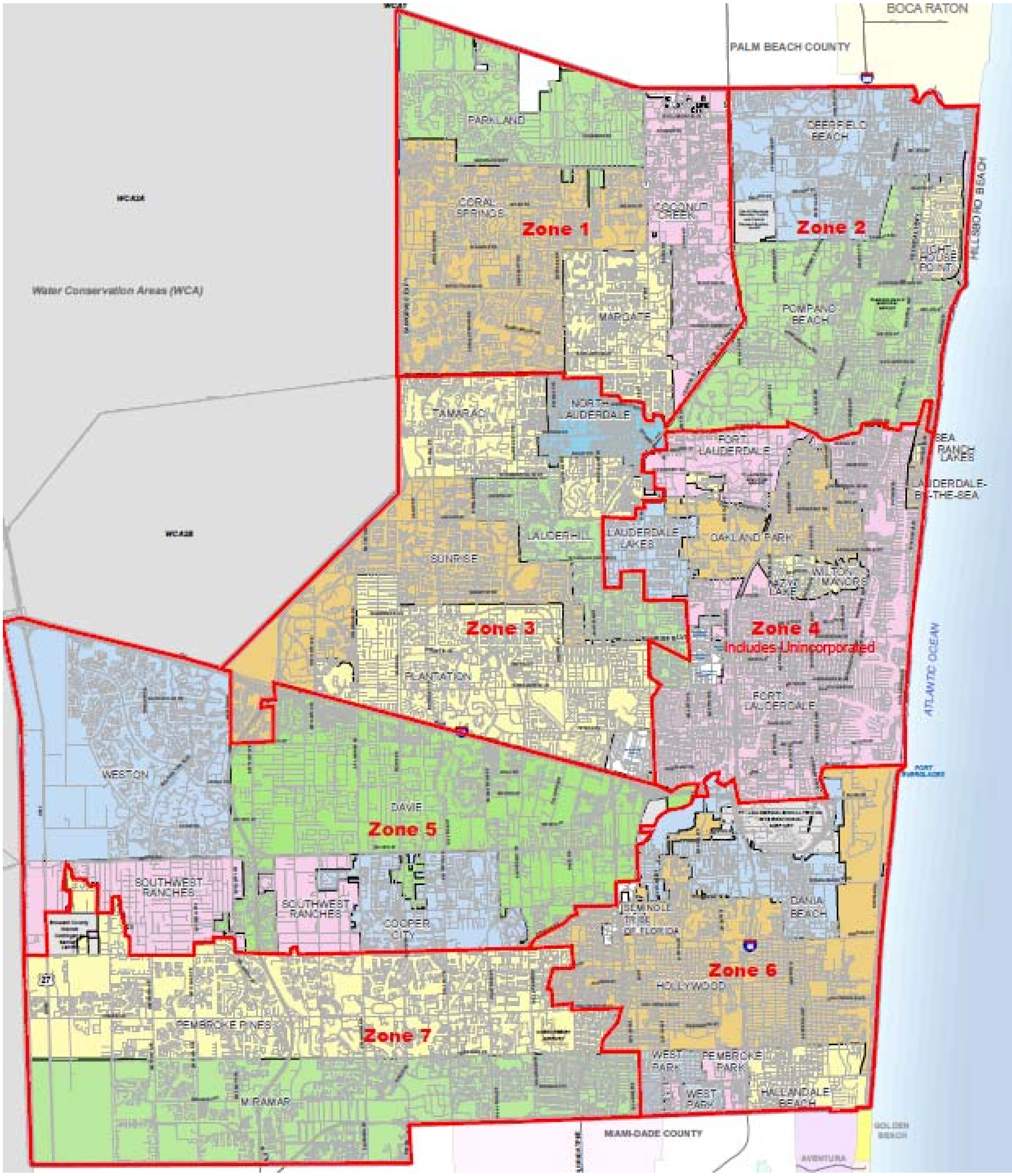


Figure 8: Geographic Zones

Figure 9 provides historical and projected population estimates for each of the seven zones based on the 2018 TAZ and 2045-2060 projections developed by the Arcadis Team using a linear trend on the average annual percent growth rates. **Exhibit B** provides a detailed breakdown of population projections within each zone and the municipalities.

These population growth projections were used for determining waste quantity projections in Step 3.

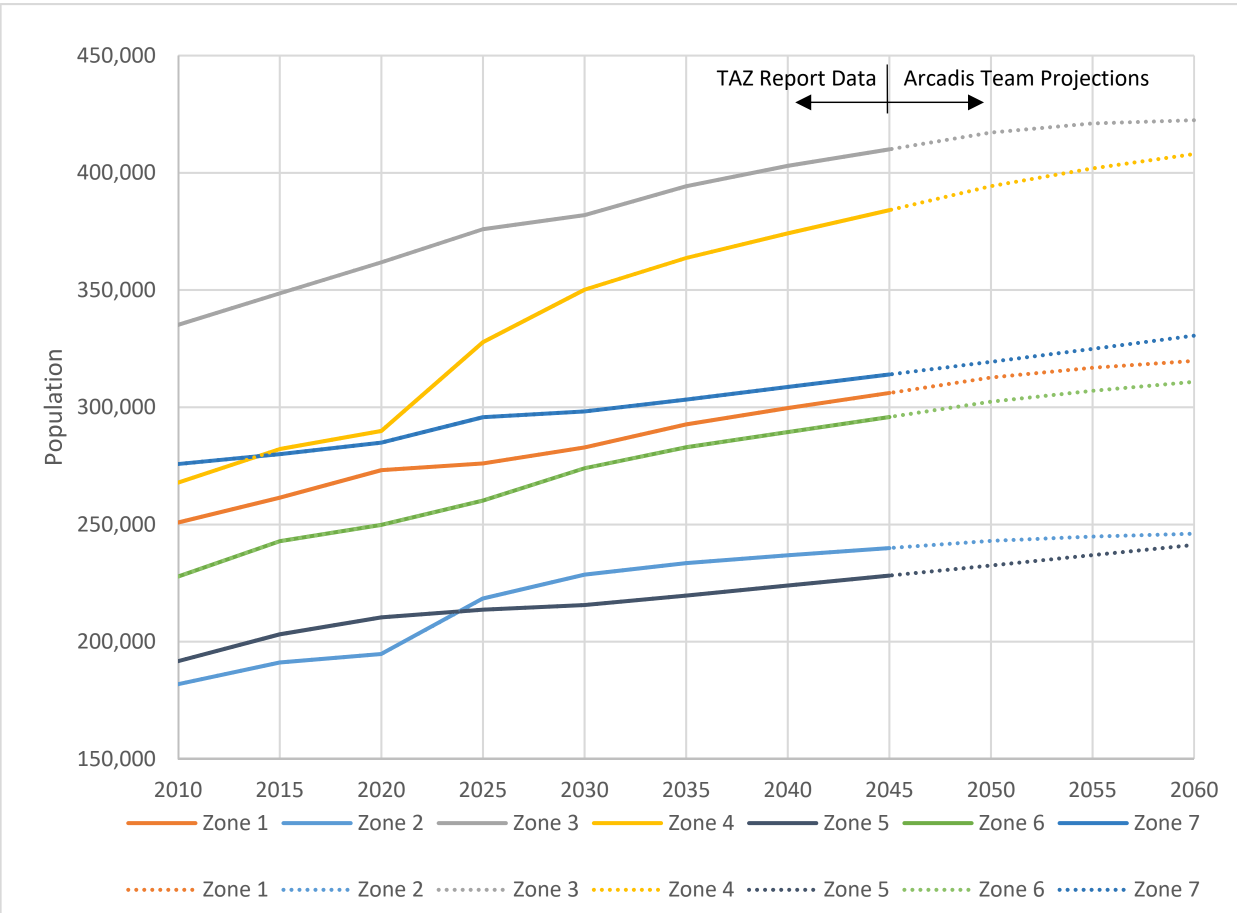


Figure 9: Broward County Population Projections Within Seven Zones

3.1.2 Step 2 – Generation Rate Trend Analysis

To estimate future waste generation and recycling in Broward County, the Arcadis Team first assessed data reported within FDEP Annual Solid Waste Reports for the past 10 years. **Figure 10** plots per-capita waste generation rate (based on total collected waste in the FDEP annual report) and per-capita recycling rate (a segment of the waste generation rate) reported by Broward County during this period.[1]

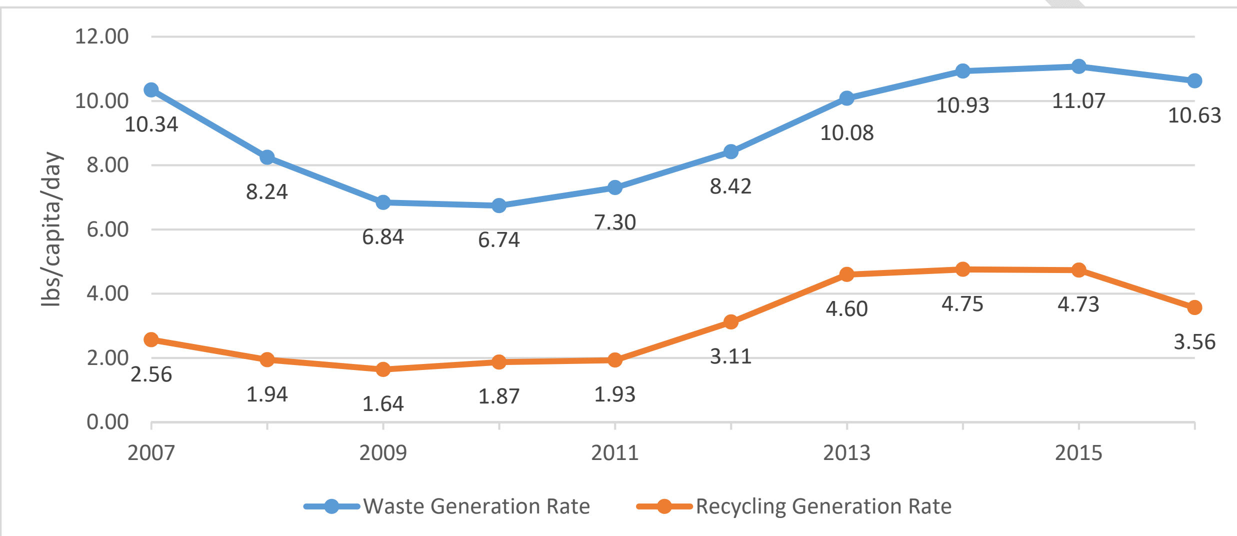


Figure 10: Historical Generation Rates

Generation rates fluctuated for a variety of reasons. For example, the recessionary economy that started around 2008 resulted in lower waste generation rates nationwide. In 2016, the recycling rate dropped primarily because of a decrease in construction and demolition and land clearing debris recycling, described in Section 2 of this Report.

Additionally, FDEP modified the annual reporting process and what counted as municipal solid waste beginning in 2012. For example, concrete from road and bridge projects that was crushed and used as fill could be counted as recycled. As shown in **Figure 10**, this caused significant increases in the quantity of waste generated and materials recycled. However, this reporting impact was external, meaning that it was not a result of changes in actual waste generation habits, which was taken into consideration when projecting future waste generation rates.

A series of trend analyses were performed on the historical per-capita waste generation rates, which included 3-year, 5-year, and 10-year linear trends; 5-year and 10-year rolling averages; and a constant 5-year average. **Figure 11** provides the results of the waste and recycling generation rates trend analysis. The 5-year linear trend was excluded from **Figure 11** as it produced unreasonable generation rates at the end of the planning period due to the upward trend in waste generation rates in the years directly following the 2012 changes in the annual reporting process discussed above.

[1] Recycling + Disposal = Generation

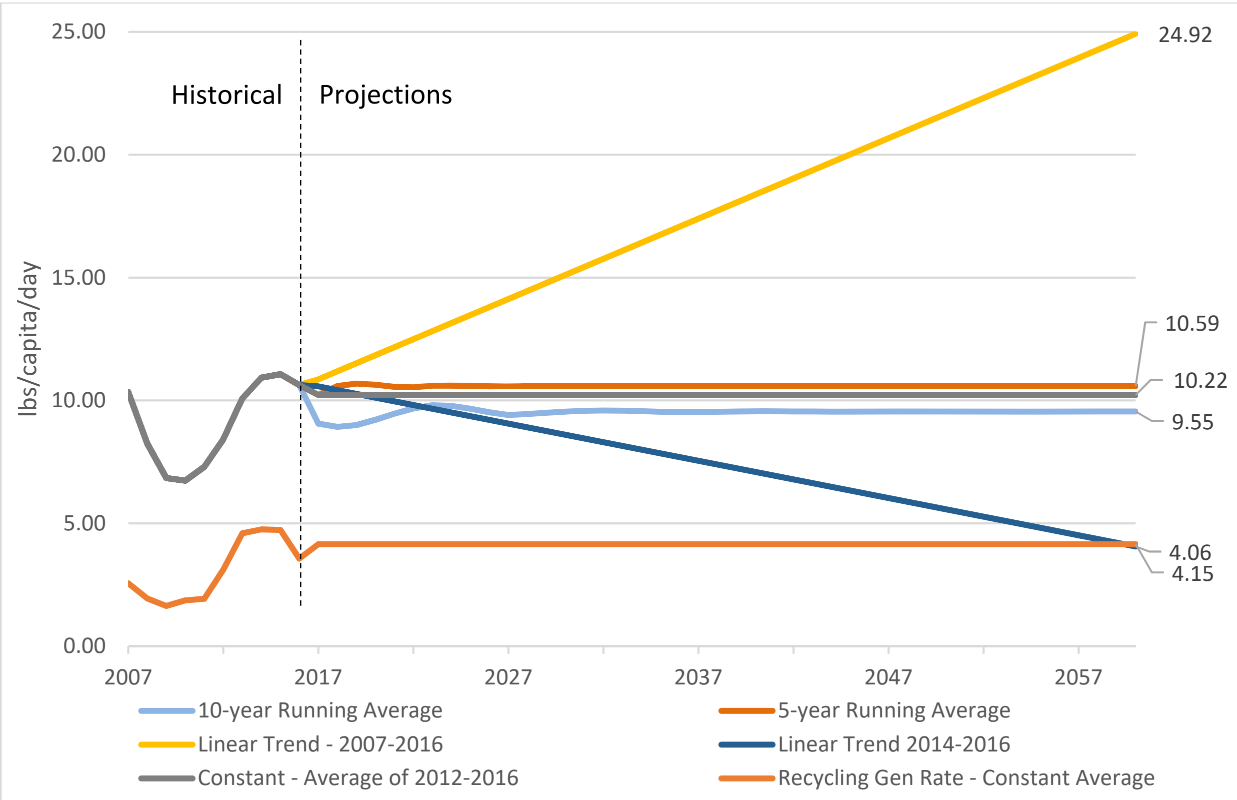


Figure 11: Generation Rates Trend Analysis

Based on the trend analysis, three trends were selected to develop projections of high, low, and probable waste generation scenarios. **Table 6** provides a summary of the trends selected.

A baseline projection for recycling was also determined. The historic trends for the per capita waste and recycling generation rates are similar. Therefore, the probable trend using a constant rate based on the average of 2012-2016 was selected as the preferred scenario for projecting the recycling baseline.

Table 6: Generation Rate Trend Analyses Selected

Generation Scenario	Selected Trend	Generation Rate in 2060 (lbs/capita/day)
Low	10-year Running Average	9.55
Probable	Constant Rate Based on Average of 2012-2016	10.22
High	5-year Running Average	10.59
Recycling Baseline	Constant Rate Based on Average of 2012-2016	4.15

The selected per-capita generation rate projections are used for determining waste quantity projections in Step 3.

3.1.3 Step 3 – Waste and Baseline Recycling Quantity Projections

To determine waste and recycling quantity projections, the selected per-capita generation rate projections in Step 2 were applied to the population growth projections in Step 1. **Figure 12** provides the results of the total waste quantity projections for three scenarios of high, low, and probable, as well as the recycling projections for all of Broward County. Population projections are shown for referencing purposes. **Exhibit C** provides a detailed breakdown of quantity projections.

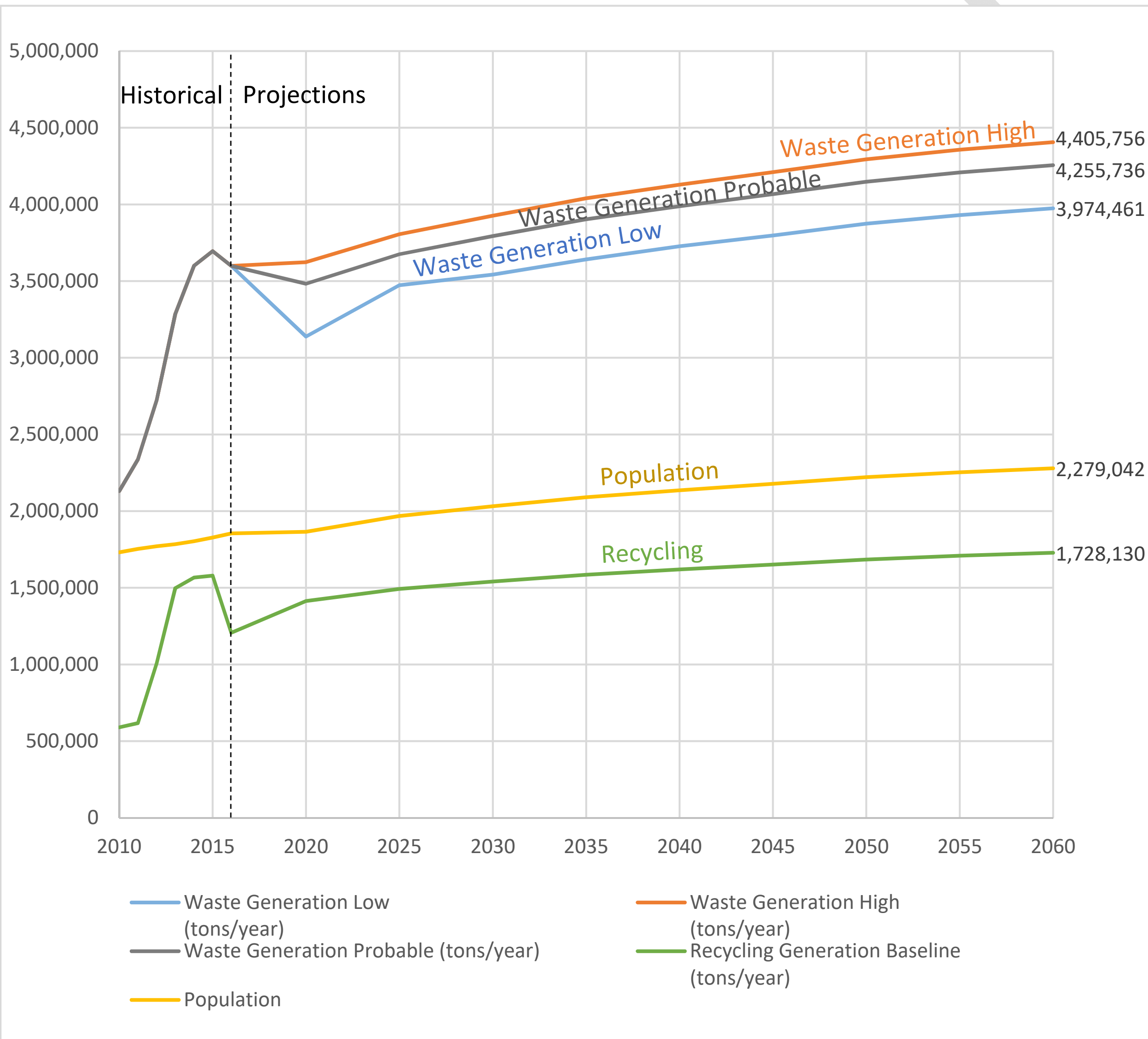


Figure 12: Waste and Baseline Recycling

The projections for the probable waste generation and baseline recycling use a constant generation rate and therefore correlate directly with population growth for years 2020-2060. The low and high waste generation estimates are based on running averages; therefore, waste estimates vary from year to year and eventually reach a steady state at which point it correlates directly with population growth.

The Arcadis Team then developed waste generation and recycling projections for the seven zones delineated in **Figure 8**. The per-capita generation rates were applied equally to all populations. **Figure 13** provides a summary of the waste generation scenarios and recycling projections within each zone in year 2060. **Figure 14** provides waste projections for the probable scenario for each zone. **Exhibit D** provides a detailed breakdown of quantity projections by zone.

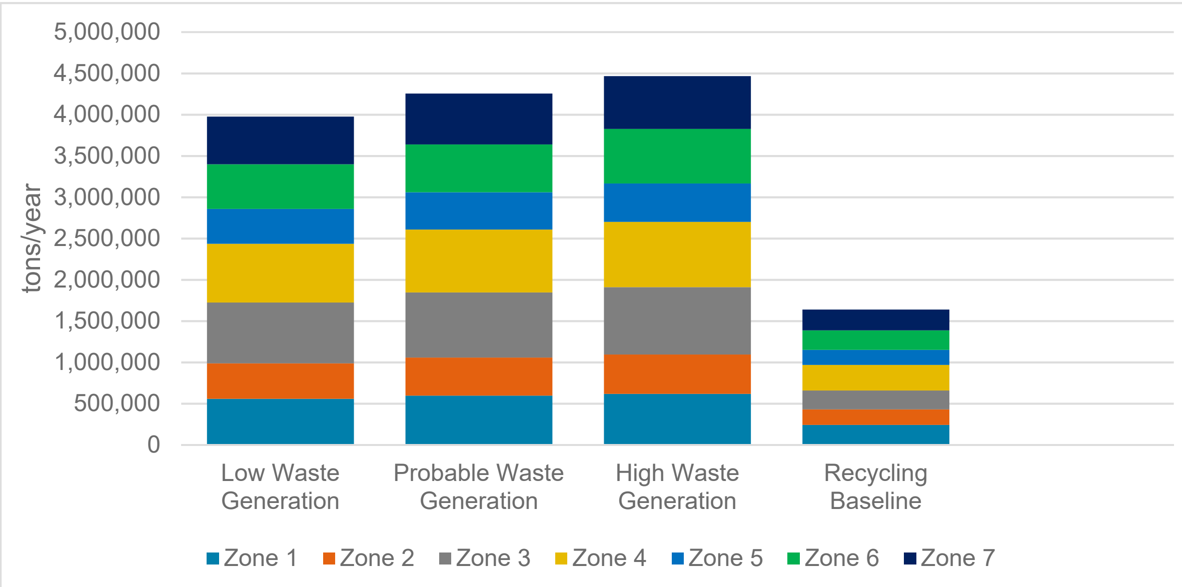


Figure 13: Projections Waste and Recycling Generation in 2060

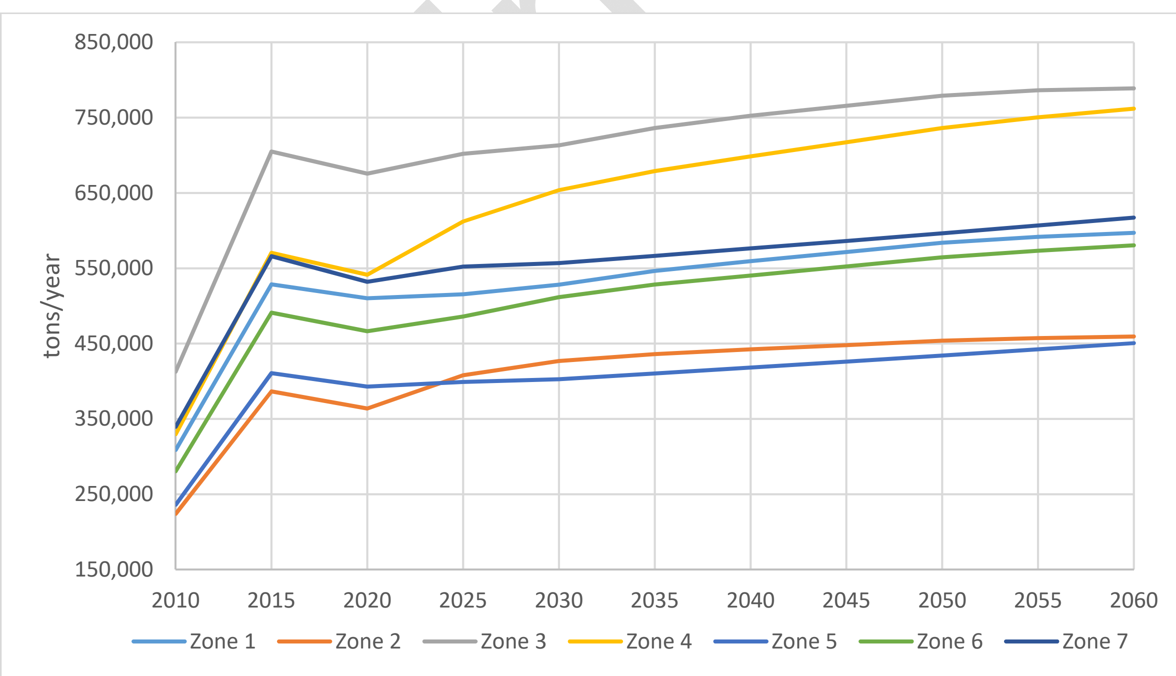


Figure 14: Waste Projections within Each Zone for the Probable Scenario

4 ALTERNATIVES AND OPTIONS FOR IMPROVEMENT TO ACHIEVE RECYCLING GOALS

The solid waste composition and quantity estimates described in Sections 2 and 3 of this Report were used to identify and evaluate waste diversion alternatives and options to assist Broward County in achieving the State's 75 percent recycling goal by 2020. The following items are discussed in this Section 4 of the Study Report:

- Relative effectiveness of the 20 recycling programs listed in the Broward County Comprehensive Plan Solid Waste Element
- Possible reasons for fluctuations in the recycling rate
- Recyclable materials market analysis
- Existing processing, transfer, and disposal facilities
- Recycling and related waste processing technologies
- Identification of opportunities and options to increase recycling
- Assessment of potential diversion options
- Potential facility needs

Based on discussions with the Working Group regarding various diversion options and an assessment of those options of greatest interest to the Working Group, short-term, mid-term, and long-term approaches were identified for increasing the County's recycling rate. The Arcadis Team developed three scenarios based on feedback received from the Working Group. Projection models of these scenarios indicate the potential for the County to attain a 64 percent recycling rate by 2020 and to approach or achieve 75 percent recycling by 2025 should the proposed policies, programs, and facilities described in this Section 4 be fully and effectively implemented. A detailed analysis of the potential estimated materials recovery and recycling rates over the 40-year planning period along with the assumptions on which the analysis was based, are described in the subsections below.

4.1 Effectiveness of Programs Listed in County Comprehensive Plan

To evaluate the 20 programs listed in Policy 6.1.2 of the Broward County Comprehensive Plan Solid Waste Element, the Arcadis Team relied on information provided by the County or readily available to the Team. The scope of work did not include any form of municipal survey. However, the Arcadis Team interviewed several County and municipal staff to gain insight into the effectiveness of certain programs.

Table 7 summarizes the relative effectiveness of the 20 programs listed in Policy 6.1.2 of the Broward County Comprehensive Plan Solid Waste Element.

Table 7: Effectiveness of 20 Recycling Programs in Broward County Comprehensive Plan

Program		Status or Effectiveness	Importance or Potential to Increase Recycling Rate
1	Residential recycling program supported by Material Recovery Facilities (MRFs)	• All municipalities except Pembroke Park and unincorporated county reported having residential recycling programs • Waste Management processes >80% of residential recyclables at Sun 11 or Reuter MRFs • Waste Connections transfers <20% of residential recyclables from Pembroke Park transfer station to Miami MRF	Key element of existing recycling program
2	Residential single stream recycling, including multi-family	• Residential recycling tonnage increased 12% after conversion to single stream (see discussion below) • An estimated 300 pounds of single stream recyclables are collected per household per year (see discussion below)	Key element of existing recycling program
3a	Single stream roll carts	• 28 largest municipalities use roll carts • Residential recycling tonnage increased another 13% after switching from bins to roll carts (see discussion below)	Key element of existing recycling program
3b	Recycling incentive program	• 11 municipalities have recycling incentive programs, although some are better advertised and have higher participation than others • In general, incentive programs are not achieving noticeable results; however, residents who use them enjoy the programs (see discussion below)	Low
4	Pay-As-You-Throw (PAYT)	• Only Plantation has a PAYT program (see discussion below)	Moderate
5	Green waste programs	• Most municipalities collect yard waste with bulky waste • Food waste collection may be occurring on a small scale, but no municipality has a comprehensive program	High
6a	Multi-family recycling	• At least 26 municipalities have multi-family recycling programs of which at least 14 require multi-family recycling • Enforcement of recycling requirements or mandates is low which is often contributed to lack of resources	High

Program		Status or Effectiveness	Importance or Potential to Increase Recycling Rate
6b	Commercial recycling	• At least 14 municipalities require commercial waste contractors to provide recycling services • At least 5 municipalities require recycling haulers to be registered or permitted • 5 municipalities have commercial recycling mandates; however, enforcement is low which is often contributed to lack of resources • Some haulers are eliminating the collection of glass and plastics 3-7 from commercial accounts	High
7	Recycling at food service facilities	• Food waste recycling at food service facilities may be occurring on a small scale, but no municipality has a comprehensive program	High
8	Recycling in public places	• At least 10 municipalities include public places recycling services in their hauler agreements ranging from a limited number of public events per year to routine collection from split-containers at public spaces and events • Recycling tonnage and usage data at public spaces is typically not monitored • Contamination is an ongoing issue	Moderate
9	Recycling in public facilities	• At least 13 municipalities have collection contracts that include recycling services at public facilities	High
10	Affirmative procurement policies (strategy to increase purchasing of environmentally preferable products)	• Some municipalities have affirmative procurement policies that vary in stages of implementation and usage. Limited information regarding the policies was made available.	Indirect impact
11 12	Electronics recycling Household Hazardous Waste (HHW) recycling	• 9 municipalities participate in County program, which provides 3 permanent drop-off locations and special events (4 in 2018) at other locations • 5 municipalities have a joint program to provide monthly drop-off locations, which has had steady participation with increases in volume • 14 municipalities have their own program • 2 municipalities have or will be implementing HHW and/or electronics curbside collection programs where safety and environment are the highest concerns	Low tonnage, but high value in properly managing harmful waste streams

Program		Status or Effectiveness	Importance or Potential to Increase Recycling Rate
13	Beach renourishment pilot project	• In 2008, pilot project was stopped due to costs and the recession • In 2013, Broward County Commission decided against further study because of testing and analysis costs and inability to find a company with equipment and expertise (only one company in the US was known)[2] • Palm Beach County concluded it was not cost-effective; costs of transporting and processing glass exceeded costs of mined or dredged sand[3]	Not applicable
14	Construction and Demolition material (C&D) reuse & recycling; incentives	• C&D recycling has decreased in recent years • No incentive programs for C&D recycling were noted • At least one municipality has a C&D recycling program requiring recycling for all public construction projects	High
15	Building code requirements to facilitate recycling	• Ordinances and building codes that include recycling aspects typically include dumpster enclosure requirements • Some building codes reference green building standards, require equal access to recycling as waste disposal options, and/or require recycled material content in new developments	High
16	Container deposit program	• Container deposit legislation is usually enacted at the state level, which is unlikely in Florida	Not applicable
17	Monitor research of waste-to-energy (WTE) ash reuse	• Recycling credit for WTE is now included in the state reporting process; therefore, recycling of WTE ash would likely have minimal impact on recycling rate	Not applicable
18 19	Outreach programs Recycling educational programs	• Most municipalities have recycling education and outreach programs, of which at least 7 are operated or assisted by the private hauler • Several municipalities indicated additional education and outreach efforts are needed to help achieve the States 75 percent recycling goal	High

[2] https://www.local10.com/news/using-recycled-glass-as-sand-for-beach-restoration-on-hold_20151127203612854
[3] http://articles.sun-sentinel.com/2013-08-12/news/fl-county-recycling-glass-beaches-20130812_1_sand-leanne-welch-glass

Program		Status or Effectiveness	Importance or Potential to Increase Recycling Rate
20	Attraction of recycling and reclamation businesses	• No programs to attract recycling and reclamation businesses were noted	High for businesses targeting materials with limited markets

More detailed analysis of the effectiveness of several programs was conducted than could be reflected in the table above. These analyses are discussed in the following subsections.

4.1.1 Single Stream Recycling and Roll Carts

Figure 15 provides the annual tonnage of residential recyclables received from participants in the former System. Jurisdictions in the System began converting to single stream recycling in 2009, which resulted in a 12 percent increase in recycling tonnage. When programs started converting to carted collection of single stream recyclables in 2011, another 13 percent increase in recycling tonnage occurred. This demonstrates not only the effectiveness of converting to single stream, but also the use of roll carts.

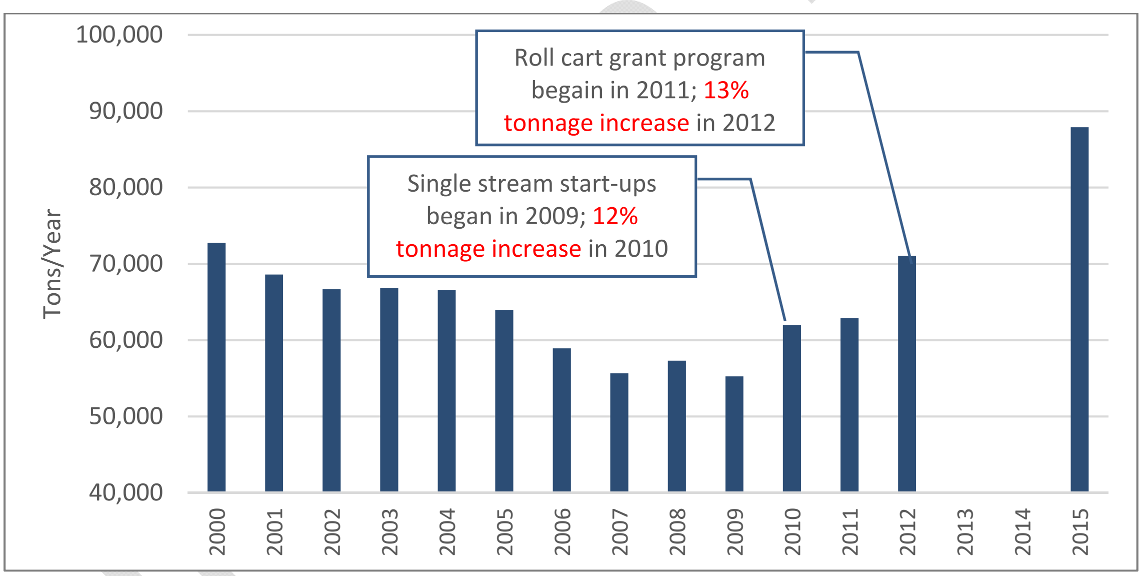


Figure 15: Residential Recyclables Collected in RRB Communities

Sources: Broward County MRF tonnages for years 2000 through 2012; Coconut Creek Survey for year 2015 (adjusted to include only RRB participants), which might include some commercial recycling tonnage. Data for years 2013 and 2014 were not available.

When the System disbanded in 2013, the County no longer had a direct means to track residential recycling tonnages. Therefore, data for years 2013 and 2014 were not available. The City of Coconut

Creek conducted a municipal survey for the year 2015 that indicated a 24 percent increase in recycling tonnage between 2012 and 2015; however, this might include some commercial recyclables as well. Assuming these recyclables were all from residents, an estimated 300 pounds of single stream recyclables were collected per household in 2015. Communities with high-performing recycling programs report recovery rates of 400 pounds per household per year and higher, with some exceeding 500 pounds per household.[4] While conversion to single stream recycling has increased recycling tonnage, opportunities for further improvements in residential recycling in Broward County exist.

4.1.2 Recycling Incentive Programs

Typically, incentive programs are operated and managed by a third party for a monthly fee per household paid by the municipality. The third party is responsible for marketing to residents and obtaining rewards/coupons from local businesses as rewards for customers based on their participation in recycling. If a resident is interested in joining the program, they typically sign up online.

The following recycling incentive programs currently are operating within Broward County: Waste Pro Rewards, Republic Rewards, RecycleBank, Recycle Rewards, and Recycling Perks.

Key feedback obtained during interviews with various municipal representatives regarding the effectiveness of incentive programs included the following:

- Some municipalities have seen an increase in the recycling frequency by those who participate in the program while other municipalities have not seen a notable increase in participation.
- Residents must have access to the internet to sign up and participate which has been an issue.
- Marketing and outreach from the third party to residents can be poor. Some municipalities are working to promote the program.
- Residents who participate in the program seem to like the program.
- Reporting from the third parties varied; some municipalities receive reports while others do not.
- The cost of incentive programs varies widely. For example, one program costs $0.98 per household per month, while several programs are included in private hauler contracts that do not break out program costs. Some municipalities stated the third-party incentive program cost more than it was worth.
- One municipality operates its own rewards program, Recycle Rewards, which is different than the third-party programs. Recycle Rewards is a monthly drawing of all residents who recycled the prior month (based on RFID reporting). The recipients receive a free month of waste services. The program is not heavily advertised or promoted.

In summary, incentive programs received mixed reviews. The individuals interviewed were not able to provide a quantitative link between the rewards program and the quantity of recyclables collected.

[4] The Recycling Partnership, *The 2016 State of Curbside Report*, January 2017.

4.1.3 PAYT Program

Pay As You Throw (PAYT) programs provide an incentive to reduce waste disposal and increase recycling by charging residents based on the quantity (typically volume) of waste set out for collection. The only PAYT program within Broward County is in Plantation, which has one of the longest-running PAYT programs in the United States. The program uses four types of bags based on material type and quantity, each at a different cost. Plantation recently implemented the use of carts for multifamily and select communities.

The estimated quantity of single stream recyclables collected in Plantation is comparable to the countywide estimate (300 pounds per household per year). The impact on waste disposal and other recyclables such as yard waste and bulk waste could not be assessed based on available information.

The structure of PAYT programs can vary. The bag system used in Plantation can pose issues with recycling as bagged materials impact material recovery facility (MRF) operations. Other programs offer varying sizes of roll carts and/or stickers at varying rates.

While PAYT programs have not caught on in Florida, numerous sources report the effectiveness of these programs in increasing recycling, organics collection and source reduction, with a commensurate decrease in waste generation. Reported increases in recycling typically range from 30-90 percent and decreases in waste generation typically range from 25-50 percent.[5]

4.2 Probable Reasons for Decline in Recycling Rates

Most jurisdictions experience fluctuations in waste generation and recycling over time. **Figure 16** depicts per capita waste generation (materials recycled plus waste disposed) and per capita recycling in Broward County from 2005-2016. The figure also depicts the quantity of residential recyclables collected from 2000-2015, although data was not available for certain years.

[5] Sources include: http://wastezero.com/success-stories/; http://www.p2pays.org/payt/main/casestudies.htm; https://archive.epa.gov/wastes/conserve/tools/payt/web/html/success.html

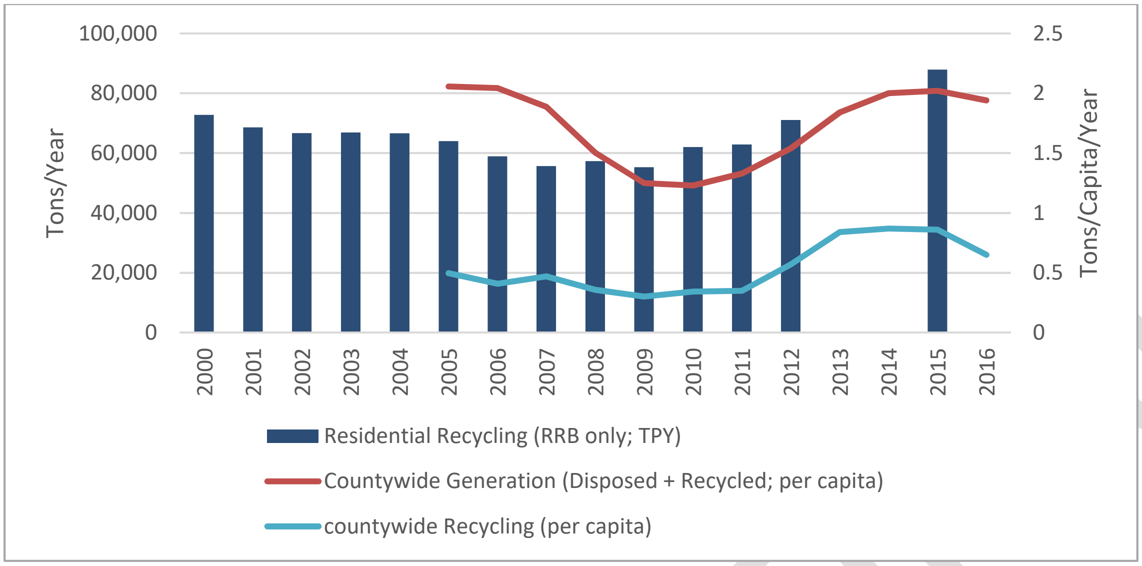


Figure 16: Waste Generation and Recycling in Broward County over Time

Note 1: Countywide per capita waste generation and recycling data is based on annual reports to FDEP.

Sources: Broward County MRF tonnages for years 2000 through 2012; City of Coconut Creek Survey for year 2015 (adjusted to include only System participants), which might include some commercial recycling tonnage. Data for years 2013 and 2014 were not available.

Factors that influenced the recycling rate during this period include but are not limited to the following:

- Economy – As overall consumption of goods decreased nationally during the recessionary period from about 2008-2011, so did per capita waste generation. Along with a reduction in the amount of waste generated came a reduction in recyclables generated. This trend was observed nationally and can be seen in **Figure 16**.
- Changes in consumer habits – During the last decade, consumers have increasingly converted to digital news media, resulting in less newspaper and magazines in the recycling stream.
- Changes in product packaging – Changes in product packaging, such as reducing the weight of aluminum cans and plastic bottles (light-weighting) and converting to lighter but non-recyclable types of plastics, in turn reduce the weight of the recycling stream.
- Complacency – Unless an effective and ongoing education and outreach program is implemented, established recycling programs often experience a slow decline in the quantity of recyclables collected. New residents and businesses in the community need to be informed of the recycling program. For existing residents and businesses, an education and outreach program provides a reminder and encourages them to recycle the full range of materials included in the recycling program.
- Conversion to single stream recycling – As mentioned previously, conversion to carted single stream recycling increased the quantity of residential recyclables collected. It appears to have more than offset some of the decreases caused by the above factors.

- Changes in FDEP reporting – Increases in recycling during the last few years can also be attributed to changes in what FDEP counts toward recycling. This is addressed further in the following discussion regarding construction and demolition (C&D) debris.

The Arcadis Team also analyzed changes in C&D debris recycling from 2014-2016. **Figure 17** depicts the quantities of C&D debris, including land clearing debris, recycled and disposed during that period.

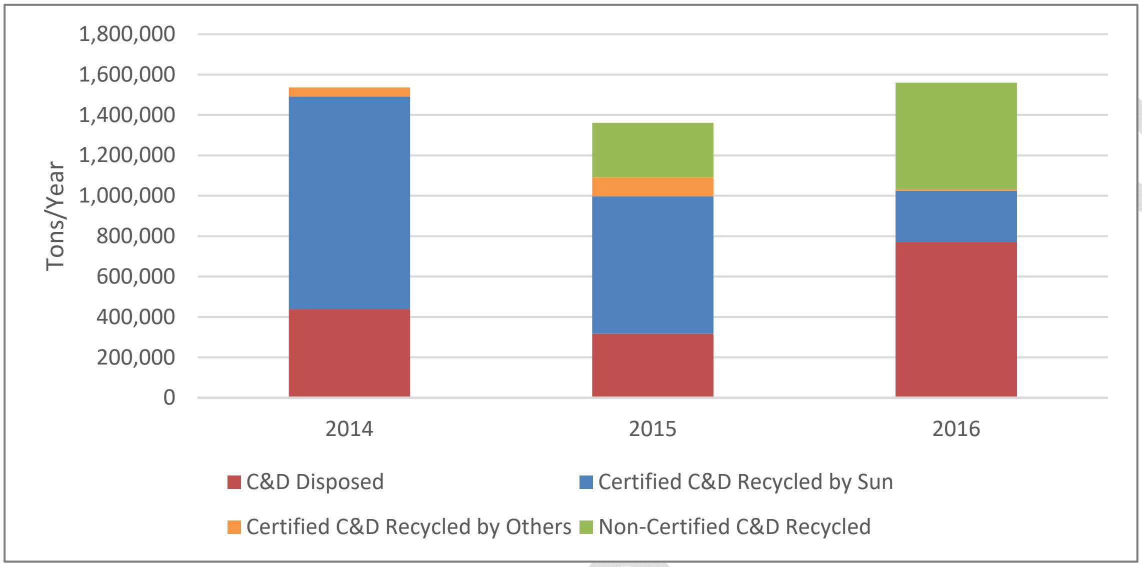


Figure 17: Broward County C&D Debris Recycling and Disposed, 2014-2016

Note 1: C&D debris recycled includes land clearing debris.
Note 2: Certified C&D Recycled by Sun is composed of C&D debris reported to FDEP as recycled by the Sun Recycling facilities.
Note 3: Certified C&D Recycled by Others is composed of C&D debris reported to FDEP by other facilities as recycled.
Note 4: Non-Certified C&D Recycled includes additional C&D debris recycling that was identified by County staff.
Source: Based on information provided by Broward County.

Factors that influenced these fluctuations in C&D debris recycling appear to include the following:

- Reduction in recycling at Sun Recycling facilities – As can be seen in **Figure 17**, the Sun Recycling facilities recycled more than 1 million tons of C&D materials in 2014, which accounted for 96 percent of C&D materials recycled that year. By 2016, the quantity of C&D materials recycled at the Sun Recycling facilities dropped by about 75 percent to approximately 254,000 tons.
- Changes in FDEP reporting – Beginning in 2012, FDEP changed what counted toward county recycling rates. Most notably, recycled transportation-related concrete (e.g., from roads and bridges) was not previously counted in the recycling rate, but now can be counted if counties are able to identify and quantity these recycling activities. Broward County staff has identified increasing amounts of non-certified C&D recycling, especially in 2016, which helped offset some of the decreases in recycling at the Sun Recycling facilities.

4.3 Recyclable Materials Market Analysis

4.3.1 General Market Drivers

Markets for recyclable materials are influenced by many drivers acting at various stages throughout the recovery supply chain. General drivers include the intrinsic value of raw materials used to manufacture products and packaging (e.g., the cost to produce aluminum, polyethylene terephthalate (PET) containers, or cardboard from virgin materials), the supply-demand balance, the relative health of domestic and international economies, ability to meet market specifications, and the prevailing costs of solid waste management. In addition, markets for each recyclable material can be influenced by specific drivers unique to that material, such as export demand, seasonal fluctuations, and operating rates and inventories at manufacturing facilities.

Major market disruptions like the global recession beginning in 2008 and the current China National Sword policy, which restricts the import of 24 categories of solid waste and recovered commodities, can negatively impact demand leading to oversupply and weak pricing. However, disruptions create opportunities to adjust recovery programs and processing operations or expand alternative end-use markets that consume low-cost supplies of recycled materials.

More detailed information regarding market drivers for various recyclable materials is provided in **Exhibit E**.

4.3.2 Recovered Commodity Pricing

When viewed over the span of years, it has been shown that while recycled material commodity prices sometimes experience dramatic short-term price peaks and valleys, the markets respond to these imbalances and average prices stay within relatively narrow ranges. To demonstrate this, Figures 18 and 19 provide price histories for corrugated containers (OCC) and PET containers in the Southeast United States (SE USA) and in North America (No America).

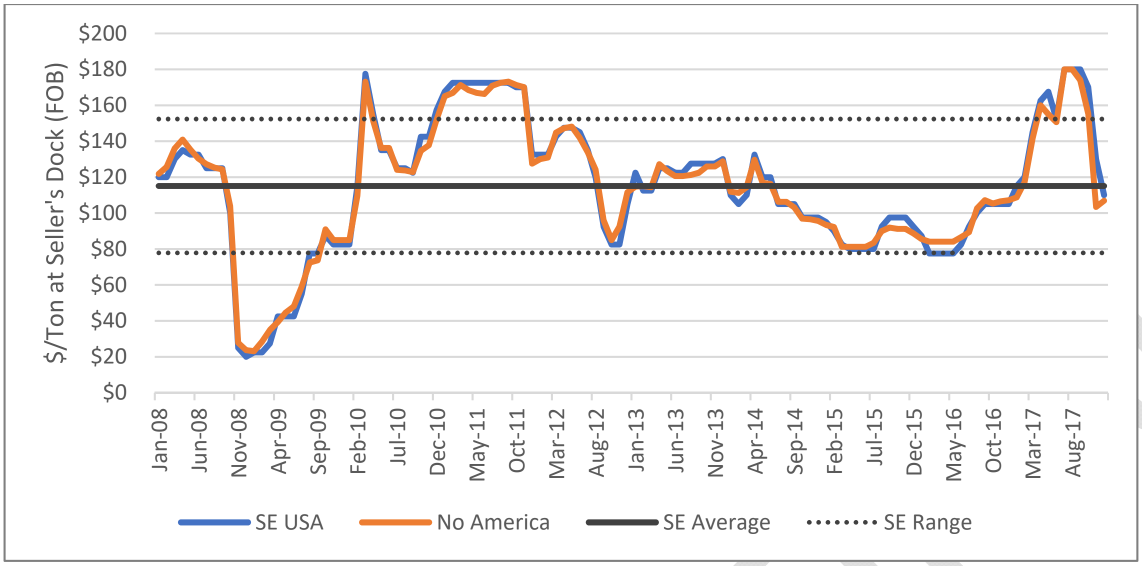


Figure 18: Recovered OCC Price History

Source: Kessler Consulting, Inc. analysis of recovered material prices published by RecyclingMarkets.net.

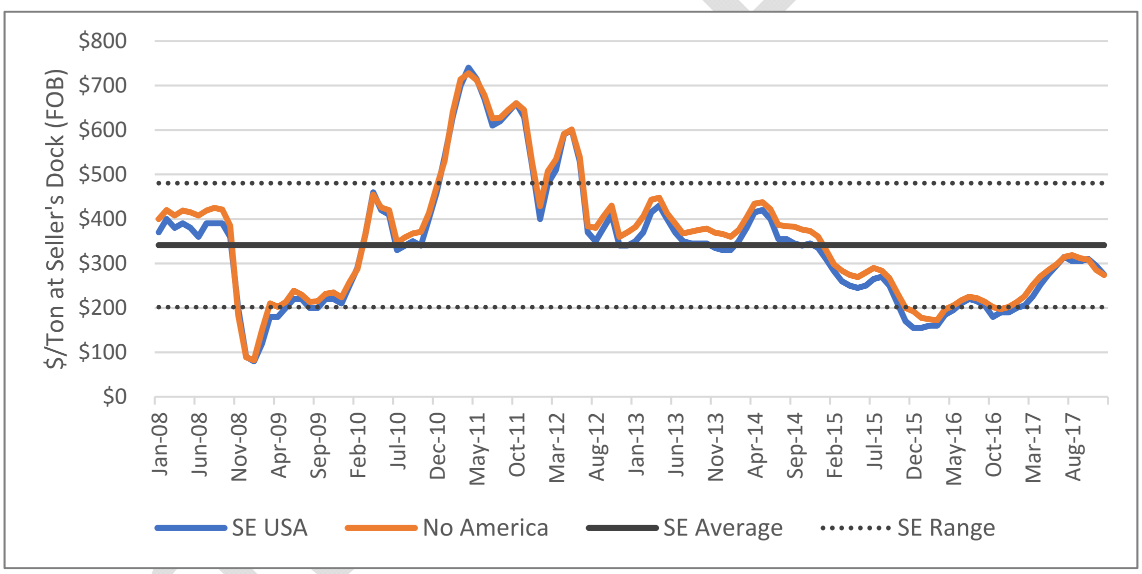


Figure 19: Recovered PET Container Price History

Source: Kessler Consulting, Inc. analysis of recovered material prices published by RecyclingMarkets.net.

Figure 20 provides the estimated net value (revenue less processing cost) of recyclable materials typically included in single stream programs based on the 10-year average commodity price and the price in December 2017 in the SE USA. This figure assumes the materials are commingled, requiring separation at a MRF with an estimated processing cost of $80 per ton. Materials segregated at the source, such as commercial OCC, would require minimal processing and have a higher net value. Some processors are encouraging the removal of materials such as glass and 3-7 plastics from recycling programs because of low market prices.

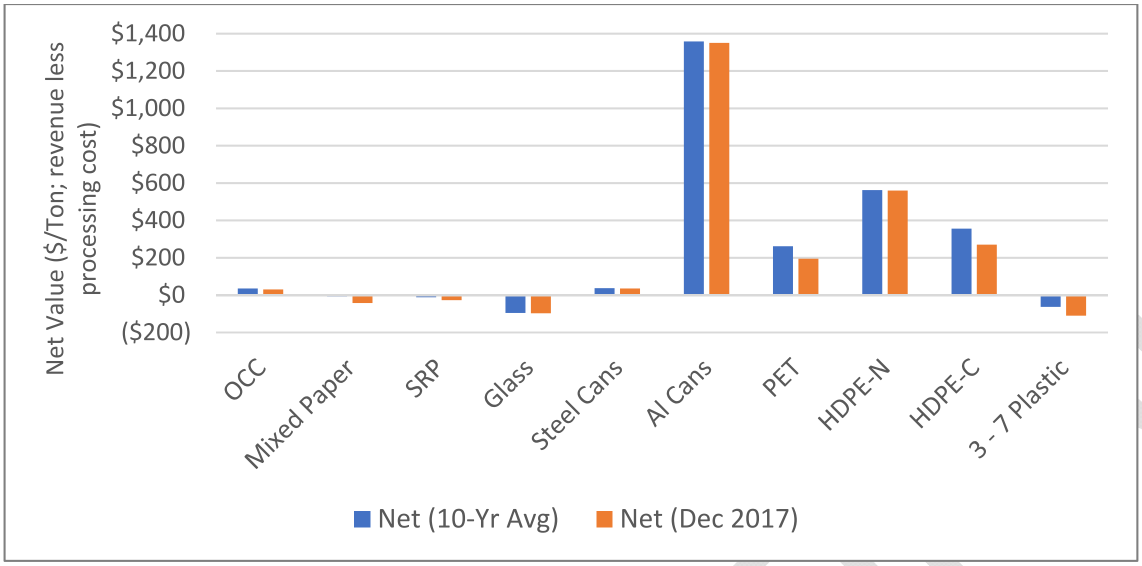


Figure 20: Net Value of Processed Materials, SE United States

Source: Kessler Consulting, Inc. analysis of recovered material prices published by RecyclingMarkets.net.

4.3.3 Public Policy and Investment

The public sector can implement policies and take actions to influence recycled commodity markets. These drivers can be broadly categorized as supply drivers and demand drivers. Recycling goals, recycling mandates, disposal bans, and public awareness are examples of supply drivers. These public policies and programs can boost the supply of recovered materials, which in turn can impact the supply-demand balance, medium-term market prices, and long-term investment in demand capacity.

Policy/investment demand drivers (i.e., market development efforts) include research and development of new product/packaging applications, recycled infrastructure investment incentives, standardization of commodity specifications, and technical assistance to recycled commodity consumers. All have the goals of expanding existing markets and creating new markets for recycled commodities. An example of a demand driver is the Florida Recycling Loan Program that provides Florida businesses with low-cost, long-term, fixed interest rate loans for the purchase or refinance of equipment and machinery used to expand industrial recycling activities. Government agencies are major buyers of products and Environmentally Preferable Purchasing programs also help drive demand.

In aggregate, the public sector can employ a comprehensive “toolbox” to facilitate markets for recycled commodities and noted in **Figure 21**. The current analysis focuses primarily on supply drivers, but demand drivers are equally important, especially for commodities with limited end-use markets.

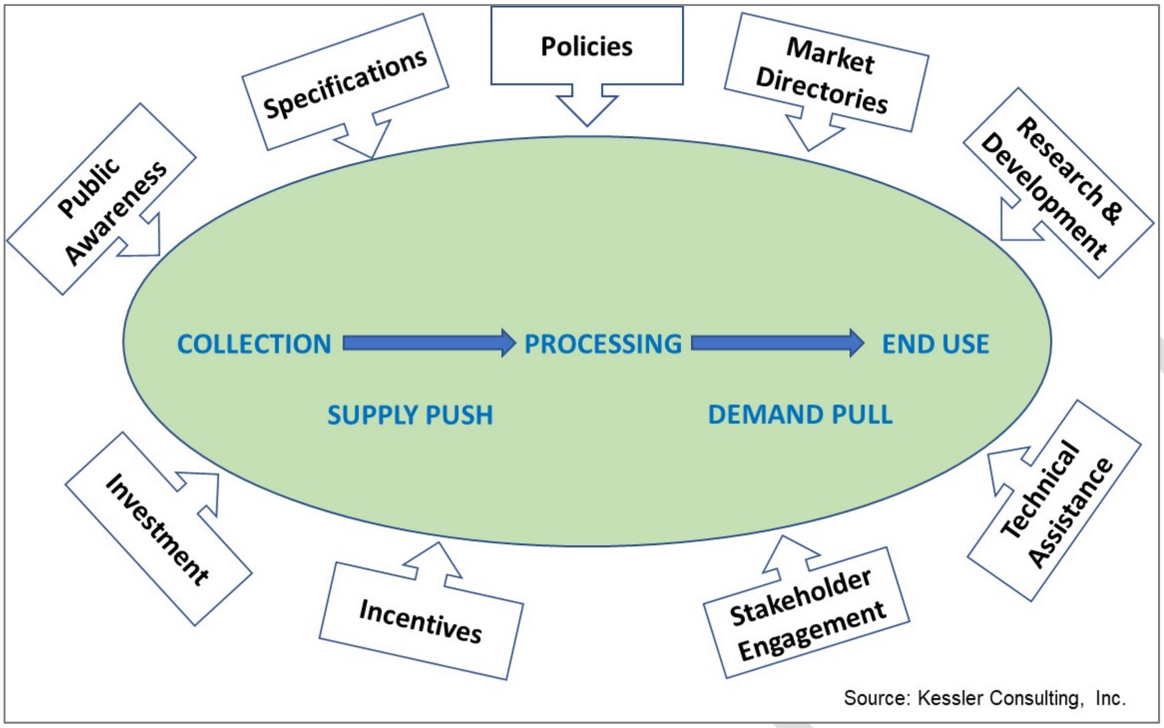


Figure 21: Public Sector "Tools" to Enhance Supply and Demand for Recycled Materials

4.4 Existing Processing, Transfer, and Disposal Facilities

To assist in evaluating the potential need for future facilities, the Arcadis Team compiled an initial list of existing processing, transfer, and disposal facilities located in Broward County or currently used by the County or municipalities (see **Table 8**). While this list might not be exhaustive, it includes key facilities relevant to this analysis. **Figure 22** depicts the locations of the larger facilities within or in close proximity to Broward County that might be capable of handling substantial quantities of materials.

Table 8: Existing Processing, Transfer and Disposal Facilities in Local Market Area

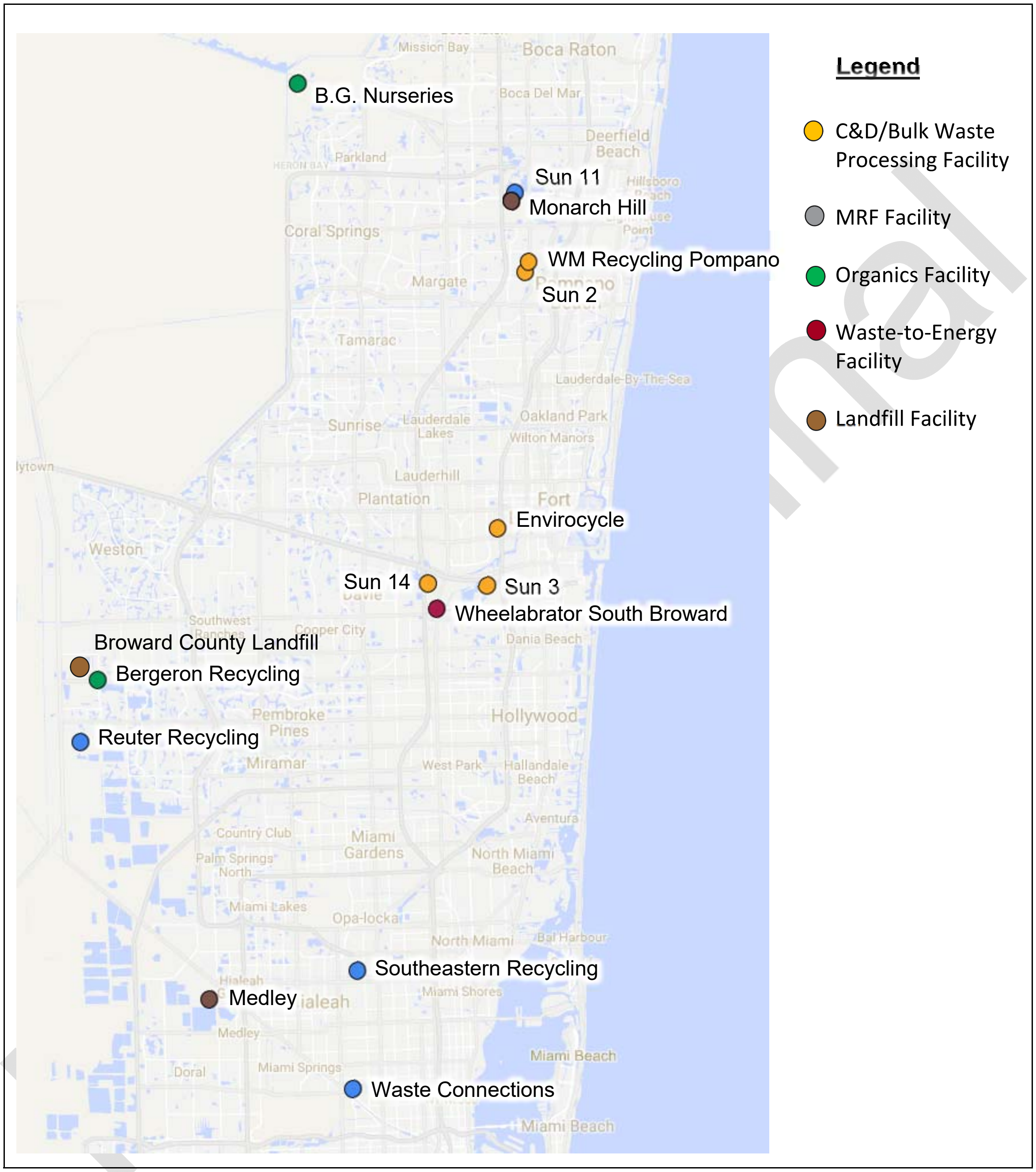
Facility Type	Facility Name	Owner	Location	Materials Accepted	Estimated Throughput (tons/year, where available)
C&D/Bulk Waste (BW)/ Yard Trash (YT) Processing	Envirocycle	Republic	Fort Lauderdale	Comm Rec, BW	Not Available
	J&A Waste	J&A Waste	Deerfield Beach	C&D, BW	Not Available
	Lindimar MRF	Lindimar Recycling	Pompano Beach	C&D, BW	Not Available
	MKS Environmental	MKS Environmental	Davie	C&D, BW	Not Available
	Monarch Hill	Waste Management	Pompano Beach	C&D, BW	Not Available
	Sun 14	Waste Management	Davie	C&D, BW, YT	555 (2016 recycled)
	Sun 2	Waste Management	Pompano Beach	C&D, BW	108,576 (2016 recycled)
	Sun 3	Waste Management	Fort Lauderdale	C&D, BW, YT	160,427 (2016 recycled)
	WM Recycling Pompano	Waste Management	Pompano Beach	C&D, BW	825 (2016 recycled)
MRF	Reuters Recycling	Waste Management	Pembroke Pines	Single Stream Rec	140,000
	Southeastern Recycling	Waste Management	Miami	Single Stream Rec	63,000
	Sun 11	Waste Management	Deerfield Beach	Single Stream Rec	19,500
	SWA MRF	Palm Beach County	West Palm Beach	Single Stream Rec	108,000
	Waste Connections	Waste Connections	Miami	Single Stream Rec	33,300
Paper Processors	Gorgy Recycling	Gorgy Recycling	Miami	OCC, Comm Paper	Not Available
	Miami Waste Paper	Miami Waste Paper	Miami	OCC, Comm Paper	60,000
	Only Recycling	Only Recycling	Opa Locka	OCC, Comm Paper	30,000
	Panzarella Waste	Panzarella Waste	Pompano	OCC, Comm Paper	30,000

Facility Type	Facility Name	Owner	Location	Materials Accepted	Estimated Throughput (tons/year, where available)
	Republic Service	All Services Refuse	Fort Lauderdale	OCC	12,000
	West Rock	WestRock	Fort Lauderdale	OCC, Comm Paper	60,000
	White Cardboard	White Cardboard	Miami	OCC	60,000
	World Waste Recycling	World Waste Recycling	Miami	OCC, Comm Paper	30,000
Organics Processors/Transfer	B.G. Nurseries	B.G. Nurseries	Parkland	YT	88,000 cubic yds/yr
	Bergeron Recycling	Bergeron Recycling	Pembroke Pines	Hurricane Debris	6 temporary storm debris sites
	Landworks Depot	Landworks Depot	SW Ranches	YT	Limited to own material
	Monarch Hill	Waste Management	Pompano Beach	YT	33,000
	Snyder Park Transfer	Ft Lauderdale	Fort Lauderdale	YT	Limited to city material
	The Bushel Stop	The Bushel Stop	Pembroke Pines	YT	Limited to own material
	True Enterprise, Inc.	True Enterprise, Inc.	Miramar	YT	Limited to own material
Transfer Stations	Monarch Transfer	Waste Management	Pompano Beach	MSW, C&D	Not Available
	Sun 12	Waste Management	Davie	MSW, Rec	Not Available
	Waste Connections – Deerfield Beach	Waste Connections	Deerfield Beach	C&D, Bulk, YT, MSW	Not Available
	Waste Connections – Pembroke Park	Waste Connections	Pembroke Park	MSW, Rec, C&D, YT	Not Available
	Wheelabrator North	Waste Management	Pompano Beach	MSW, BW	Not Available

Facility Type	Facility Name	Owner	Location	Materials Accepted	Estimated Throughput (tons/year, where available)
WTE	SWA WTE	Palm Beach County	Palm Beach	MSW	
	Wheelabrator South	Wheelabrator	Fort Lauderdale	MSW, BW	
Landfill	Broward County Landfill	Broward County	Fort Lauderdale	C&D, YT, Bulk	Not Available
	JED Landfill	Waste Connections	St Cloud	MSW, C&D	Not Available
	Medley Landfill	Waste Management	Medley	MSW, C&D	Not Available
	Monarch Hill Landfill	Waste Management	Pompano Beach	MSW, C&D	3,500 tons/day

Note 1: Based on data provided by Broward County and research conducted by Kessler Consulting, Inc.

Figure 22: Larger Processing Disposal Facilities in Broward County



4.5 Recycling and Related Waste Processing Technologies

The Arcadis Team considered a range of existing and emerging recycling and related processing technologies that might assist Broward County in achieving the 75 percent recycling goal. Materials processing technologies can be placed in three general categories:

- **Physical processing** relies on mechanical and manual means to sort, segregate, and consolidate materials to produce recoverable commodities.
- **Biological processing** optimizes natural decomposition processes to convert organic materials into usable products such as compost, digestate, and biogas.
- **Thermal processing** utilizes high temperatures to combust or convert carbon-based materials and generate energy or fuels.

The categories overlap to some degree. For example, physical and thermal processing can be combined to physically process a fuel that is thermally combusted. Physical and biological processing can be combined in a facility that recovers recyclables and anaerobically digests organic materials.

Exhibit F provides a table that summarizes the technologies included in each of these categories, materials processed and products/byproducts of each, and whether commercial-scale facilities are operational in the United States. Based on diversion opportunities identified in Broward County and the status of these processing technologies, the Arcadis Team focused on various types of physical and biological processing and waste-to-energy (WTE) for further consideration.

4.6 Opportunities and Options to Increase Recycling

Based on the solid waste composition and quantity estimates described in Sections 2 and 3, **Figure 23** depicts the estimated composition of materials recycled and disposed within Broward County. The blue segments of the pie chart represents materials that are recycled, which currently account for about 34 percent of waste generated in Broward County. The remaining segments of the pie chart are various material streams that are disposed. Quantities are estimated based on data provided by the County for 2014-2016 and waste composition studies conducted in other similar Florida counties.

Key opportunities for increasing recycling, in terms of tonnage, include the following:

- C&D Debris – On a tonnage basis, C&D debris offers the greatest opportunity to increase recycling, especially since the amount of certified recycled C&D debris has decreased substantially during the last three years, noted in **Figure 17**.

- Recyclable Paper and Containers – These are traditional recyclables accepted in many residential and commercial (including institutions and industries) recycling programs that are still disposed. Programs for collecting these materials in Broward County are generally well established for single-family residents but could be enhanced for multi-family residents and commercial entities.
- Organics – This includes yard trash, food waste, and possibly compostable paper. Additionally, some portion of bulky waste consists of yard trash.
- Bulky Waste – The distinction in tonnage between bulky waste and C&D debris was difficult to make because much of the material is managed at the same facilities. Yard trash and wood are generally predominant components of this waste stream.
- Other Potential Recyclables – Other potential recyclables include textiles, various types of plastics, metals, and electronics. Identifying markets for these materials is critical prior to establishing a recycling program.

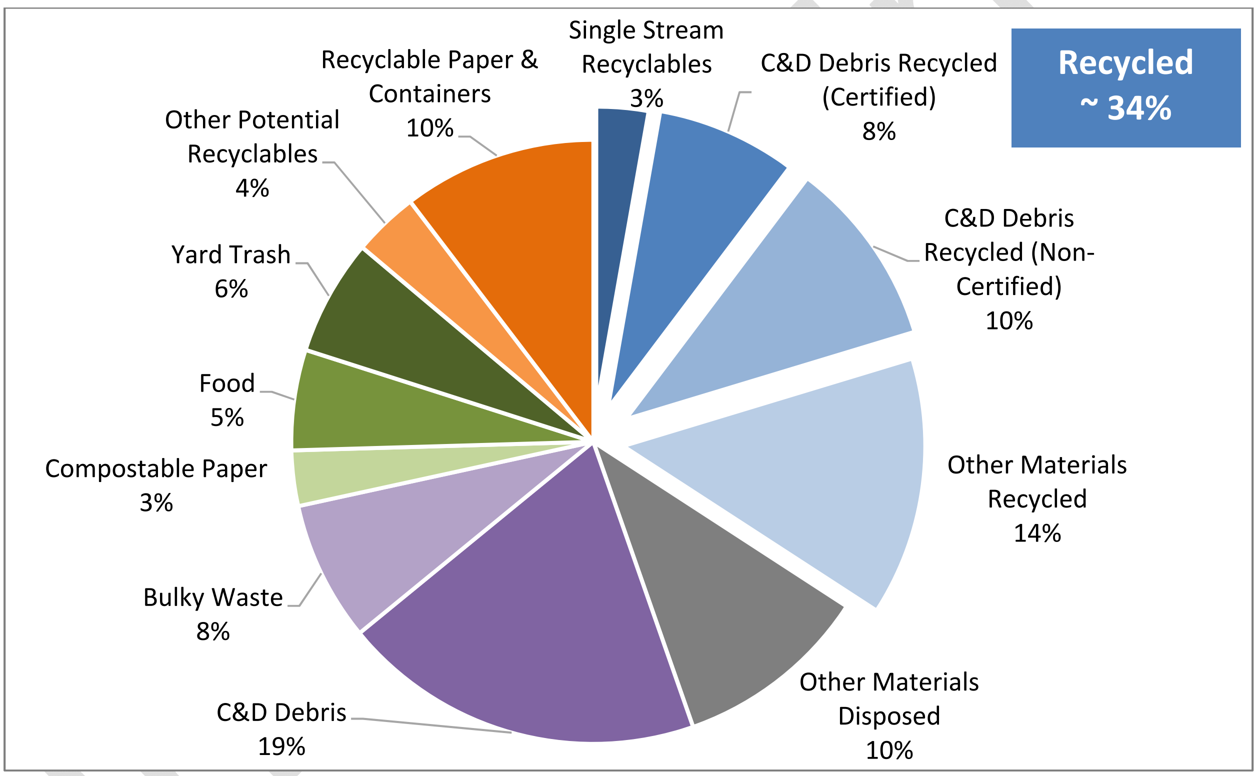


Figure 23: Estimated Current Average Composition of Broward County Materials Recycled and Disposed (percent by weight)

Note 1: Other Potential Recyclables includes textiles, bulky rigid plastics, other ferrous and non-ferrous, white goods, and electronics.

Table 9 lists basic approaches or options for increasing the recycling of these various material streams. The table is organized by voluntary and mandatory approaches. Education and outreach is a part of any type of program and is therefore not specifically listed in the table.

Table 9: Basic Approaches to Increase Recycling by Material Type

	C&D Debris	Bulky Waste	Recyclable Paper & Containers	Yard Trash & Food Waste
Estimated Percent of Waste Stream Targeted	19%	8%	10%	11%
Voluntary Options	• Encourage use of existing reuse & recycling outlets • Incentive program (e.g., expedited permitting, reduced permit fees)	• Voluntary processing of bulky waste at C&D/bulky waste facility	• Commercial & multi-family technical assistance • All-in commercial service fees (i.e., recycling included) • Expand PAYT • Incentive program • Mixed waste processing	• Voluntary processing of commingled yard trash/bulky waste • Yard trash collected separate from bulky waste • Commercial food waste collection • Residential food waste collection
Mandatory Options	• Minimum recycling levels (linked to permits & fees) • Processing required prior to disposal • Minimum recycling rate for processing facilities	• Processing required prior to disposal • Minimum recycling rate for processing facilities	• Require recycling space at new developments • Mandatory recycling	• Processing of mixed yard trash/bulky waste required prior to disposal • Yard trash disposal ban • Mandatory food waste recovery
Related Facilities	• C&D/bulky waste processing facilities	• C&D/bulky waste processing facilities	• Single stream MRFs • Mixed waste MRFs	• Organics processing facilities

4.7 Assessment of Potential Diversion Options

The Arcadis Team presented a summary of these various voluntary, mandatory, and technology-related approaches to the Working Group during a webinar conducted on March 21, 2018. Based on feedback received from the Working Group, a more in-depth assessment of the approach is depicted in **Figure 24**.

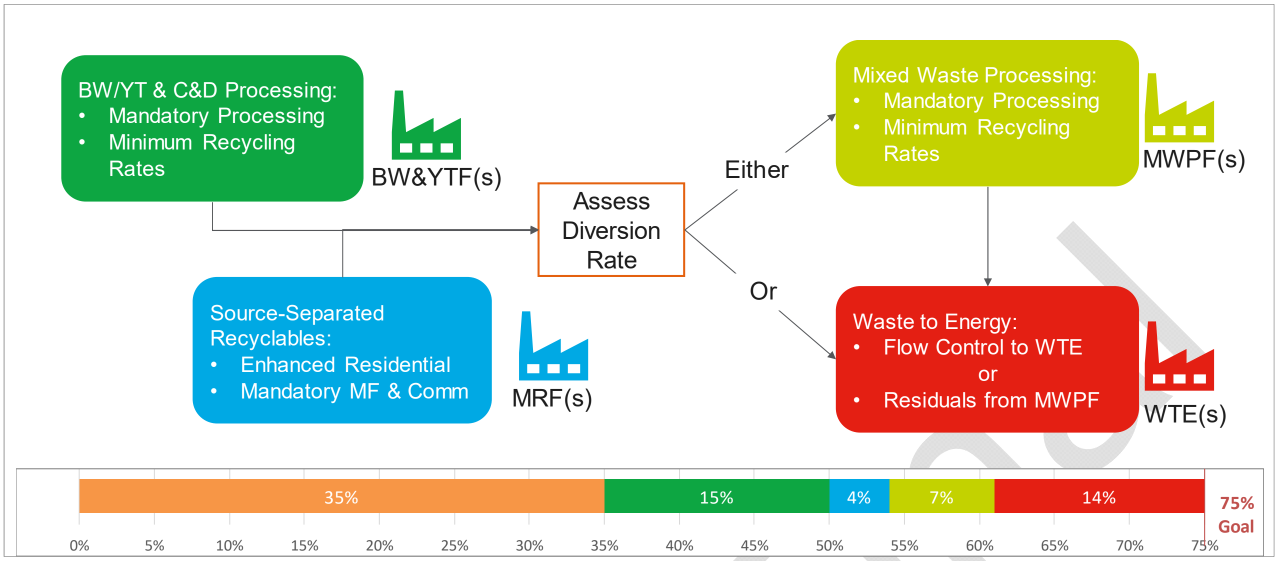


Figure 24: Schematic of Proposed Approach to Increase Recycling

Tables 10 through 12 provide more detailed explanations of the proposed short-term, mid-term, and long-term actions, respectively, associated with implementing this approach. Each table outlines the policies, programs, and facilities that are proposed to recycle more of the following material streams: C&D debris, bulky waste and yard trash; commercial recyclables, and residential recyclables. Additionally, each table includes actions to obtain renewable energy credits for materials that are not recycled.

Key elements of this approach are listed below. Following the tables, a discussion is provided regarding the viability, general cost-effectiveness, diversion potential, environmental benefits, and historical success of each of these elements.

- Mandatory C&D debris, bulky waste, and yard trash processing and recycling.
- Mandatory multi-family and commercial recycling.
- Mixed waste processing (MWP) – Based on assessment of the diversion rate after implementation of the above mandatory programs, MWP may be considered with residuals going to WTE.
- WTE – If MWP is implemented, residuals would be sent to WTE. If MWP is not established, then remaining waste would go to WTE to maximize energy credits.

Table 10: Proposed Short-Term Strategies and Actions

		Policies	Programs	Facilities	Target Diversion Increase
SHORT-TERM – 2018-2020	C&D, Bulky Waste & Yard Trash	Require C&D debris, bulky waste & mixed bulky waste/yard trash to be processed prior to disposal Set minimum C&D recycling rate (linked to permits & fees) Set minimum recycling rate for processing facilities	Develop implementation program, including standards, reporting, monitoring & enforcement Provide technical assistance during implementation	Utilize existing facilities in near-term Construct C&D/bulky waste processing facilities as needed Construct yard trash processing facilities	12%
	Commercial Recycling	Require new multi-family and commercial developments to provide adequate space for recycling Require multi-family complexes and commercial businesses to establish comprehensive recycling programs	Develop implementation program, including standards, reporting, monitoring & enforcement Provide technical assistance during implementation	Utilize existing facilities in near-term Construct single stream MRF	3%
	Residential Recycling	Maintain existing processing contracts; limit term to keep options open Direct (some or all) recyclables to publicly owned MRF upon completion	Comprehensive & coordinated marketing campaign Evaluate PAYT on case-by-case basis	Utilize existing facilities in near-term Construct single stream MRF	<1%
	Energy Credits	Maintain existing disposal contracts; limit term to keep options open Commit to directing waste to regional WTE facility upon expiration	Not Applicable	Evaluate feasibility of purchasing or entering into long-term WTE contract with Wheelabrator South Based on waste commitment, evaluate need for additional WTE capacity	Not Applicable

Table 11: Proposed Mid-Term Strategies and Actions

		Policies	Programs	Facilities	Target Diversion Increase
MID-TERM – 2021-2024	C&D, Bulky Waste & Yard Trash	Evaluate effectiveness of policies & modify as needed Ban disposal of yard trash if necessary	Actively monitor & enforce policies Evaluate & modify program elements as needed Continue providing technical assistance	Explore alternative markets or seek to attract markets for hard-to-recycle materials in C&D and bulky waste streams	3%
MID-TERM – 2021-2024	Commercial Recycling	Evaluate effectiveness of policies & modify as needed Commit to directing waste to regional mixed waste processing (MWP) facility if developed	Actively monitor & enforce policies Evaluate & modify program elements as needed Continue providing technical assistance	Assess program effectiveness Decide whether to establish MWP/ organics processing facilities & initiate development if appropriate	1%
MID-TERM – 2021-2024	Residential Recycling	Commit to directing waste to regional MWP facility if developed	Continue comprehensive & coordinated marketing campaign Evaluate program effectiveness	Expand single stream MRF processing capacity as needed Decide whether to establish MWP/ organics processing facilities & initiate development if appropriate	<1%
MID-TERM – 2021-2024	Energy Credits	Commit to directing waste to regional WTE facility	Not Applicable	Consider purchasing or entering into long-term WTE contract Initiate construction of additional WTE capacity if needed & depending on MWP decision	Not Applicable

Table 12: Proposed Long-Term Strategies and Actions

		Policies	Programs	Facilities	Target Diversion Increase
LONG-TERM – 2025+	C&D, Bulky Waste & Yard Trash	Evaluate effectiveness of policies & modify as needed	Actively monitor & enforce policies Evaluate & modify program elements as needed Continue providing technical assistance	Explore alternative markets or seek to attract markets for hard-to-recycle materials in C&D and bulky waste streams	Maintain diversion rate
	Commercial Recycling	Commit to directing waste to regional MWP (if developed) or WTE facility	Actively monitor & enforce policies Evaluate & modify program elements as needed Continue providing technical assistance	Initiate operation of MWP facility or additional WTE capacity depending on scenario selected	19-21%
	Residential Recycling	Commit to directing waste to regional MWP (if developed) or WTE facility	Continue comprehensive & coordinated marketing campaign Evaluate program effectiveness		
	Energy Credits	Commit to directing waste to regional WTE facility	Not Applicable		

4.7.1 Mandatory C&D Debris, Bulky Waste, and Yard Trash Processing and Recycling

A key element is to establish policies that drive the recycling of C&D debris, bulky waste, and yard trash by requiring processing of these materials prior to disposal and establishing minimum recycling standards.

Viability: The viability of processing and recovering materials from C&D debris and commingled bulky waste/yard trash that can be put to beneficial use is best demonstrated by the fact that approximately 750,000 additional tons of these materials were recycled in 2014 than in 2016.[6]

General cost-effectiveness: Numerous full-scale C&D processing facilities are operating in the United States and in Florida with varying levels of sophistication and diversion capabilities. Many of these facilities, including the Sun Recycling facilities, are privately owned which indicates the ability to operate such facilities cost-effectively. Tipping fees in the local area can impact the diversion rate. Where tipping fees are high, operators may find it cost-effective to utilize additional manual and mechanized resources to maximize material recovery and reduce the amount of material disposed.

Diversion potential: This strategy targets C&D debris (19 percent of waste generated), bulky waste (8 percent), and yard trash (6 percent). Based on previous recovery rates for these material streams, the additional diversion potential of this strategy is estimated at 15 percent once fully implemented. C&D materials are generated in new construction, remodeling, deconstruction and demolition. Common components of new construction include wood, concrete/masonry, wallboard, metal, corrugated cardboard, bottles and cans. Demolition debris includes concrete, wood, metal, asphalt, brick, and roofing. Many of these materials can be recycled and made into new products. For example, clean, untreated wood can be made into new wood products (i.e., furniture, and wood chips and mulch for landscaping purposes); gypsum wallboard can be ground into a gypsum powder that is then manufactured into new plasterboard or applied as a soil amendment; and asphalt shingles can be recycled into cold patch, new shingles, or hot mix asphalt.

Environmental benefits: Because of the bulky nature of these materials, they are not conducive to combustion in a WTE facility. Therefore, increasing recycling conserves landfill space and offsets the environmental impacts associated with the extraction and consumption of virgin resources and production of new materials.

Historical success: Increasing numbers of state and municipal governments are either mandating C&D debris recycling or banning disposal of materials found in C&D debris. At least 13 states have some form of C&D material disposal ban or recycling requirement.[7] These programs can take many different forms. Several Florida counties have implemented C&D mandates of some form including Lee and Sarasota.

4.7.2 Mandatory Multi-Family and Commercial Recycling

While many municipalities in Broward County report some level of multi-family and commercial recycling, a key element of the proposed approach is to maximize this recycling through mandates.

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[6] This does not include non-certified C&D debris recycling identified by County staff in 2015 and 2016. This is recycling that normally takes place and is outside of the traditional MSW stream.

[7] Northeast Recycling Council, *Summary of U.S. State and Municipal C&D Regulations and Requirements*, June 2012.

Concern was expressed over the legality of mandating commercial recycling in Florida. Florida law prohibits a local government from dictating where a commercial establishment must direct its source-separated recyclable materials but does not prohibit mandating commercial recycling.[8]

Viability: Communities with some of the highest reported recycling rates in the Unites States have employed recycling mandates or disposal bans. Several Florida counties currently mandate multi-family and/or commercial recycling, including Alachua, Lee, Miami-Dade, and Sarasota.

General cost-effectiveness: The cost of establishing recycling collection infrastructure is placed on the multi-family complexes and business owners or operators. The County and municipalities will need to develop the program structure and reporting requirements and provide technical assistance during implementation, as well as monitor and enforce compliance. Combining resources and information will enhance the cost-effectiveness.

Diversion potential: This strategy targets an estimated 6-8 percent of total waste generated within the County. The anticipated recovery rate will be highly dependent on the level of enforcement but is projected to increase the recycling rate by 3-4 percent.

Environmental benefits: Increasing recycling conserves landfill space and offsets the environmental impacts associated with the extraction and consumption of virgin resources and production of new materials.

Historical success: Mandates and bans are typically applied in conjunction with mature infrastructure and programs to drive higher diversion rates if voluntary programs have stagnated. In 2012, California state law mandated commercial businesses that generate four cubic yards or more of solid waste per week and multi-family residential dwellings of five or more units to arrange for recycling services. Individual communities may have mandatory commercial recycling ordinances with different thresholds or more specific requirements.[9] Arcadia, CA requires commercial businesses to recycle 50 percent of solid waste generated and reported a diversion rate of 86 percent in 2014. Fresno, CA mandated commercial recycling in 2005. Prior to enactment, the citywide diversion rate was 32 percent. Following implementation of mandatory commercial recycling, the rate climbed to 62 percent.[10]

4.7.3 Mixed Waste Processing

The proposed approach calls for evaluating the effectiveness of the mandatory multi-family and commercial recycling programs and deciding whether to develop MWP capacity to recover additional recyclables from the waste stream or to merely direct remaining waste to WTE. MWP would not replace existing recycling programs and infrastructure in the County but could complement them. MWP and single stream processing are often combined in the same facility.

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[8] Per Section 403.7046(3), F.S.: Except as otherwise provided in this section or pursuant to a special act in effect on or before January 1, 1993, a local government may not require a commercial establishment that generates source-separated recovered materials to sell or otherwise convey its recovered materials to the local government or to a facility designated by the local government, nor may the local government restrict such a generator's right to sell or otherwise convey such recovered materials to any properly certified recovered materials dealer who has satisfied the requirements of this section. A local government may not enact any ordinance that prevents such a dealer from entering into a contract with a commercial establishment to purchase, collect, transport, process, or receive source-separated recovered materials.

[9] CalRecycle. Mandatory Commercial Recycling, 2015.

[10] Institute for Local Government, Waste Reduction & Recycling Case Stories: http://www.ca-ilg.org/post/waste-reduction-recycling-case-stories.

A MWP facility could be designed and operated to capture marketable commodities, divert non-combustible materials such as wet organics, and direct the remainder to WTE to generate energy. Processing mixed waste to remove recyclable materials could reduce the amount of remaining waste to an amount within current WTE capacity, thereby reducing the amount of waste landfilled and eliminating the need to construct additional WTE capacity.

Viability: According to Government Advisory Associates, 29 MWP facilities are operational in the United States with approximately 10 additional facilities in the planning stages.[11] More recently constructed or upgraded facilities use more sophisticated, state-of-the-art sortation technology and generally report higher material recovery rates.

General cost-effectiveness: MWP is generally more cost-competitive in areas with high disposal fees. On a cost-per-ton basis, it would be difficult for a state-of-the-art MWP facility to compete with Florida's relatively low landfill tipping fees. However, if striving to achieve the State's 75 percent recycling goal, MWP might be more cost-effective than constructing additional WTE capacity.

Diversion potential: This strategy targets all residential and commercial waste that is not source-separated for recycling, excluding C&D debris and bulky waste/yard trash. Material recovery rates depend on the composition of incoming material, type of processing equipment, and level of mechanization. Higher recovery rates are generally anticipated from more highly mechanized systems. Recovery rates for recyclables depend on the sophistication of the equipment used but range from 25-90 percent depending on the material being recovered. Facilities that also recover organics report recovery rates as high as 90 percent of organic materials.

Environmental benefits: Increasing recycling conserves landfill space and offsets the environmental impacts associated with the extraction and consumption of virgin resources and production of new materials. Recovering and processing organics can also produce a soil amendment and biogas (energy) depending on the technology used.

Historical success: Numerous state-of-the-art MWP facilities are successfully operating in the United States, with most located in California where tipping fees are generally higher than in the Southeast. The MWP facility in Montgomery, Alabama closed after operating for only 15 months because the sustained downturn in recycling commodity markets made it impossible for the operator to meet its contractual obligations with the City. Additionally, the planned organics processing and energy recovery portion of the facility were never developed. The City acquired the MWP facility and is reportedly seeking another operator. Despite closure of the Montgomery facility, other facilities in the United States have successfully demonstrated the ability to recover recyclables from mixed waste using state-of-the-art MWP equipment.

4.7.4 WTE

WTE would continue to be an important element in the County's overall strategy to achieve 75 percent recycling.

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[11] Rosengren, Cole, "MRF Survey," *Waste Dive*, November 7, 2016.

Viability and historical success: The viability and success of WTE are demonstrated by its history of use in Broward County.

General cost-effectiveness: The Wheelabrator facilities lost market share to less expensive landfill disposal options in Broward County, which led to the closure of Wheelabrator North. As mentioned previously, if the Broward community is committed to achieving the 75 percent recycling goal, a key consideration will be whether MWP with residuals going to WTE or expanding WTE capacity is more cost-effective.

Diversion potential: For every megawatt-hour of energy generated, the County receives one ton of recycling credit. From 2014-2016, this averaged about 0.56 renewable energy credits per ton combusted. If the County's traditional recycling rate reaches 50 percent, the recycling credit increases to 1.25 tons per megawatt-hour, or an estimated 0.70 renewable energy credits per ton combusted.

Environmental benefits: Combustion of waste conserves landfill space and generates energy.

4.8 Assessment of Diversion Potential

To estimate the potential of the approach and strategies outlined above to increase recycling, three scenarios were evaluated. All three scenarios assumed the short-term strategies and actions outlined in **Table 10** would be implemented, including (1) increased source-separation of recyclables through enhanced programs and mandates and (2) increased bulky waste, yard trash, and C&D debris recycling by requiring processing prior to disposal and setting minimum recycling standards for processing facilities. The three scenarios differ in how mixed residential and commercial waste that is not source-separated for recycling would be managed, which is explained in greater detail below.

The assessment used waste composition estimates and generation projections discussed in Sections 2 and 3 of this Report. Additional key assumptions used in evaluating the diversion potential are as follows:

- Comprehensive and coordinated marketing of residential source-separated recycling
  - 30 percent of mixed waste[12] is residential
  - Recovery of 25 percent of recyclable paper and containers currently disposed
  - 100 percent of source-separated residential recyclables directed to public MRF
- Mandatory multi-family and commercial recycling
  - 70 percent of mixed waste is multi-family/commercial
  - Recovery of 50 percent of recyclable paper and containers currently disposed
  - 40 percent of source-separated multi-family/commercial recyclables directed to public MRF
- Mandatory processing and recycling of bulk waste/yard trash and C&D debris
  - 30 percent is residential, and 70 percent is multi-family/commercial

[12] Throughout this discussion, the term mixed waste is used to refer to mixed residential and commercial waste that does not include mixed bulky waste/yard trash or source-separated C&D debris.

  - 85 percent is directed to processing by 2020, increasing to 90 percent by 2025
  - Recovery of 70 percent of incoming yard trash by 2020, increasing to 75 percent by 2025
  - Recovery of 50 percent of other incoming materials by 2020, increasing to 55 percent by 2025
  - 100 percent of residential materials and 25 percent of multi-family/commercial materials directed to public processing facilities
- Scenario A – Mixed waste would be processed at a MWP facility. Recyclables would be recovered and marketed and wet organics would be recovered and processed. Residuals would go to WTE.
  - 100 percent of mixed waste directed to public MWP facilities that would be fully operational by 2025
  - Recovery of 50 percent of recyclable paper and containers
  - Recovery of wet organics (food waste, compostable paper, and other organics materials) equivalent to 75 percent of incoming food waste
  - 100 percent of residuals directed to WTE
  - Renewable energy credits of 0.56 credits per ton combusted when traditional recycling rate is less than 50 percent and 0.70 credits per ton when traditional recycling rate is 50 percent or higher
- Scenario B – Mixed waste would be processed at a MWP facility. Recyclables would be recovered and marketed; residuals would go to WTE.
  - 100 percent of mixed waste directed to public MWP facilities that would be fully operational by 2025
  - Recovery of 50 percent of recyclable paper and containers
  - 100 percent of residuals directed to WTE
  - Same renewable energy credits as above
- Scenario C – Mixed waste would go to WTE.
  - 100 percent of mixed waste directed to WTE by 2025
  - Same renewable energy credits as above

Table 13 provides the estimated recycling rates for the three scenarios for comparison. If fully implemented, all three scenarios are projected to increase the County's recycling rate, however, only Scenario A is predicted to achieve the 75 percent recycling goal during the planning period.

Table 13: Estimated Recycling Rate Projections

SCENARIO A: MWP with Recyclables and Organics Recovery; Residuals to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
MWP - Recyclables Recovery	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
MWP - Organics Recovery	0%	0%	4%	4%	4%	4%	4%	4%	4%	4%
WTE Credits	10%	13%	14%	14%	14%	14%	14%	14%	14%	14%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	75%	75%	75%	75%	75%	75%	75%	75%

SCENARIO B: MWP with Recyclables Recovery; Residuals to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
MWP - Recyclables Recovery	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
WTE Credits	10%	13%	17%	17%	17%	17%	17%	17%	17%	17%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	74%	74%	74%	74%	74%	74%	74%	74%

SCENARIO C: Mixed Waste to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
WTE Credits	10%	13%	19%	19%	19%	19%	19%	19%	19%	19%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	73%	73%	73%	73%	73%	73%	73%	73%

4.9 Potential Facility Needs

Fully implementing the proposed approach will require development of additional public and/or private processing capacity. For illustrative purposes, **Figures 25-27** provide schematics of the estimated material flow in 2025 if all elements of Scenarios A, B and C, respectively, were fully implemented.

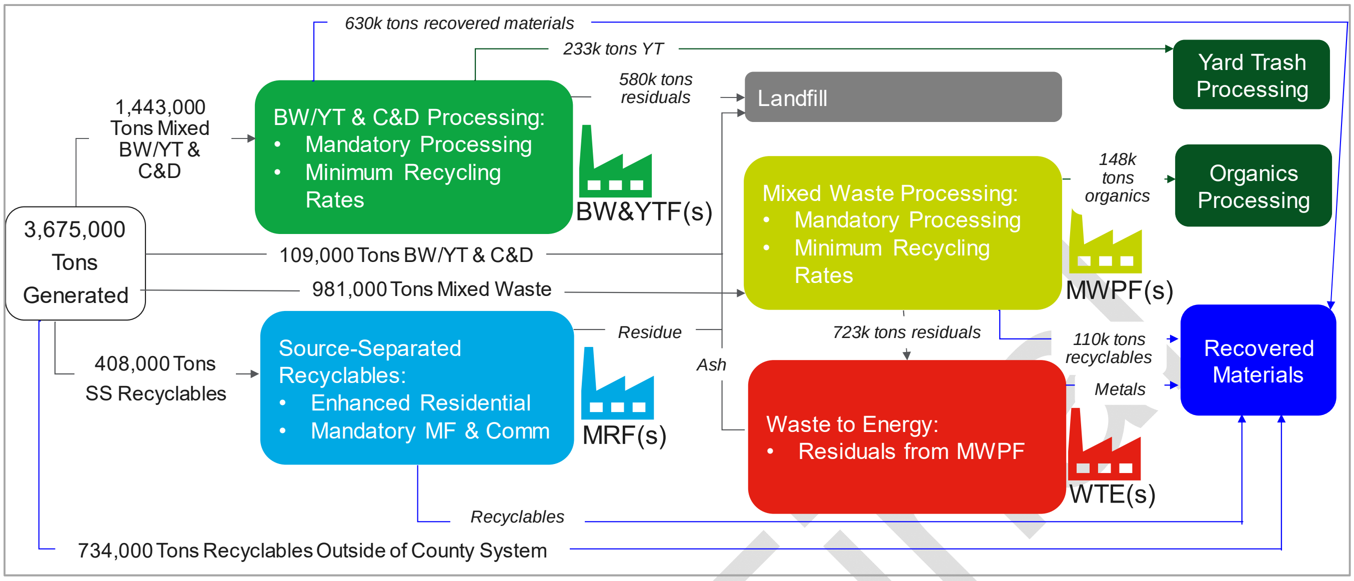


Figure 25 Schematic of Projected Scenario A Material Flow in 2025

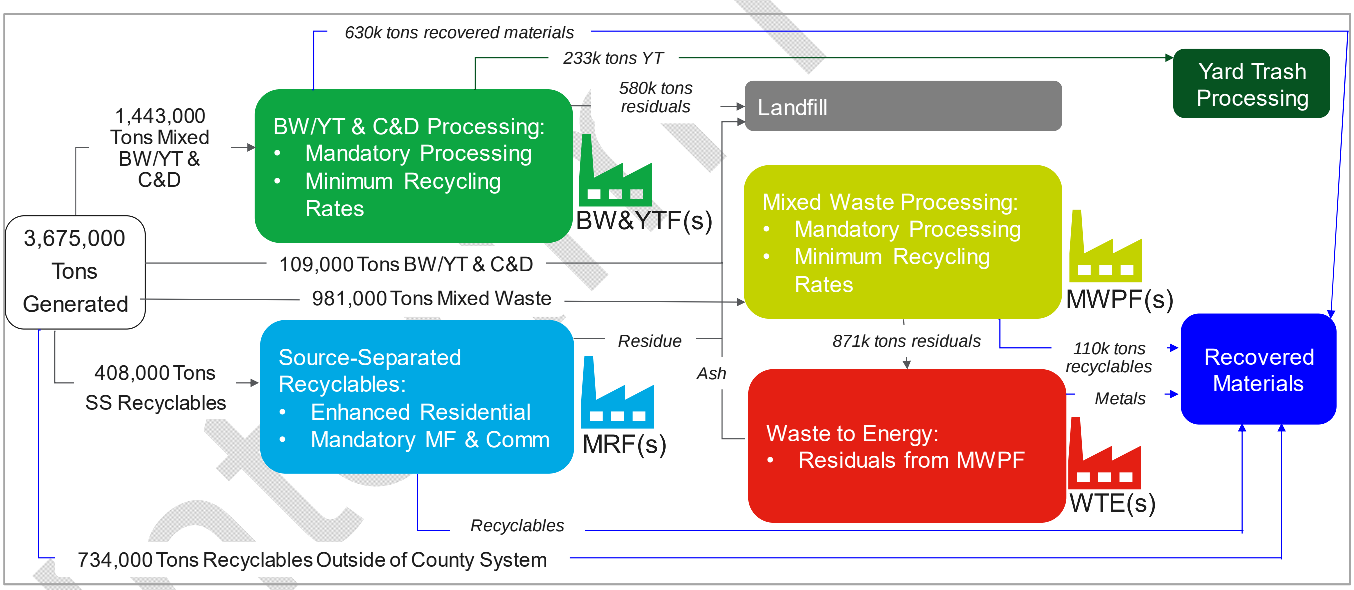


Figure 26: Schematic of Projected Scenario B Material Flow in 2025

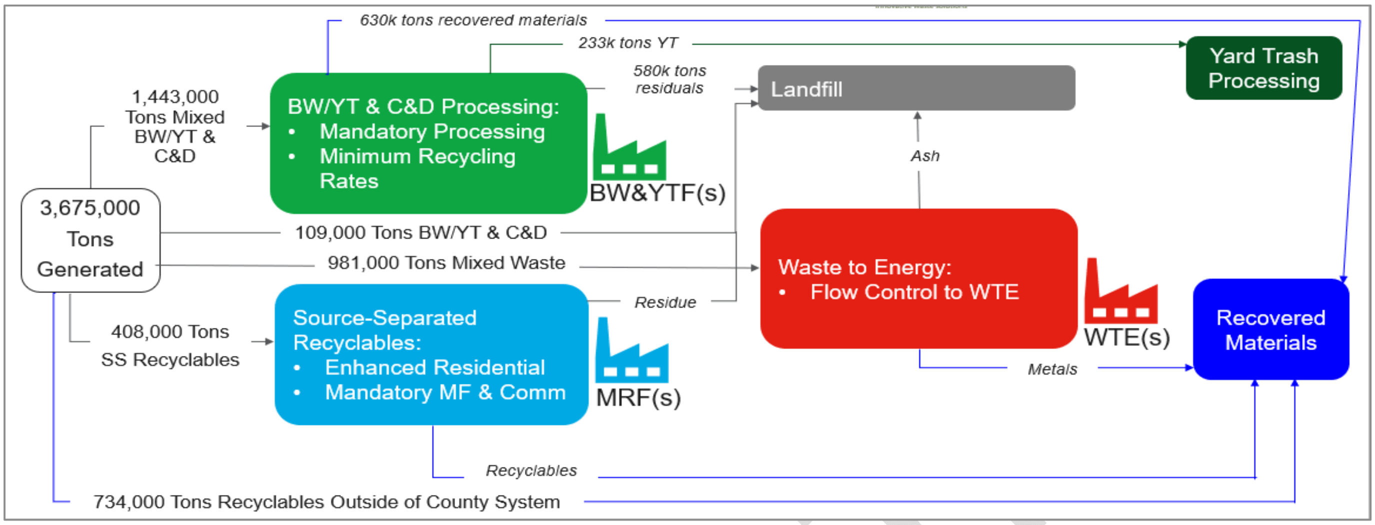


Figure 27: Schematic of Projected Scenario C Material Flow in 2025

Table 14 provides a summary of the types of processing facilities that would be part of the proposed system and estimated capacity needs. Capacities are best estimates based on the assumptions outlined in the previous section. These will vary depending on the degree to which the proposed approach is implemented, timeline for implementation, number and location of facilities, local government control of material flow, future changes in waste composition, and other factors. Facility capacity needs were allocated by projected population in the seven zones previously defined and are provided in **Exhibit G**.

Table 14 also provides estimated capacities for publicly owned or controlled facilities (whether by the County, municipality, or public authority). Most jurisdictions have control over where residential materials will be processed but generally less or no control over commercial materials. This consideration, as well as lack of or exclusive control over privately owned processing capacity were primary factors in estimating publicly owned or controlled capacity needs.

Cost will certainly be a factor in deciding which if any of these approaches and scenarios to implement. For example, developing MWP capacity would prolong and possibly eliminate the need to develop additional WTE capacity. Additionally, developing a MWP facility might be more cost-effective than developing additional WTE capacity. The Arcadis Team developed conceptual construction cost estimates for the proposed facilities and are described in further detail in Section 7 of this Report.

No matter which approach or scenario the Working Group decides to pursue, waste quantity, composition, and recovery projections will need to be re-evaluated during the course of the 40-year planning period. The system will need to be adjusted based on more current data, technology developments, changes in product packaging and consumption habits, stakeholder input, and a multitude of other factors.

Table 14: Estimated Facility Needs over 40-Year Planning Period

Single Stream MRF	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Estimated Tons per Year	241,333	361,562	408,217	421,385	433,558	443,017	451,809	460,809	467,465	472,742
Contribution to Recycling Rate	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Estimated Public Capacity	0	218,903	241,674	249,469	256,676	262,276	267,481	272,809	276,750	279,873

Bulky Waste/Yard Trash/C&D Processing Facility	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Bulk/YT/C&D Processing										
Estimated Tons per Year	1,340,001	1,303,737	1,442,990	1,489,535	1,532,567	1,566,003	1,597,081	1,628,894	1,652,423	1,671,074
Estimated Yard Trash Recovery	0	188,128	223,095	230,291	236,944	242,114	246,919	251,837	255,475	258,359
Estimated Other Recovery	270,001	517,491	630,041	650,364	669,152	683,751	697,321	711,211	721,484	729,628
Contribution to Recycling Rate	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
Estimated Public Capacity	0	388,626	430,264	444,142	456,973	466,943	476,210	485,696	492,711	498,272
Yard Trash Processing										
Estimated Tons per Year	0	188,128	223,095	230,291	236,944	242,114	246,919	251,837	255,475	258,359
Estimated Public Capacity	0	56,078	66,521	68,667	70,651	72,192	73,625	75,092	76,176	77,036

SCENARIO A: MWP with Recyclables and Organics Recovery; Residuals to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Waste Processing Facility										
Mixed Waste	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Estimated Recyclables Recovery	0	0	109,497	113,029	116,294	118,832	121,190	123,604	125,389	126,805
Contribution to Recycling Rate	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Organics Processing										
Organics from MWP	0	0	148,296	153,080	157,502	160,939	164,132	167,402	169,820	171,737
Contribution to Recycling Rate	0%	0%	4%	4%	4%	4%	4%	4%	4%	4%
Estimated Public Capacity	0	0	148,296	153,080	157,502	160,939	164,132	167,402	169,820	171,737
WTE										
Residuals from MWP	670,000	648,093	723,033	746,355	767,917	784,671	800,243	816,183	827,973	837,318
Renewable Energy Credit	10%	13%	14%	14%	14%	14%	14%	14%	14%	14%
Estimated Public Capacity	0	0	723,033	746,355	767,917	784,671	800,243	816,183	827,973	837,318

SCENARIO B: MWP with Recyclables Recovery; Residuals to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Waste Processing Facility										
Mixed Waste	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Estimated Recyclables Recovery	0	0	109,497	113,029	116,294	118,832	121,190	123,604	125,389	126,805
Contribution to Recycling Rate	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
WTE										
Residuals from MWP	670,000	648,093	871,330	899,435	925,419	945,609	964,375	983,585	997,793	1,009,055
Renewable Energy Credit	10%	13%	17%	17%	17%	17%	17%	17%	17%	17%
Estimated Public Capacity	0	0	871,330	899,435	925,419	945,609	964,375	983,585	997,793	1,009,055

SCENARIO C: Mixed Waste to WTE	2014 - 2016 Weighted Avg Estimate	2020	2025	2030	2035	2040	2045	2050	2055	2060
WTE										
Mixed Waste	670,000	648,093	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Renewable Energy Credit	10%	13%	19%	19%	19%	19%	19%	19%	19%	19%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860

5 SITE EVALUATION INTRODUCTION

Section 4 of this Report identified six types of solid waste processing facilities that would assist the County in achieving the 75 percent recycling goal, which are summarized below.

- Materials Recycling Facility (MRF): receives, separates and prepares recyclable materials for marketing to end-user manufacturers.
- Combined Bulky Waste (BW)/Yard Trash (YT)/Construction & Demolition Debris (C&D) Processing Facility – receives and processes bulk waste, which includes waste types that are too large to be accepted by the regular waste collection; yard trash, which is vegetative matter resulting from landscaping maintenance or land clearing operations; and construction and demolition debris, which includes the discarded materials from construction/demolition activities.
- Yard Trash (YT) Processing Facility: receives vegetative matter resulting from landscaping maintenance or land clearing operations and is processed into a size-reduced, usable material or is composted.
- Mixed Waste Processing (MWP) Facility: receives a mixed solid waste stream, separates designated recyclable materials through a combination of manual and mechanical sorting.
- Organics Processing (OP) Facility (excludes Yard Trash) – receives organic solid waste stream that is processed using a composting technology, such as physical turning, windrowing, aeration, or other mechanical handling of organic matter.
- Waste-to-Energy (WTE) Facility – receives solid waste which is combusted to produce electricity.

This section of the Report provides a preliminary evaluation of the Alpha 250 Site to determine if it could be utilized for construction of any of the proposed facilities, thereby assisting the County in achieving the 75 percent recycling goal and whether it should be retained in public ownership.

5.1 Alpha 250 Site Evaluation

The fate of the Alpha 250 Site (Site) was one of the driving forces for moving forward with the Solid Waste and Recycling Issues Study. The Arcadis Team was tasked with developing general, non-site-specific criteria to determine if the solid waste processing facilities identified in Section 4 of the Report could be constructed on the Site to assist in meeting the 75 percent recycling goal or provide other benefits in connection with solid waste disposal within Broward County. Additionally, the Arcadis Team was tasked with investigating up to four other general geographic areas, currently not used for solid waste or recycling purposes, which could be suitable for development of the proposed facilities. The Arcadis Team developed the following constraints and limitations checklist to further evaluate the Site:

- Current Zoning and Land Use
- Available Building Area and Site Shape;
- Utilities
    - Electrical

    - Water and Wastewater
- Traffic Impacts
- Social and Political Acceptance

5.2 Current Zoning and Land Use Information

The Alpha 250 Site is composed of two parcels, a northern and southern parcel, that are separated by Blount Road. The North Alpha 250 Site is located east of the Florida Turnpike, as shown in **Figure 28**, and falls within the zoning jurisdiction of the City of Pompano Beach. The Site is zoned General Industrial (I-1), the intent of the I-1 zoning designation, in accordance with Pompano Beach Planning and Zoning Code (Zoning Code) Section 155.3402, is to accommodate a range of light and moderate manufacturing, assembly, fabrication, processing, storage and construction industry uses, excluding heavy or hazardous manufacturing processes. Uses for areas with the General Industrial designation are defined in Appendix A: Consolidated Use Table of the Zoning Code. Waste-related uses are allowed in areas with the General Industrial designation as a special exception and would require approval from the City of Pompano Beach Zoning Board of Appeals (ZBA) in accordance with Section 155.2406 of the Zoning Code. The following waste-related uses were noted in the Consolidated Use Table: C&D debris disposal facility, land clearing debris disposal facility, MRF, solid waste transfer station, tire disposal or recycling facility, waste composting facility, and WTE facility.

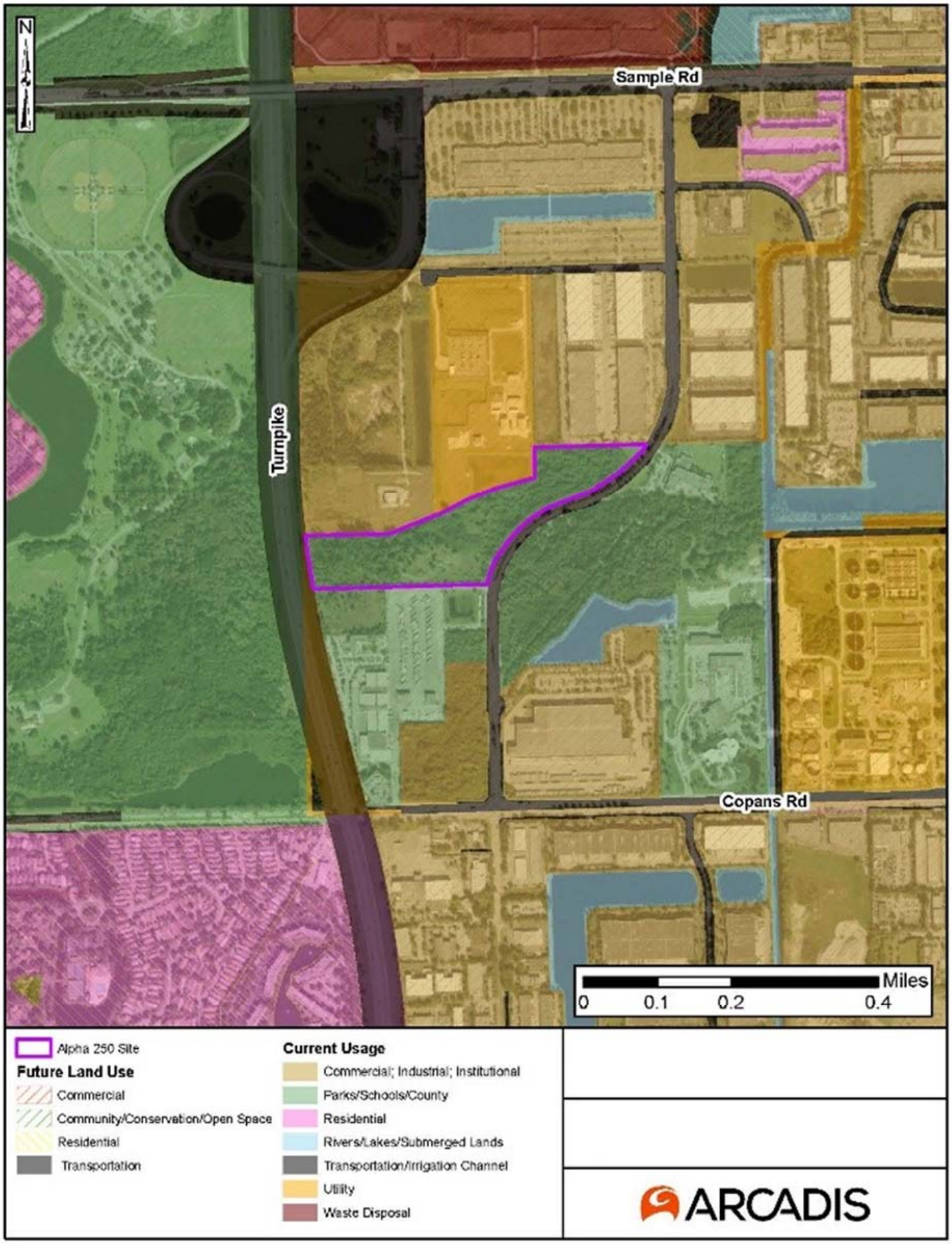


Figure 28: North Alpha 250 Site and Zoning Map

Of the facilities recommended to be implemented, all but the MWP are noted as an allowed use. However, a special exception could be requested for the development of a MWP on the Site, therefore the MWP should not be precluded from the list of proposed facilities that could be developed at the Site.

The South Alpha 250 Site was excluded from the site evaluation process as the entire parcel has been classified by the County as a Natural Resource Area and a perpetual conservation easement was granted for this portion of the parcel, therefore it cannot be developed for any purpose.

Table 15 provides a summary of the current zoning and land use information for the North Alpha 250 Site.

Table 15: Current Zoning and Land Use Information

North Alpha 250 Site	
Broward County Future Land Use Code	• 60 - Commerce
County Land Use Code	• 82 - Forests, Parks, Recreational Areas
City of Pompano Beach Municipal Zoning Code	• I-1 – General Industrial

Permitted Uses	• Waste Related Uses (with approval as special exception)
	   • C&D Disposal Facility
	   • Land Clearing Debris Disposal Facility
	   • MRF
	   • Solid Waste Transfer Station
	   • Tire Disposal or Recycling Facility
	   • Waste Composting Facility
	   • Waste-to-Energy Facility
	• Other Light Industrial Uses
	• Communication (Newspaper/magazine publishing, telecommunications facilities, etc.)
	• Community Service (Museum, Senior and Youth Centers)
	• Government Uses (Fire/EMS/Police Station, Fire Training Facility, etc.)
	• Health Care Uses (Hospital, Medical/Dental lab, etc.)
	• Transportation Uses (Aircraft/Aviation Sales or Rental, etc.)
	• Utility Uses (Solar Energy and Major/Minor Utility Use)

Setback Requirements	• Front Yard – minimum 25 feet • Side Yard – minimum 10 feet • Rear Yard – minimum 30 feet
Size	• Lot coverage, maximum 65 percent
Height	• Maximum 45 feet

5.3 North Alpha 250 Site - Available Buildable Area and Shape

The Site has a total acreage of 22.07 acres; however, the total useable area is approximately 18.9 acres based on an assessment of the setback restrictions associated with the zoning designation. The buildable portion of the site was further limited through a Plat Amendment (Instrument Number 110507399) that was recorded by the Broward County Records Division in January 2012, clarifying that the parcel is limited to 342,000 square feet (approximately 7.85 acres) of industrial use.

To determine if the Site would be suitable for constructing the solid waste facilities proposed in the Alternatives and Options White Paper, the Arcadis Team conducted a review of reference facilities throughout the United States to determine the range of actual facility footprint and site sizing needs to process Broward County's solid waste stream through the planning period. **Table 16** summarizes the facility sizing ranges determined for each of the facility types proposed. The Arcadis Team then compared the estimated sizing needs against the buildable portion of the Site, taking the existing zoning and Plat Amendment restrictions into consideration.

Table 16: North Alpha 250 Suitable Facilities

Proposed Facilities	Range of Reference Facility Size (and Throughput)	Suitable for Site with Plat Amendment Restrictions (342,000 sq ft)
MRF	60,000-135,000 sq ft (211-400 tpd)	Yes
Combined Bulky Waste/Yard Trash/C&D	300,000 sq ft (350-415 tpd)	Yes
Yard Trash	300,000 sq ft (350-400 tpd)	Yes
Mixed Waste Processing Facility*	30,000-175,000 sq ft (183-3,846 tpd)	Yes
Organics Processing Facility (excludes Yard Trash)	300,000 sq ft (2,200 tpd)	Yes
Waste-to-Energy	1,000,000-2,200,000 sq ft (2,250-3,000 tpd)	No

Preliminary evaluation of the Site indicates that there is sufficient buildable area to provide for five of the six types of facilities proposed. The shape of the North Alpha 250 Site is not ideal. However, if the facility selected is sited in the western portion, with access in the eastern portion, the shape should not preclude the Site from development.

The Arcadis Team recommends investigating the Plat Amendment (Instrument Number 110507399), which limits the useable area of the Site to 7.85 acres (342,000 sq ft) of the possible 18.9 acres (832,000 sq ft) to determine if a subsequent Plat Amendment could be pursued to increase the buildable area and provide more options for developing the Site for solid waste purposes.

5.4 Site Access

Currently, an access point to the Site does not exist, however, an access point could be constructed along its eastern boundary with Blount Road. Blount Road is bounded to the north by Sample Road and Copans Road to the south. The Florida Turnpike has interchanges at Sample Road to the north and Atlantic Boulevard (northbound lanes) or Hammondville Road (southbound lanes) to the south. Interstate 95 also has interchanges at both Sample Road and Copans Road. Therefore, access from major thoroughfares to the Alpha 250 Site is available and could allow for the transport of solid waste.

5.5 Utilities

The Arcadis Team conducted a review of existing utility infrastructure at the Site. The following subsections presents a summary of the utility findings.

5.5.1 Electrical Utilities

The solid waste facility with the highest peak power demands that could be constructed within the useable area and zoning constraints of the Alpha 250 Site is a MRF. The approximate peak power demand for a 100,000 ton per year (tpy) MRF, could be 1000 kVA, or 1,200 amps at 480 volts, depending on the processing equipment selected. A 3-phase transformer would be needed to meet the peak power demand needs, based on the above assumptions.

Currently, the Alpha 250 Site does not have existing electrical infrastructure needed to power the process equipment that would be needed for a MRF. However, the following existing electrical infrastructure was identified on adjacent sites:

- Florida Transmission Gas Company, LLC site
    - Existing 3-phase transformer
        - Approximately 1,600 ft from the western boundary of the site
        - Approximately 800 ft from the northern boundary of the site
- Duke Realty Warehouse site
    - Two existing 3-phase transformers
        - Approximately 2,300 ft from the western boundary of the site
        - Approximately 200 ft from the northern boundary of the site
    - One existing switch cabinet
        - Approximately 2,500 ft from the western boundary of the site
        - Approximately 300 ft from the northern boundary of the site

It may be possible to extend electrical infrastructure and service from the existing 3-phase transformers located on the Duke Realty Warehouse site through the existing switch cabinet. However, the existing electric loads of the transformers and equipment selected would need to be reviewed to determine adequate electrical service.

The absence of existing electrical infrastructure at the North Alpha 250 Site does not preclude the Site from development. Required electrical infrastructure could be provided by Florida Power & Light, the electric utility service provider, to meet the needs of a MRF or any other facility selected for construction at the Site.

5.5.2 Water and Wastewater Utilities

Process equipment associated with the facilities that could be constructed within the useable area of the Alpha 250 Site will likely not require water for operations. The water needs for any of the facilities selected would provide for sanitary water uses, wash water uses and fire protection. An existing 8-inch diameter water main line is located along the southern perimeter of the Site along Blount Road. Service could be extended from this water main line to provide water for any of the facilities.

Sanitary wastewater will be generated within the proposed facilities in the personnel service areas, (i.e. washrooms, locker rooms, break rooms, etc.). The personnel service areas will tie into the sanitary system of the Broward County North Regional Wastewater Treatment Plant. An existing 6-inch diameter sanitary force main is located along the southern perimeter of the Site along Blount Road. Service could be extended from this force main line to provide sanitary sewer access for any of the facilities.

5.6 Traffic Impacts

The facility with the highest truck traffic volume that could be constructed within the useable area of the Alpha 250 Site is a MRF. The average daily truck volume for a 100,000 tpy MRF, with 35 employees could result in approximately 60-70 vehicles per day along with Personally Occupied Vehicle (POV) traffic volumes, which could vary based on public transit options and ride sharing preferences of employees. The Florida Department of Transportation (FDOT) District 4 Level of Service (LOS) Assessment Report for 2016 indicates that Blount Rd. between Copans Road and Sample Road currently operates at a LOS C, which indicates an average volume of traffic. The increased volume of truck traffic may impact the LOS of the roadway; however, the traffic impacts should not preclude the Alpha 250 Site from development.

5.7 North Alpha 250 Site – Social and Political Acceptance

The North Alpha 250 Site is located in a commercial area within the political subdivision of the City of Pompano Beach, FL. The existing uses for the land areas adjacent to the North Alpha 250 Site include the following:

- Northeast Boundary – Cypress Run Elementary School
- North Boundary – Various commercial warehouses and gas utility
- South Boundary – Broward County transportation area
- Southeast Boundary – South Alpha 250 conservation area
- West Boundary – Florida Turnpike

Utilizing the North Alpha 250 Site for any of the solid waste facilities noted in **Table 16** would result in increased noise, odor, emissions, and truck traffic, which may adversely impact the existing uses of the neighboring properties. In addition to these adjacent properties, there are several large residential communities located within the Political Subdivisions of the City of Coconut Creek, City of Margate and the City of Deerfield Beach that are approximately three miles from the Site along with Tradewinds Park (Park) and several retail stores, which are depicted in **Figure 29**. Residents in these communities along with individuals utilizing the Park and retail stores may perceive that the use of the Site for solid waste processing purposes could negatively impact their quality of life or property values.

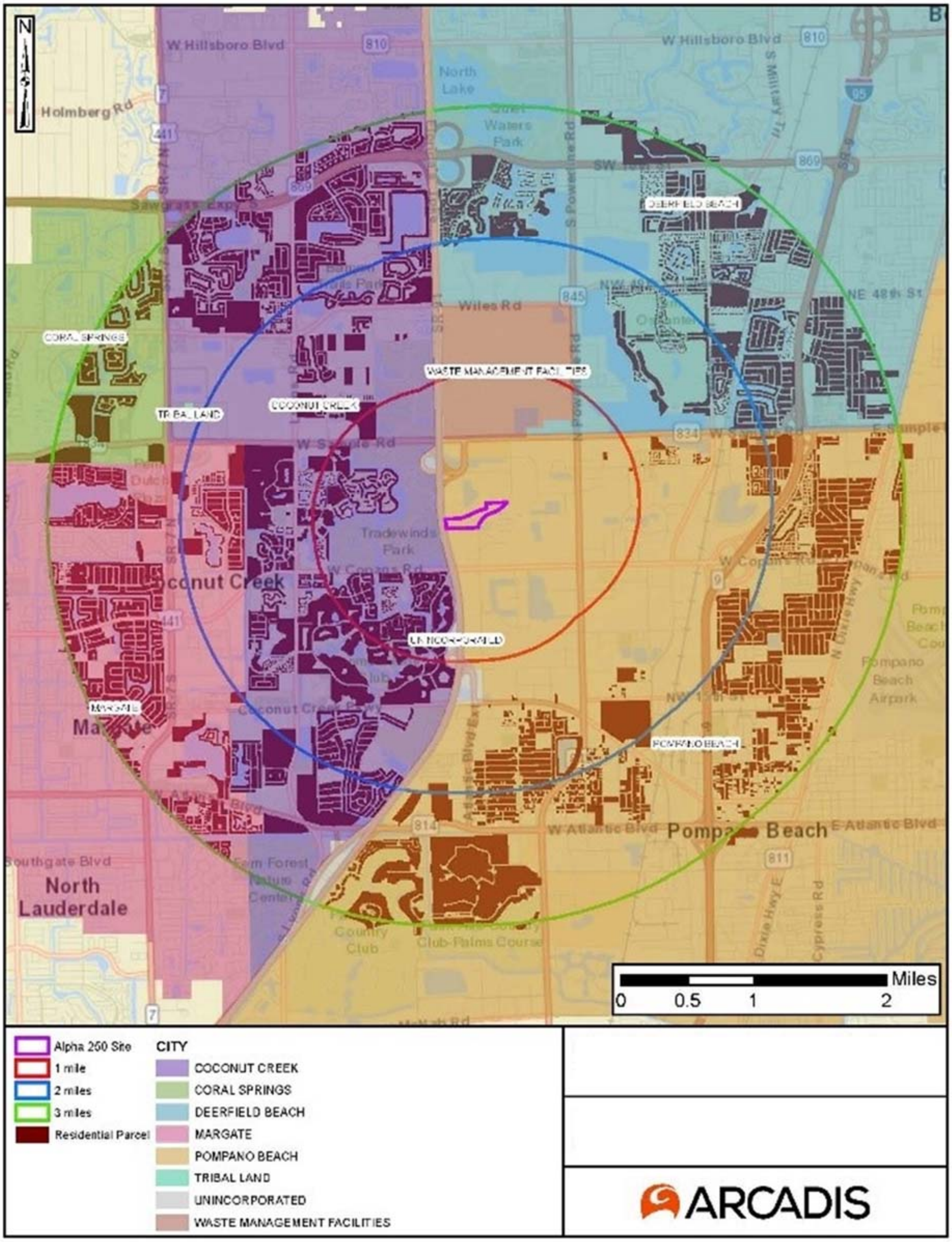


Figure 29: Communities within 3-mile Radius of Alpha 250 Site

In order to ameliorate both real and perceived negative social and political concerns associated with developing the Site for solid waste processing purposes, the Arcadis Team recommends initiating and implementing an extensive education and outreach program to proactively inform the public and neighboring communities of the proposed use. Engaging stakeholders of all levels at the onset of the ultimate development effort is crucial in attaining the social and political acceptance necessary for the approval and development of the Site for solid waste purposes. Meetings with elected officials along with public outreach workshops for communities and special interest groups throughout the County is recommended.

5.8 North Alpha 250 Summary Findings

There are many factors that may pose constraints or limitations for the development of any solid waste facility. However, the preliminary review of the criteria indicates that there are no constraints or limitations precluding the North Alpha 250 Site from being a viable location for the development of some of the proposed facilities that would enable the County to reach the 75 percent recycling goal. Retaining the North Alpha 250 Site in public ownership for solid waste purposes is recommended, however, additional investigations must be conducted at the Site, such as geotechnical and environmental, and investigation of the constraints and limitations checklist would need to be revisited upon selection of the proposed facility(ies) to be developed at the Site in consideration of the conceptual design. A summary of the constraints and limitations findings are noted in **Table 17**.

Table 17: Summary of Alpha 250 Constraints and Limitations

Facility Type	Current Zoning and Land Use	Available Building Area and Site Shape	Electrical Utilities	Water and Wastewater	Traffic Impacts	Social and Political Acceptance	Alpha 250 Suitable for Facility Type
Materials Recovery Facility	Facility is a permitted use, special exception approval needed.	Suitable	Existing electrical infrastructure absent, but could be provided.	Existing water and wastewater infrastructure present, could provide service to facility.	High truck traffic impact potential	High potential for public resistance for solid waste use. Robust public outreach program needed.	Yes
Combined Bulky Waste/Yard Trash/C&D Facility	Facility is a permitted use, special exception approval needed.	Suitable	Existing electrical infrastructure absent, but could be provided.	Existing water and wastewater infrastructure present, could provide service to facility.	Moderate truck traffic impact potential	High potential for public resistance for solid waste use. Robust public outreach program needed.	Yes
Yard Trash Facility	Facility is a permitted use, special exception approval needed.	Suitable	Existing electrical infrastructure absent, but could be provided.	Existing water and wastewater infrastructure present, could provide service to facility.	Moderate truck traffic impact potential	High potential for public resistance for solid waste use. Robust public outreach program needed.	Yes
Mixed Waste Processing Facility	Facility is currently not a permitted use. However, a special exception could be requested.	Suitable	Existing electrical infrastructure absent, but could be provided.	Existing water and wastewater infrastructure present, could provide service to facility.	Moderate truck traffic impact potential	High potential for public resistance for solid waste use. Robust public outreach program needed.	Yes

Facility Type	Current Zoning and Land Use	Available Building Area and Site Shape	Electrical Utilities	Water and Wastewater	Traffic Impacts	Social and Political Acceptance	Alpha 250 Suitable for Facility Type
Organics Processing Facility (excludes Yard Trash)	Facility is a permitted use, special exception approval needed.	Suitable	Existing electrical infrastructure absent, but could be provided.	Existing water and wastewater infrastructure present, could provide service to facility.	Moderate truck traffic impact potential	High potential for public resistance for solid waste use. Robust public outreach program needed.	Yes
Waste-to-Energy Facility	Facility is a permitted use, special exception approval needed.	Not Suitable	Not Evaluated Due to Buildable Area and Site Shape Restrictions	Not Evaluated Due to Buildable Area and Site Shape Restrictions	Not Evaluated Due to Buildable Area and Site Shape Restrictions	Not Evaluated Due to Buildable Area and Site Shape Restrictions	No

5.9 General Geographic Areas for Solid Waste Facility Development

The Arcadis Team was tasked with identifying up to four general geographic areas, other than those sites currently used for solid waste or recycling processing, within Broward County, which may be suitable for the development of the facilities identified in Section 4 of this Report. To determine the location of the four general geographic areas, the Arcadis Team, utilizing GIS and readily available data files provided on the County website, created a map of Broward County noting the location of existing private and publicly owned solid waste facilities. The boundaries of the seven Geographic Zones, that were defined in Section 3 of this Report, were then added to identify the general geographic areas where a solid waste facility could be developed, which is shown in **Figure 30**.

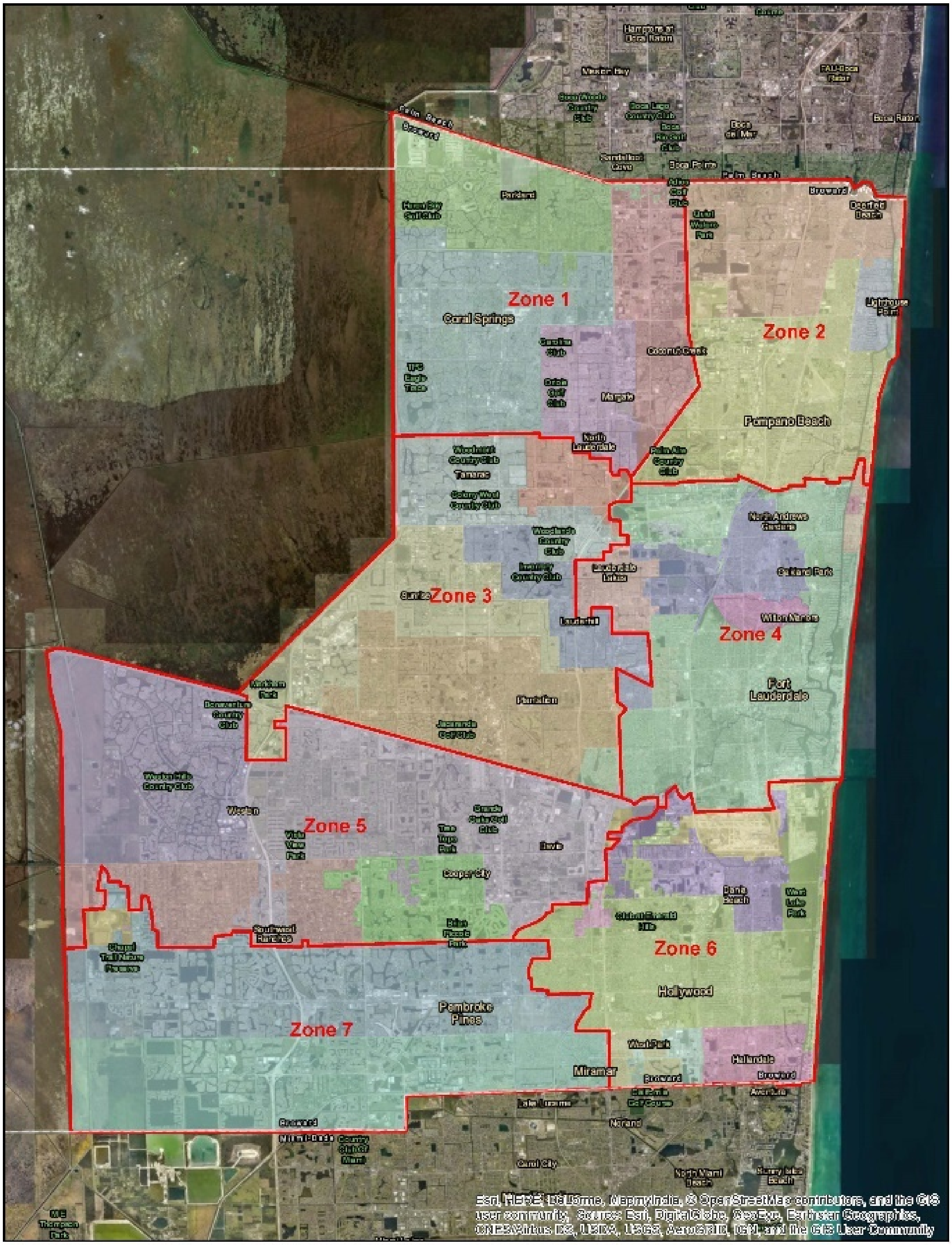


Figure 30: Geographic Zone Boundaries

The Arcadis Team then selected areas to investigate within Geographic Zones 1, 5 and 7 where existing public and private solid waste facilities are absent. GIS was then utilized to identify parcels of land within these Geographic Zones that were between 5 and 25 acres in size, have a Broward County Land Use Code of vacant commercial, vacant industrial, agricultural, or vacant institutional and were located near major thoroughfares.

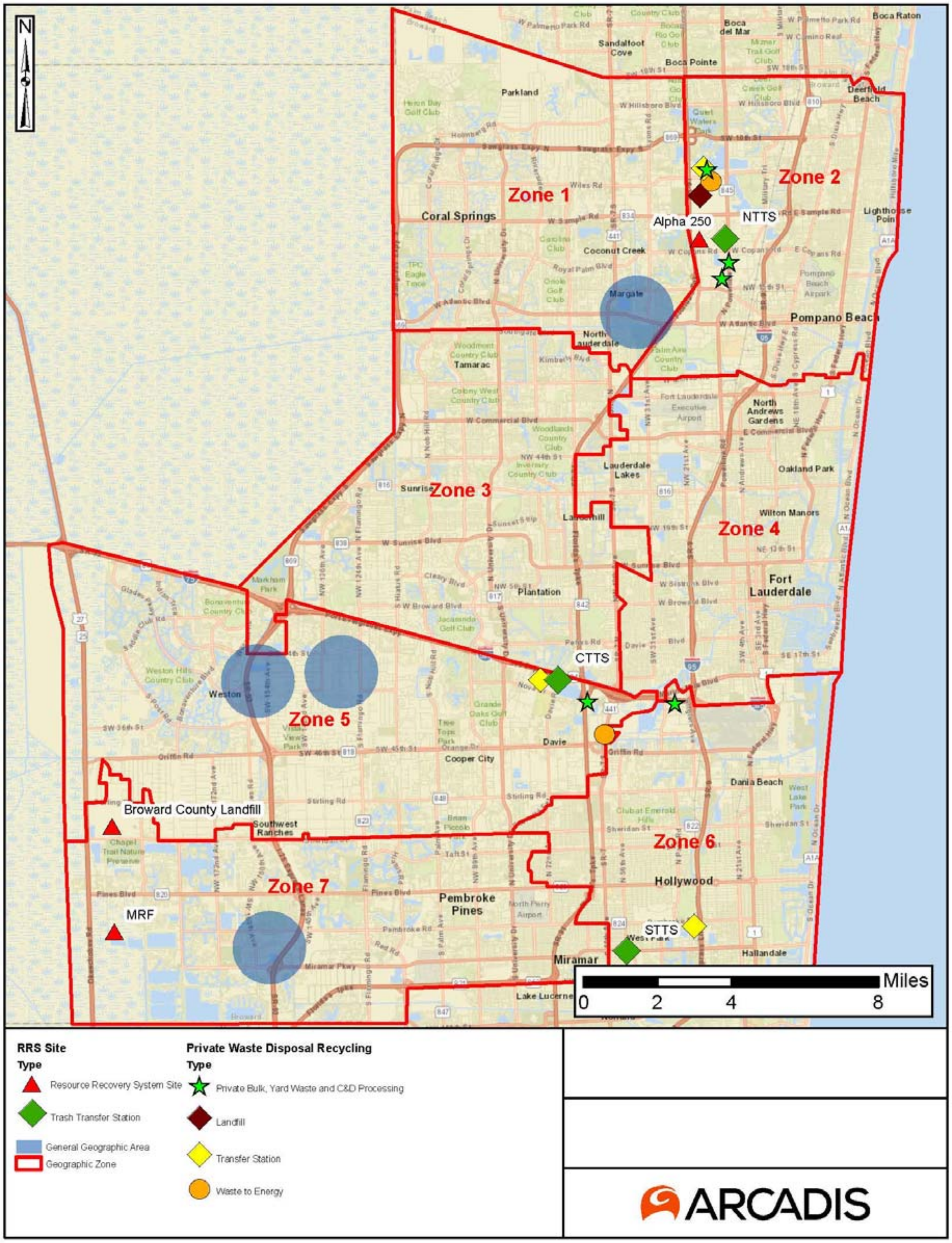


Figure 31: General Geographic Areas

Figure 31 shows the general geographic areas noted by shaded spheres representing areas of approximately 2-miles in diameter, in relation to the Geographic Zones and existing private and public solid waste facilities and land where the Working Group and County could investigate for development of solid waste processing facilities.

6 ALTERNATIVES AND OPTIONS FOR THE FUTURE OF SOLID WASTE MANAGEMENT

6.1 Historical Governance of Broward County Solid Waste District

Broward County entered into an ILA with 26 of 31 municipal cities within the County, which created a dependent Solid Waste Disposal District (Former District). The Former District allowed the County to guarantee waste quantities in order to obtain tax exempt financing, Industrial Development Revenue Bonds, for the construction of solid waste disposal facilities, including Wheelabrator North and South Broward, which created the Resource Recovery System (System) that provided a regional approach to managing the waste stream generated within Broward County.

In accordance with the ILA, the Former District was governed by the Board of County Commissioners with non-binding administrative council from the Resource Recovery Board (Board) for coordinating the transport and disposal of solid waste generated by ILA Cities and unincorporated Broward County. The five cities that did not execute the ILA (non-ILA Cities) were each responsible for the disposal and administration of their own solid waste. The ILA expired in July 2013, leaving all parties individually responsible to administer contracts for the disposal of their solid waste streams.

During the Project Kick-off Meeting held in December 2017, the Working Group noted that many Cities were interested in moving back to a regional solid waste management approach, in which a collective governance system would be instituted, requiring solid waste generated by any parties to the governance system to direct their waste to system facilities. The following subsections represent the Arcadis Team's findings associated with identifying the alternatives and options for the future of solid waste management in Broward County based on this feedback.

6.2 Key Regulatory Considerations

6.2.1 Solid Waste Flow Control

Flow control is the ability to direct the ultimate disposition of solid waste generated within the boundaries of a governmental entity to a specific facility and assists governmental entities with generating and guaranteeing revenue for their solid waste management system. Directing the flow of waste to Broward County solid waste facilities is a key component to implementing a regionalized solid waste system, as it will be required in order to obtain financing, such as revenue bonds, needed to implement the proposed facilities outlined in Section 3 of this Report. Additionally, enacting solid waste flow control in Broward County will create a dedicated revenue stream, through user and/or tipping fees, needed to repay the debt incurred to finance the implementation of the regional solid waste system as well as pay for operating and maintenance costs. System wide flow control can be implemented in Broward County through regulatory, contractual, or economic mechanisms.

6.2.1.1 Federal Consideration - Regulatory Solid Waste Flow Control

Regulatory flow control uses the regulatory abilities of a governmental entity to dictate the flow of waste. In the past, regulatory solid waste flow control was implemented through general law or special act as part of the charter establishing the creation of the governmental entity controlling the disposition of the waste. However, in 1994, the United States Supreme Court decision in C&A Carbone, Inc. vs. Town of Clarkstown 511 U.S. 383 (1994) (Carbone), declared that such solid waste flow control legislation violated the interstate commerce clause of the United States Constitution because it potentially infringes on interstate commerce. This ruling effectively removed a governmental entity's ability to direct waste to designated facilities.

In a separate Supreme Court ruling, United Haulers Association Inc. v. Oneida-Herkimer Solid Waste Management Authority, 550 U.S. 330 (2007) (United Haulers) flow control rights were clarified confirming that governmental entities do, in fact, have the ability to direct, or control the flow of MSW, to be delivered to publicly-owned facilities. However, since this ruling, there have been other federal court challenges resulting in injunctions prohibiting governmental entities from enforcing their flow control ordinances due to issues other than violation of the interstate commerce clause. Therefore, relying on local ordinance driven regulatory flow control may result in legal challenges and increased risk related to dependent financing.

6.2.1.2 State Regulatory Considerations – Regulatory Solid Waste Flow Control

The State of Florida enacted Florida Statute (F.S.) 403 Environmental Control Part IV Resource Recovery and Management to plan for and regulate all aspects of solid waste with the goal of protecting public safety, health, welfare; and enhancing the environment for the people of this state; and recover resources which have the potential for further usefulness. F.S. 403.713(2) states that "*Any local government which undertakes resource recovery from solid waste pursuant to general law or special act may institute a flow control ordinance for the purpose of ensuring that the resource recovery facility receives an adequate quantity of solid waste from solid waste generated within its jurisdiction.*" The statute further defines resource recovery as *"the process of recovering materials or energy from solid waste."*

Wheelabrator South Broward (WSB) meets the definition of a resource recovery facility described in F.S. 403.713(2). Additionally, considering the broader definition of resource recovery described in F.S. 403.703(32), the proposed MRF, MWP Facility and BW/YT Facilities described in Section 4 recover materials from solid waste and would be utilized to meet the short, mid, and long-term disposal needs for Broward County. In addition, certain types of organics processing facilities may also meet the definition of resource recovery described in F.S. 403.703(32) if they generate electricity, such as through use of an anaerobic digestion process, or recover material such as to produce a soil amendment. Therefore, specifying flow control to WSB and the proposed facilities, within the governmental entity charter may allow for regulatory ordinance-driven flow control of solid waste to these facilities. However, careful consideration must be made in developing the flow control ordinance within the charter to limit legal risk associated with interstate commerce issues.

6.2.1.3 Contractual and Economic Considerations - Solid Waste Flow Control

Contractual and economic flow control mechanisms could also be implemented to direct solid waste to the system facilities. Contractual flow control can be achieved through the development of interlocal agreements between Cities and the new solid waste governance system. Economic flow control could be achieved by providing solid waste processing and disposal services at the lowest total cost, creating an economic incentive to direct solid waste to the system facilities. To attain the lowest total cost, fees could be subsidized through an annual assessment or non-ad valorem property tax to residents within the participating Cities; or alternative sources of funding, such as charging user-based waste generation fees or instituting environmental investment charges for haulers and/or generators bypassing system facilities or through implementing a combination of these funding sources.

6.3 Local Regulatory Considerations – Charter Defining Powers, Functions and Duties

Throughout the Solid Waste and Recycling Issues Study, the Working Group stated that the following actions be prioritized:

- Implement a regional solid waste system.
- Create a collective governance system to dictate the policies needed to implement the regional solid waste system.
- Create legal, contractual and economic flow control.
- Increase recycling to achieve a 75 percent recycling goal.
- Create incentives for re-use of recyclable content generated within Broward County.

The following table presents a summary of designated authority that could be defined in a charter establishing a solid waste governing system that best meets the needs of the County and Cities.

Table 18: – Summary of Potential Policy, Desired Outcome, Advantages and Disadvantages

Potential Policy	Desired Outcome	Advantages	Disadvantages
Prohibition of solid waste generated within the boundaries of the governmental entity to be disposed outside of the County. Applicable to private and public entities.	Flow Control	Solid waste flows to in-County facilities, guaranteeing minimum capacity requirements.	Risk for legal challenges, as restricting private entities from disposing in-County solid waste may unreasonably interfere with interstate commerce.

Potential Policy	Desired Outcome	Advantages	Disadvantages
Prohibit disposal of solid waste generated outside of Broward County at any of the in-County landfills. Applicable to private and public facilities.	Flow Control	Maintains future disposal capacity at public and private landfills, for waste generated within Broward County.	High risk for legal challenges, as restricting private entities from disposing out-of-County solid waste may unreasonably interfere with interstate commerce. Must be conducted in compliance with F.S. 403.70605 (3)(a). Displacement of Private Companies to reduce legal risk. Private entities may lose revenue if solid waste originating within Broward County does not replace tonnage disposed and revenue received from out-of-County waste sources.
Require enhanced permitting and/or licensure requirements for public and private solid waste haulers and facilities to increase regulation of haulers and facilities as well as to incentivize behavior. This allows for better tracking of waste and identifying haulers suspected of non-compliance, as well as provides a mechanism(s) to incentivize participation in the potential voluntary agreements which could allow haulers to be exempt from certain reporting requirements.	Flow Control	Increases control over private solid waste facilities within the County. Require haulers to provide detailed reporting data, noting tonnage of solid waste stream collected and facility delivered to. Require facilities to provide detailed reporting data, noting the haulers delivering waste, tonnage of solid waste stream delivered, processed, recycled, disposed, etc.	Increased reporting requirements may be cost prohibitive and possibly drive smaller companies out of the marketplace, and could violate parts of F.S. 403.70605 Solid Waste Collection Service in Competition with Private Companies. Oversight and enforcement would be required to ensure compliance, which may increase the cost to administer.

Potential Policy	Desired Outcome	Advantages	Disadvantages
Incentivize the transition from private entity collection and transport to public entity (Cities) through reduced disposal fees charged to participating Cities delivering waste to system owned facilities.	Economic Flow Control	Cities taking over the various hauling contracts would deliver solid waste collected to system owned facilities, guaranteeing minimum tonnage.	Must be conducted in compliance with F.S. 403.70605 (3)(a). Displacement of Private Companies to reduce legal risks. Costs for establishing city collection and transport system may outweigh the incentive of reduced disposal fees. Existing contracts may need to expire before transition from private to public collection and transport is implemented. However, if the terms of the existing contracts allow for “termination for convenience”, implementation of the proposed policy could be completed in the near-term. Existing contracts without termination for convenience could also be amended to provide for an early termination.

Potential Policy	Desired Outcome	Advantages	Disadvantages
Assess solid waste collection and disposal fees for residential and governmental entities annually as part of the annual non-ad valorem tax bill. Haulers will subsequently be paid for collecting waste after delivery to a facility within the regional system.	Economic Flow Control	Solid waste flows to system facilities, guaranteeing minimum capacity requirements. May eliminate the need for mandated Flow Control and reduce risk of legal action associated with interstate commerce violations.	Public outreach would be necessary to explain why residents' taxes are being increased. Existing contracts may need to expire before new payment terms can be implemented. However, if the terms of the existing contracts allow for "termination for convenience", implementation of the proposed policy could be completed in the near-term. Existing contracts without termination for convenience could also be amended to provide for either an early termination or revision to the payment terms. Implementation may need to be staggered due to the varying contract expiration dates, renegotiation process and approval of the non-ad valorem tax.
Require minimum percentage of products or materials purchased for public projects be made from recyclable materials generated and processed within Broward County.	Flow Control Affirmative Recycling Code Creates Market for Broward County Recycled Content	Incentivizes recycling within the County as well as directs recyclable materials to in-County recycling facility. Complies with F.S. 403.7065 Procurement of products or materials with recycled content.	Oversight and enforcement would be required to ensure compliance, which may increase the cost to administer. May be several years before suppliers can fill the need in the marketplace for certain products.

Potential Policy	Desired Outcome	Advantages	Disadvantages
Require enhanced permitting requirements and fees for new private and public projects generating C&D debris within the municipal boundaries of the member Cities. Enhanced permitting requirements and fees would be reduced or eliminated through an agreement providing for the delivery of C&D debris to a recycling facility or meeting a specified recycling rate.	Flow Control Affirmative Recycling Code	Incentivizes C&D debris recycling.	Education campaign and technical assistance would be needed prior to and during implementation. Oversight and enforcement would be required to ensure compliance, which may increase the cost to administer.
Require minimum percentage of products or materials purchased for public projects to be made from recyclable materials.	Affirmative Recycling Code Increase Recyclable Market Demand	Incentivizes use of recyclable material, increasing demand in the local market.	Oversight and enforcement would be needed to ensure compliance, which may increase the cost to administer.
Require Cities participating in the solid waste system to mandate single family, multi-family and commercial recycling within their municipal boundaries.	Affirmative Recycling Code	Incentivizes single family, multi-family and commercial recycling.	Education campaign and technical assistance would be needed prior to and during implementation. Oversight and enforcement would be needed to ensure compliance, which may increase the cost to administer.
Require new multi-family and commercial developments to provide adequate space for recycling and assess annual fines for developments that do not provide adequate space.	Affirmative Recycling Code	Incentivizes multi-family and commercial recycling.	Oversight and enforcement would be needed to ensure compliance, which may increase the cost to administer.

Potential Policy	Desired Outcome	Advantages	Disadvantages
Require new multi-family complexes and commercial developments to develop and implement comprehensive recycling programs and assess annual fines for those that do not develop recycling programs and continue to implement the programs.	Affirmative Recycling Code	Incentivizes multi-family and commercial recycling.	Education campaign and technical assistance would be needed prior to and during implementation. Oversight and enforcement would be needed to ensure compliance, which may increase the cost to administer.
Implement mandatory recycling of commercial organics through a "phase-in" approach initially targeting larger food waste generators within a certain distance from a permitted organic waste recycling facility.	Affirmative Recycling Code	Incentivizes organic material composting.	Education campaign and technical assistance would be needed prior to and during implementation. Oversight and enforcement would be needed to ensure compliance, which may increase the cost to administer. Requires infrastructure to be developed to collect and process food waste.
Require development of recycling outreach program to be implemented by all participating Cities.	Increase Recycling and Reduce Non-Recyclable Residue Contamination	Robust recycling outreach programs are needed for residents to understand the importance of recycling as well as teach residents the proper recycling methods. Comprehensive outreach could increase recycling trends over time and increase awareness of waste reduction and reuse opportunities. Increased outreach could decrease contamination in recyclable material stream and increase the quality of recyclable products.	Initial and on-going administrative costs associated with development and implementation of ongoing strategic recycling outreach campaign required throughout the life of the program. Quantitative results associated with the outreach efforts may be difficult to measure.

6.4 Governance Options and Regionalized Approach for the Future of Solid Waste Management

Broward County and its Cities must choose a path regarding the future of solid waste management. In order to assist with the decision-making process, the Arcadis Team conducted an Interim Governance Workshop with the Working Group on February 28, 2018 (Workshop). The goal of the Workshop was to obtain feedback on potential governance structures that could be created to manage waste from the County and Cities. The Arcadis Team provided an overview of the various forms of solid waste governance structures utilized within Florida and nationally, which included a comparison of singular governmental entities, such as a department within a county or a municipality, as well as independent and dependent special districts.

The main difference between these governance structures is their purpose. Singular governmental entities provide local, general governmental services and have broad power, while independent and dependent special districts provide local specialized governmental services and have limited and specifically prescribed powers.

At the end of the presentation portion of the Interim Governance Workshop, County, Working Group and members of the various Cities participating as audience members were given the opportunity to ask questions as well as provide feedback. The discussions affirmed that the governance structure of greatest interest should allow for fiscal independence from Broward County, Cities to be involved in governance and policy decisions, and provide a financing mechanism necessary to construct the solid waste infrastructure needed to create a regional solid waste management system. Therefore, the Arcadis Team focused on the implementation of a special district form of governance. **Table 19** provides a summary of the advantages of special districts, as they related to the needs of Broward County and the Cities.

Table 19: – Advantages of Special Districts

Special District Advantages	How Special District Advantages Meet County and City Needs
Empowers citizens to get involved in the governance of their own neighbourhood or community.	Cities have expressed interest in the ability to participate in the ultimate form of governance selected.
Serves as a financing mechanism that can be used to provide for the costs to govern, finance, construct, operate and maintain essential public services and facilities.	Creating a special district will enable participating County and Cities to utilize the special districts credit to finance the development of a regional solid waste system.
Special districts have the ability to sell tax-exempt bonds.	Tax-exempt bonds can be utilized to construct the facilities needed to attain the 75 percent recycling goal and create a regional solid waste system.
Special districts can provide governmental services when needs transcend the boundaries.	The Working Group and County have stated that a regional approach to solid waste management is desired. However, not all Cities will participate in the new regional solid waste system. A special district will enable County and Cities participating in the new system to provide services beyond their boundaries.

Special District Advantages	How Special District Advantages Meet County and City Needs
Special districts provide the ability to appoint or elect people who have the appropriate expertise, skills and experience to govern and oversee the special district's specialized function.	The individuals appointed or elected to govern and oversee the special district can be required to have specific knowledge of solid waste processing and disposal, made up of a collection of County and City representatives, etc., in order to meet the representation needs of the County and Cities participating in the new system.

6.4.1 Dependent vs. Independent Special Districts

A special district is a unit of local government created for a special purpose, as opposed to a general purpose, that has jurisdiction to operate within a limited geographic boundary and is created by:

- general law
- special act
- local ordinance
- rule of the Governor and Cabinet

The Former District was created through County Ordinance 87-3 and was a dependent special district. A district is considered dependent if it meets any one or more of the following criteria as defined in F.S. 189.012(2):

- The membership of its governing body is identical to that of the governing body of a single county or a single municipality.
- All members of its governing body are appointed by the governing body of a single county or a single municipality.
- During their unexpired terms, members of the special district's governing body are subject to removal at will by the governing body of a single county or a single municipality.
- The district has a budget that requires approval through an affirmative vote or can be vetoed by the governing body of a single county or a single municipality.

Dependent special districts are responsible to a single county or municipality.

A district is considered independent if it does not meet any of the criteria defined above. The Florida Legislature may create an independent special district to provide for solid waste purposes by a special act or if more than one city and/or more than one county execute an Interlocal Agreement meeting the criteria above, the independent special district could be created by general law.

6.4.2 Recommended Governance Structure – Independent Special District

Based on the feedback received during the Study kick-off meeting, the Interim Governance Workshop, as well as review of historical documentation, reports and existing hauling and processing contracts, the

Arcadis Team recommends that the Working Group and County move towards creating an independent special district. This form of governance structure was selected as it provides a mechanism that does not allow a large City or the County to control the district. An independent solid waste district creates a collaborative governance structure, enabling both the County and Cities to participate in policy decisions along with the other advantages identified in **Table 19**.

6.5 Contract Expiration and New District Implementation

When the Former ILA expired in July 2013, each of the Cities and unincorporated Broward County negotiated contracts with private entities to provide processing and hauling of their waste streams. Of the known contracts, during Calendar Year (CY) 2018, approximately 70 MSW, BW, C&D, YW and recycling processing and/or disposal contracts have or will expire, and any new form of governance will not be in place when this occurs. Therefore, implementing the recommended governance structure will require Cities to consider signing short-term agreements or include “termination for convenience” terms in their contracts.

These options would enable the County, Working Group and Cities to work together to develop a charter for the independent solid waste district, including authority and responsibility, functions and duties, and structure as well as develop a solid waste master plan identifying the facilities proposed in Section 4.

6.5.1 Advantages and Disadvantages of Public/Private Ownership Options

As Broward County and the Cities consider development of facilities described in Section 4, it is important to consider the advantages and disadvantages of the public and private ownership options available. Ownership options range from complete public ownership, similar to the Broward County Landfill, to public/private partnerships, such as the Solid Waste Authority of Palm Beach County Palm Beach Renewable Energy Facilities No.’s 1 and 2, to full privatization for the ownership, operation, maintenance, and management such as the Monarch Hill Landfill.

In general, ownership options are represented in the following categories with discussion of debt service arrangements:

- **Publicly-Owned and Operated.** The public entity retains full responsibility for the facility, including all capital and operational costs as well as operations and maintenance services. Under this type of arrangement, the public entity would be required to finance the capital cost of the facility through either cash reserves, if available, or through financed debt service.
- **Public/Private Partnership Contracts.** A contractual agreement is developed between a public and a private entity in which the role of the private entity can vary. Generally, the public entity retains ownership of the facility and the private entity provides some or all operations and management support. Examples of public/private arrangements include:
  - *Operation Contract:* A private entity is retained to provide all operational services for the facility.

- *Collection Contract:* A private entity is retained to provide all collection services for the public agency. Depending on the size of the area to be covered by collection services, more than one private entity may be selected.
- *Transportation Contract:* A private entity is retained to transport solid waste from a facility (such as a transfer station, residue from a MRF or MWP Facility, or ash from a WTE Facility), to another processing facility, such as a WTE facility or for ultimate disposal at a landfill, on behalf of the public entity.
- *Disposal Contract*: Private entities are retained to provide disposal services for the public entity.
- *Design-Build or Design-Build-Operate:* A public entity contracts with a private firm to design/build or design/build/operate the proposed facility. The public entity retains ownership of the facility.
- Different vendors can be selected for each of these service areas or a single vendor can be selected for one or more of the waste services (i.e., transport, disposal, collection, operation and maintenance).
- *Public-private financing*: A public entity provides for issuance of industrial development revenue bonds as a financing mechanism to pay for the facility or portion thereof; however, ownership typically remains with the public entity.

- **Private Ownership:** Approaches common with private ownership include:
  - *Merchant*: A private entity builds and operates a facility separate from and without any public responsibility.
  - *Asset Sale:* A publicly-owned facility could be sold to a private firm, transferring ownership and operation.
  - *Public-private financing:* A public entity provides for issuance of industrial development revenue bonds as a financing mechanism to pay for the facility or portion thereof; however, ownership remains with the private entity.

Table 20 summarizes the relative advantages and disadvantages of the various public/private ownership and operational arrangements.

Table 20: Advantages and Disadvantages of Various Public/Private Ownership Options

Ownership Options	Advantages	Disadvantages
Publicly Owned and Operated	▪ Provides public entity direct control over operations and maintenance staff and knowledge base. ▪ Ability for public entity to respond to emergencies, customer complaints, and policy changes. ▪ Less formality in implementing changes in service, greater ability to address public needs. ▪ Ability to use general obligation bonds or other municipal financing instruments.	▪ Impact on public entity's financial position (liabilities remain with the public entity including impact on bonding capacity). ▪ Potential staffing challenges if public entity does not have existing personnel with the needed skillset. ▪ Public entity would be responsible for developing the resources and structure necessary to manage, implement, and operate the facility. ▪ Public procurement and purchasing restrictions may be lengthy and cumbersome, resulting in the inability to respond to emergency or specific scenarios requiring a rapid response.
Public Ownership/Private Partnership	▪ Public entity retains ownership of the facility. ▪ Enables the public entity to replace contractor(s) periodically, if needed or wanted. ▪ Obtains State-of-the-Art knowledge from the private industry. ▪ Service Fee is a small fraction of the overall operating budget limiting risk a private management company will assume. ▪ Private financing of capital and repair and replacement (R&R) costs could be provided for within the operations contract. ▪ Provides longer-term stability for operations of the system. ▪ Provides latest operations practices. ▪ Redundancy of trained operations staff from other locations.	▪ Reduced level of control of day-to-day operations as compared to publicly owned and operated. ▪ Public entity typically retains financing and some level of permit responsibilities. ▪ Capital improvements/major repair and replacement activities may not be included in contractor's scope of work above a certain financial limit or due to uncontrollable circumstances. ▪ Disputes over R&R versus capital improvement responsibilities can occur. ▪ Can be difficult to administer and monitor for operations contracts. ▪ Difficult dispute resolution. ▪ Termination can be difficult unless provisions are included in the operating contract. ▪ Private sector needs to make return on investment and pays taxes, which can negate cost efficiency savings.

Ownership Options	Advantages	Disadvantages
Privately Developed and Operated	▪ Eliminates long-term responsibility of assets by the public entity. ▪ Provides potential financial relief/assistance of public budget constraints. ▪ Majority of liabilities removed from the public entity. ▪ Public entity does not need to develop an implementation and operating structure as well as the needed personnel to operate the facility. ▪ Opportunity for public entity to obtain additional revenue stream through host fees or accepting spot market (waste generated outside of Broward County) waste. ▪ Takes advantage of private sector efficiencies. ▪ Can generate property tax revenues for the public entity.	▪ Relies solely on private sector with no public control to provide services. ▪ Public entity no longer has control or voice in the development, construction, operation and governance of the facility. ▪ Private entity not eligible for grants/loans and likely not for tax-exempt financing. ▪ Can have highest cost to users due to less favourable financing and need for return on investment. ▪ Typically requires put-or-pay commitment of tonnage by public entity. ▪ Public entities will typically have no infrastructure in place upon contract expiration.

6.5.2 Recommended Public/Private Ownership Options

Broward County and participating Cities have developed publicly owned and operated facilities, such as the solid waste transfer stations, as well as signed disposal agreements with private entities serving as both owner and operator, such as the Reuters MRF and the WSB WTE facility. The dissolution of the former System has left the County and Cities with the majority of in-County processing and disposal options controlled by the private sector.

Therefore, the Arcadis Team recommends developing the selected solid waste processing facilities through a public/private partnership ownership option. This will provide for public ownership of the solid waste facility(ies) constructed and financed by the New District. Public/private partnerships provide more control and input into the daily operations and maintenance activities of the facility(ies) as well as the ability to negotiate the terms of the operating agreement with the selected private entity than compared to the privately developed and operated option.

7 CONCEPTUAL-LEVEL COST ESTIMATE

The Arcadis Team prepared conceptual construction cost estimates for the construction of the facilities proposed in Section 4, in order to assist the Working Group and County with evaluating the relative financial impact of each facility as it related to the options proposed. The following section provides the conceptual-level construction cost estimates for the common system elements (MRF, Combined BW/YT/C&D Facility and YT Facility) for each of the three proposed solid waste flow scenarios identified in Section 4, which are described in **Table 21**. **Table 22** provides the estimated recycling rates associated with each of the three scenarios throughout the planning period for comparison and **Table 23** provides the processing capacity needs throughout the planning period.

Table 21: Description of Alternatives and Options White Paper Scenarios A through C

Scenario Name	Scenario Description
Scenario A: Mixed waste would be processed at a MWP Facility. Recyclables would be recovered and marketed and wet organics would be recovered and processed. Residuals would go to WTE.	
Scenario A – Detailed Assumptions	100 percent of mixed waste directed to public MWP facilities that would be fully operational by 2025
	Recovery of 50 percent of recyclable paper and containers
	Recovery of wet organics (food waste, compostable paper, and other organics materials) equivalent to 75 percent of incoming food waste
	100 percent of residuals directed to WTE
	Renewable energy credits of 0.56 credits per ton combusted when traditional recycling rate is less than 50 percent and 0.70 credits per ton when recycling rate is 50 percent or higher*
Scenario B: Mixed waste would be processed at a MWP Facility. Recyclables would be recovered and marketed; residuals would go to WTE.	
Scenario B – Detailed Assumptions	100 percent of mixed waste directed to public MWP facilities that would be fully operational by 2025
	Recovery of 50% of recyclable paper and containers
	100 percent of residuals directed to WTE
	Renewable energy credits of 0.56 credits per ton combusted when traditional recycling rate is less than 50 percent and 0.70 credits per ton when recycling rate is 50 percent or higher*
Scenario C – Mixed waste would go to WTE.	
Scenario C – Detailed Assumptions	100 percent of mixed waste directed to WTE by 2025
	Renewable energy credits of 0.56 credits per ton combusted when traditional recycling rate is less than 50 percent and 0.70 credits per ton when recycling rate is 50 percent or higher*

*The County receives recycling credit for every megawatt-hour of energy generated at WSB. For the period from 2014-2016, the average renewable energy credit received was approximately 0.56 renewable energy credits per ton combusted. If the County's traditional recycling rate reaches 50 percent, the recycling credit increases to 1.25 tons per megawatt-hour, or an estimated 0.70 renewable energy credits per ton combusted.

Table 22: Estimated Recycling Rate Projections

SCENARIO A: MWP with Recyclables and Organics Recovery; Residuals to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
MWP - Recyclables Recovery	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
MWP - Organics Recovery	0%	0%	4%	4%	4%	4%	4%	4%	4%	4%
WTE Credits	10%	13%	14%	14%	14%	14%	14%	14%	14%	14%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	75%	75%	75%	75%	75%	75%	75%	75%

SCENARIO B: MWP with Recyclables Recovery; Residuals to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
MWP - Recyclables Recovery	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
WTE Credits	10%	13%	17%	17%	17%	17%	17%	17%	17%	17%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	74%	74%	74%	74%	74%	74%	74%	74%

SCENARIO C: Mixed Waste to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Source-Separated Recycling	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Bulk/YT/C&D Recycling	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
WTE Credits	10%	13%	19%	19%	19%	19%	19%	19%	19%	19%
Other Materials Recycling	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Estimated Recycling Rate	45%	64%	73%	73%	73%	73%	73%	73%	73%	73%

Table 23: Processing Capacity Needs over 40-Year Planning Period

Single Stream MRF	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Estimated Tons per Year	241,333	361,562	408,217	421,385	433,558	443,017	451,809	460,809	467,465	472,742
Contribution to Recycling Rate	7%	10%	11%	11%	11%	11%	11%	11%	11%	11%
Estimated Public Capacity	0	218,903	241,674	249,469	256,676	262,276	267,481	272,809	276,750	279,873

Bulky Waste/Yard Trash/C&D Processing Facility	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Bulk/YT/C&D Processing										
Estimated Tons per Year	1,340,001	1,303,737	1,442,990	1,489,535	1,532,567	1,566,003	1,597,081	1,628,894	1,652,423	1,671,074
Estimated Yard Trash Recovery	0	188,128	223,095	230,291	236,944	242,114	246,919	251,837	255,475	258,359
Estimated Other Recovery	270,001	517,491	630,041	650,364	669,152	683,751	697,321	711,211	721,484	729,628
Contribution to Recycling Rate	8%	20%	23%	23%	23%	23%	23%	23%	23%	23%
Estimated Public Capacity	0	388,626	430,264	444,142	456,973	466,943	476,210	485,696	492,711	498,272
Yard Trash Processing										
Estimated Tons per Year	0	188,128	223,095	230,291	236,944	242,114	246,919	251,837	255,475	258,359
Estimated Public Capacity	0	56,078	66,521	68,667	70,651	72,192	73,625	75,092	76,176	77,036

SCENARIO A: MWP with Recyclables and Organics Recovery; Residuals to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Waste Processing Facility										
Mixed Waste	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Estimated Recyclables Recovery	0	0	109,497	113,029	116,294	118,832	121,190	123,604	125,389	126,805
Contribution to Recycling Rate	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Organics Processing										
Organics from MWP	0	0	148,296	153,080	157,502	160,939	164,132	167,402	169,820	171,737
Contribution to Recycling Rate	0%	0%	4%	4%	4%	4%	4%	4%	4%	4%
Estimated Public Capacity	0	0	148,296	153,080	157,502	160,939	164,132	167,402	169,820	171,737
WTE										
Residuals from MWP	670,000	648,093	723,033	746,355	767,917	784,671	800,243	816,183	827,973	837,318
Renewable Energy Credit	10%	13%	14%	14%	14%	14%	14%	14%	14%	14%
Estimated Public Capacity	0	0	723,033	746,355	767,917	784,671	800,243	816,183	827,973	837,318

SCENARIO B: MWP with Recyclables Recovery; Residuals to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
Mixed Waste Processing Facility										
Mixed Waste	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Estimated Recyclables Recovery	0	0	109,497	113,029	116,294	118,832	121,190	123,604	125,389	126,805
Contribution to Recycling Rate	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
WTE										
Residuals from MWP	670,000	648,093	871,330	899,435	925,419	945,609	964,375	983,585	997,793	1,009,055
Renewable Energy Credit	10%	13%	17%	17%	17%	17%	17%	17%	17%	17%
Estimated Public Capacity	0	0	871,330	899,435	925,419	945,609	964,375	983,585	997,793	1,009,055

SCENARIO C: Mixed Waste to WTE	2014-2016 Weighted Average	2020	2025	2030	2035	2040	2045	2050	2055	2060
WTE										
Mixed Waste	670,000	648,093	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860
Renewable Energy Credit	10%	13%	19%	19%	19%	19%	19%	19%	19%	19%
Estimated Public Capacity	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860

7.1 Survey of Solid Waste Facility Construction Costs

To estimate the construction cost associated with each of the facilities presented in the proposed scenarios, the Arcadis Team surveyed over 50 solid waste facilities constructed in the United States and developed representative ton per day construction cost estimates for each type of processing facility surveyed. The Arcadis Team screened the facilities based on throughput capacity, materials processed (i.e. single stream vs. dual stream, commercial vs. residential, etc.), and processing technology, and selected the facilities that most closely resembled the scenarios outlined in Section 4. The Arcadis Team then based the construction costs, on a ton per day construction costs basis, for each type of facility proposed.

The construction costs for each of the selected reference facilities were then escalated to 2020 dollars using a factor of approximately three percent per year, in accordance with Engineering News-Record's (ENR) national average annual escalation of the Construction Cost Index from 1990 through 2017. Construction costs were also adjusted for the region of construction using ENR's Cost Indexes by City referencing 20 major cities in the United States. After screening the facilities surveyed and adjusting for year of construction and region, the estimated construction costs for each type of facility on a ton per day basis was derived and is summarized in **Table 24** below. However, the actual construction cost per ton could vary significantly depending on a variety of factors, such as financing, pass through costs, contract negotiation, etc.

Table 24: Estimated Facility Construction Cost Per Ton Per Day Throughput

Facility	Cost per tpd (2020 dollars)
Single Stream MRF	$ 60,000
Mixed Bulky Waste/Yard Trash/C&D	$ 22,000
Yard Trash	$ 11,000
Mixed Waste Processing Facility	$ 41,000
Organics Processing Facility (excludes Yard Trash)	$ 74,000
Waste-to-Energy: New Mass Burn Facility per Processing Unit	$ 300,000
Waste-to-Energy: Mass Burn Expansion (one Processing Unit with additional Turbine)	$ 240,000

7.2 Estimated Facility and Scenario Construction Costs Assumptions

Arcadis estimated the conceptual-level construction cost of the three scenarios based on the solid waste public capacity throughput estimates, provided in Section 4 and summarized in **Table 23**, multiplied by the construction cost per ton per day prepared in the survey and shown in **Table 24**. The estimates were developed to meet short, mid and long-term needs, 2025, 2040 and 2060, respectively. Assumptions used in preparing the conceptual-level cost estimates are as follows:

- Waste-to-Energy (WTE) assumptions:
  - To meet the WTE processing goals, the County will either expand the processing capacity at the existing WSB Facility or construct a new WTE Facility on system-owned

land. The system-owned facility will be designed to accommodate all of the combustible waste stream.

    - Expansion of WSB WTE Facility and development of a new WTE Facility are mutually exclusive. It is assumed that the options for expanding WSB with an additional processing unit and constructing a system-owned facility will not be combined.
    - The number of processing lines for WTE facilities allows for ten percent over-rated capacity before requiring an additional boiler unit. It is assumed that other recycling efforts and/or diversion techniques will be identified to reduce the public capacity requirement for the long-term 2060 solid waste projection estimates before a fourth boiler unit is added.
    - WSB Expansion:
        - Assumes facility capacity[13] of approximately 771,000 tons per year (tpy), based on three 750 ton per day (tpd) boilers, operating 24-hours per day, with a 94 percent availability.
        - Facility capacity will be reserved for system-supplied waste before procuring additional waste. System-supplied waste above 771,000 tons, plus the ten percent over-rated capacity, will be processed with a fourth processing unit. Only capacity not used by the system will be marketed and procured by WSB.
        - The additional boiler will have a throughput processing capacity of 750 tpd.
    - New WTE Facility Construction;
        - For Scenario A, design for three boiler units with a throughput of 750 tpd per unit.
        - For Scenarios B and C, design for three boiler units with a throughput of 1050 tpd per unit.
        - For Scenario C, design for addition of fourth boiler unit with a throughput of 1050 tpd for the long-term planning period capacity needs.
- MRF, Combined BW/YT/C&D Facility, YT Facility, MWP Facility, and OP Facility assumptions:
    - Maintenance is typically performed after-hours and on off-line days. If unscheduled outages occur during operating hours, it is assumed that the operating hours will be extended.
    - Daily throughput is based on the following operating schedule:
        - 5 days per week
        - 258 days per year (excluding Christmas and New Year's Day)
        - 8 hours per shift with 7 hours of processing operations
            - Anaerobic Digester to process wet organic waste operates 24-hours per day
    - Design throughput per operating line is as follows:
        - Single Stream MRF: 30 tons per hour (tph)
        - Bulky Waste/Yard Trash/C&D facility: 25 tph
        - Yard Trash: 40 tph
        - Mixed Waste Processing Facility: 60 tph

[13] Wheelabrator South Broward reports approximately 846,000 tons of waste processed in the previous year, per their website: https://www.wtienergy.com/plant-locations/energy-from-waste/wheelabrator-south-broward, accessed on May 30, 2018.

    - Organic Waste Anaerobic Digester: 25 tph
- The number of required facilities assumes that each facility operates on a one shift-per-day basis and each facility has two processing lines. Note that the number of facilities needed could be reduced through operational changes, such as longer shifts or operating at two shifts-per-day.
- The number of shifts-per-day were not evaluated as part of this study and will need to be included in the full-scale feasibility study of each facility.

The conceptual-level cost estimates and number of facilities required for each scenario were developed with the assumption that they are operated on a one shift-per-day basis. It is possible to decrease the number of facilities required, and decrease the estimated construction costs, by implementing longer shifts and/or moving to a two shift-per-day operating schedule. Facilities with flexible operating schedules include the MRF, Combined BW/YT/C&D, YT and MWP Facilities.

Table 25 provides a summary of the estimated solid waste facility cost projections to meet the throughput capacity requirement estimates for the short, mid and long-term needs, 2025, 2040, and 2060, respectively. This table is intended to provide conceptual-level cost estimates as a decision-making tool for the purpose of evaluating the relative financial impact of the different alternatives proposed in Section 3. Additional detail for the development of these cost scenarios is provided in **Exhibit H**.

7.2.1 Conceptual Level Construction Cost for Common Elements to All Scenarios

It is estimated that five operating lines will be necessary to process the recyclable materials generated within Broward County in the short and mid-term scenarios, increasing to six operating lines in the long-term scenario. Therefore, the County will require implementation of three MRFs by 2025 in order to meet the short-term recycling needs. The Combined BW/YT/C&D Facility will require ten processing lines in the short-term and will increase to eleven and twelve processing lines in the mid and long-term, respectively, requiring implementation of five Combined BW/YT/C&D Facilities in the short-term and six in the mid and long-term. The stand-alone YT Facility will be operated based on one processing line through the mid-term planning period and increase to two processing lines in the long-term planning period. Implementation of one YT Facility throughout the planning period would be required. A summary of the common system facilities processing lines and estimated conceptual level construction costs is as follows:

__**Common Elements to All Scenarios**__

- Materials Recycling Facility:
    - 2025: 5 processing lines and 3 facilities - $63,000,000
    - 2040: 5 processing lines and 3 facilities - $63,000,000
    - 2060: 6 processing lines and 3 facilities - $76,000,000
- Combined Bulky Waste, Yard Trash, C&D Facilities:
    - 2025: 10 processing lines and 5 facilities - $39,000,000
    - 2040: 11 processing lines and 6 facilities - $42,000,000
    - 2060: 12 processing lines and 6 facilities - $46,000,000
- Yard Trash Facility:

- 2025: 1 processing line and 1 facility - $3,000,000
- 2040: 1 processing line and 1 facility - $3,000,000
- 2060: 2 processing lines and 1 facility - $6,000,000

Common Elements Estimated Long-Term Conceptual Level Construction Cost - $128,000,000

7.2.2 Conceptual Level Construction Cost for Scenario A

In addition to the common facility elements, Scenario A includes implementation of MWP Facilities with ten processing lines and five facilities in the short and mid-term and eleven processing lines and six facilities in the long-term. OP Facilities will also be required in order to recover and recycle the wet organic waste resulting from the MWP Facility operations and will include four processing lines and two facilities throughout the planning period. Residual waste would then be processed at either the existing WSB WTE Facility or at a new system-owned WTE Facility, based on the option selected.

The existing capacity of WSB, without the expansion, can process the estimated quantity of residual and mixed waste in the near and mid-term, in accordance with the assumption that capacity at WSB will be reserved for system-supplied waste before other waste streams are procured. However, expansion of WSB would be required in the long-term, and the addition of one 750 tpd processing line would be required.

Development of a new WTE Facility that is publicly owned could also be pursued. Instead of utilizing existing capacity at WSB, all system waste could be directed to the new WTE Facility. In the short and mid-term, three 750 tpd processing lines would be required with the addition of a fourth 750 tpd processing line in the long-term.

A summary of the number of facilities, processing lines and estimated construction costs are as follows:

Scenario A

- Mixed Waste Processing Facility:
  - 2025: 10 processing lines and 5 facilities - $172,000,000
  - 2040: 10 processing lines and 5 facilities - $172,000,000
  - 2060: 11 processing lines and 6 facilities - $189,000,000
- Organic Processing Facility
  - 2025: 4 processing lines and 2 facilities - $52,000,000
  - 2040: 4 processing lines and 2 facilities - $52,000,000
  - 2060: 4 processing lines and 2 facilities - $52,000,000
- WTE Expansion
  - 2025: Expansion not required due to existing capacity - $0
  - 2040: Expansion not required due to existing capacity - $0
  - 2060: 1 additional 750 tpd processing line within existing facility - $180,000,000
- New WTE Facility
  - 2025: 3 750 tpd processing lines and 1 facility - $675,000,000
  - 2040: 3 750 tpd processing lines and 1 facility - $675,000,000
  - 2060: 4 750 tpd processing lines and 1 facility - $900,000,000

Estimated Long-Term Conceptual Level Construction Cost – WSB WTE Expansion - $549,000,000

Estimated Long-Term Conceptual Level Construction Cost - New WTE Facility - $1,269,000,000

7.2.3 Conceptual Level Construction Cost Scenario B

In addition to the common facility elements, Scenario B also includes implementation of MWP Facilities with ten processing lines and five facilities in the short and mid-term and eleven processing lines and six facilities in the long-term. However, all wet organic waste resulting from the processing activities at the MWP Facility will be processed via WTE Facility at either the existing WSB WTE Facility or at a new system-owned WTE Facility, based on the option selected.

Expansion of WSB to include one additional 750 tpd processing line would be required starting in the short-term planning period, in accordance with the assumption that capacity at WSB will be reserved for system-supplied waste before other waste streams are procured.

Development of a new WTE Facility that is publicly owned could also be pursued. Instead of utilizing existing capacity and expanding WSB, all system waste could be directed to the new WTE Facility. Throughout the planning period, three 1,050 tpd processing lines would be required.

A summary of the number of facilities, processing lines and estimated construction costs are as follows:

Scenario B

- Mixed Waste Processing Facility:
    - 2025: 10 processing lines and 5 facilities - $172,000,000
    - 2040: 10 processing lines and 5 facilities - $172,000,000
    - 2060: 11 processing lines and 6 facilities - $189,000,000
- WTE Expansion
    - 2025: 1 additional 750 tpd processing line within existing facility - $180,000,000
    - 2040: 1 additional 750 tpd processing line within existing facility - $180,000,000
    - 2060: 1 additional 750 tpd processing line within existing facility - $180,000,000
- New WTE Facility
    - 2025: 3 1,050 tpd processing lines and 1 facility - $945,000,000
    - 2040: 3 1,050 tpd processing lines and 1 facility - $945,000,000
    - 2060: 3 1,050 tpd processing lines and 1 facility - $945,000,000

Estimated Long-Term Conceptual Level Construction Cost WTE Expansion - $497,000,000

Estimated Long-Term Conceptual Level Construction Cost New WTE Facility - $1,262,000,000

7.2.4 Conceptual Level Construction Cost Scenario C

Scenario C requires that the waste stream not diverted to the common facility elements be processed at either the existing WSB WTE Facility or at a new system-owned WTE Facility, based on the option selected. If expansion of WSB is selected, in the mid and long-term, a 5th boiler unit would be required to process the projected quantity of waste, which is not possible due to the existing design of WSB. Therefore, solid waste in excess of the expanded capacity would be processed or disposed through a separate method, which could impact the projected recycling goal percentage.

Development of a new WTE Facility that is publicly owned could also be pursued and would provide for the processing needs throughout the planning period. Three 1,050 tpd processing lines would be required in the short and mid-term and a fourth 1,050 tpd processing line would be needed for the long-term.

A summary of the number of facilities, processing lines and estimated construction costs are as follows:

<u>Scenario C</u>

- WTE Expansion
    - 2025: 1 additional 750 tpd processing line within existing facility - $180,000,000
    - 2040: 1 additional 750 tpd processing line within existing facility - $180,000,000
        - Excess waste would be processed or disposed through other methods.
    - 2060: 1 additional 750 tpd processing line within existing facility - $180,000,000
        - Excess waste would be processed or disposed through other methods.
- New WTE Facility
    - 2025: 3 1,050 tpd processing lines and 1 facility - $945,000,000
    - 2040: 3 1,050 tpd processing lines and 1 facility - $945,000,000
    - 2060: 4 1,050 tpd processing lines and 1 facility - $1,260,000,000

<u>Estimated Long-Term Conceptual Level Construction Cost WTE Expansion - $308,000,000</u>

<u>Estimated Long-Term Conceptual Level Construction Cost New WTE Facility - $1,388,000,000</u>

Table 25: Summary of Estimated Solid Waste Facility Construction Cost Projections

Facility	2025			2040			2060		
	Processing Lines Required	Facilities Required [1]	Est. Facility Cost (2020 dollars)	Processing Lines Required	Facilities Required [1]	Est. Facility Cost (2020 dollars)	Processing Lines Required	Facilities Required [1]	Est. Facility Cost (2020 dollars)
Common Elements									
Materials Recycling Facility	5	3	$ 63,000,000	5	3	$ 63,000,000	6	3	$ 76,000,000
Combined Bulky Waste/Yard Trash/C&D Facility	10	5	$ 39,000,000	11	6	$ 42,000,000	12	6	$ 46,000,000
Yard Trash Facility	1	1	$ 3,000,000	1	1	$ 3,000,000	2	1	$ 6,000,000
Constants Subtotal			$ 105,000,000			$ 108,000,000			$ 128,000,000
Scenario A									
Mixed Waste Processing Facility	10	5	$ 172,000,000	10	5	$ 172,000,000	11	6	$ 189,000,000
Organics Processing Facility (excludes Yard Trash)	4	2	$ 52,000,000	4	2	$ 52,000,000	4	2	$ 52,000,000
Waste-to-Energy (WTE)									
WSB Expansion (Add 4th 750 tpd Boiler Unit)	0	0	$ -	0	0	$ -	1	0	$ 180,000,000
OR									
New WTE Facility (750 tpd Boiler Units)	3	1	$ 675,000,000	3	1	$ 675,000,000	4	1	$ 900,000,000
Scenario A (4th WTE Unit at WSB) TOTAL		**16**	**$ 329,000,000**		**17**	**$ 332,000,000**		**18**	**$ 549,000,000**
Scenario A (New WTE Facility) TOTAL		**17**	**$ 1,004,000,000**		**18**	**$ 1,007,000,000**		**19**	**$ 1,269,000,000**
Scenario B									
Mixed Waste Processing Facility	10	5	$ 172,000,000	10	5	$ 172,000,000	11	6	$ 189,000,000
Waste-to-Energy (WTE)									
WSB Expansion (Add 4th 750 tpd Boiler Unit)	1	0	$ 180,000,000	1	0	$ 180,000,000	1	0	$ 180,000,000
OR									
New WTE Facility (1,050 tpd Boiler Units)	3	1	$ 945,000,000	3	1	$ 945,000,000	3	1	$ 945,000,000
Scenario B (4th WTE Unit at WSB) TOTAL		**14**	**$ 457,000,000**		**15**	**$ 460,000,000**		**16**	**$ 497,000,000**
Scenario B (New WTE Facility) TOTAL		**15**	**$ 1,222,000,000**		**16**	**$ 1,225,000,000**		**17**	**$ 1,262,000,000**
Scenario C[2]									
Waste-to-Energy (WTE)									
WSB Expansion (Add 4th 750 tpd Boiler Unit)	1	0	$ 180,000,000	1	0	$ 180,000,000	1	0	$ 180,000,000
OR									
New WTE Facility (1,050 tpd Boiler Units)	3	1	$ 945,000,000	3	1	$ 945,000,000	4	1	$ 1,260,000,000
Scenario C (4th WTE Unit at WSB) TOTAL		**9**	**$ 285,000,000**		**10**	**$ 288,000,000**		**10**	**$ 308,000,000**
Scenario C (New WTE Facility) TOTAL		**10**	**$ 1,050,000,000**		**11**	**$ 1,053,000,000**		**11**	**$ 1,388,000,000**

Note 1: Number of required facilities assumes that each facility operates for one shift-per-day and has a maximum of two processing lines. The number of facilities, and estimated construction cost may be reduced if operating at two shifts-per-day.

Note 2: For the mid and long-term planning period of 2040 and 2060 for Scenario C, a 2nd 750 tpd processing line is required but is not possible due to the existing design of WSB. Therefore one processing line is noted due to this limitation. Additional disposal capacity will be required for any waste exceeding the capacity of WSB.

7.3 Summary of Conceptual Level Cost Estimates

The Arcadis Team has identified the number of processing lines and facilities in **Table 25** that will meet the estimated processing capacity needs. The costs associated with these recommendations are summed in **Table 26**. However, the MRF, Combined BW/YT/C&D Facility, YT Facility and MWP Facility provide for operational flexibilities, as they could be operated on a two shift-per-day basis, which would maximize waste processed, minimize the number of facilities and/or processing lines required and potentially decrease the conceptual level construction cost estimates.

Table 25: Conceptual-Level Construction Cost Estimates for Recommended Facilities/Processing Lines

Scenario [1]	2025 Est. Facility Cost (2020 dollars)	2040 Est. Facility Cost (2020 dollars)	2060 Est. Facility Cost (2020 dollars)
Scenario A[2]			
Assuming 4th WTE Unit @ South Broward	$ 329,000,000	$ 332,000,000	$ 549,000,000
Assuming New WTE Facility	$ 1,004,000,000	$ 1,007,000,000	$ 1,269,000,000
Scenario B			
Assuming 4th WTE Unit @ South Broward	$ 457,000,000	$ 460,000,000	$ 497,000,000
Assuming New WTE Facility	$ 1,222,000,000	$ 1,225,000,000	$ 1,262,000,000
Scenario C[3]			
Assuming 4th WTE Unit @ South Broward	$ 285,000,000	$ 288,000,000	$ 308,000,000
Assuming New WTE Facility	$ 1,050,000,000	$ 1,053,000,000	$ 1,388,000,000

Note 1: Scenario costs also include the estimated construction cost for the common element facilities.

Note 2: System waste can be processed within the existing capacity of WSB in the short and mid-term planning period, 2025 and 2040, assuming capacity at WSB will be reserved for system-supplied waste. Therefore the estimated construction cost associated with the addition of a 4th 750 tpd processing line at WSB is only noted in the long-term planning period of 2060 for Scenario A.

Note 3: For the mid and long-term planning period of 2040 and 2060 for Scenario C, a 2nd 750 tpd processing line is required but is not possible due to the existing design of WSB. Therefore the estimated construction cost assumes one processing line.

Note that while construction cost is a major contributor to the overall cost of a project, there are other costs to consider that are not included in this analysis. Cost considerations do not include annual operating fees, operations and maintenance, pass through, residue transport and disposal, metals recovered transport, purchase of land, financing, engineering, legal, permitting and procurement. Additionally, revenue generation opportunities are also present for each type of facility that is incorporated into the proposed solid waste system. **Table 27** below provides a summary of potential revenue generation opportunities and costs not considered in the construction cost for each type of facility.

Table 26: Facility Revenue Generation Opportunities

Facility Type	Revenue Generation Opportunity	Other Cost Considerations Not Included in Construction Cost
Single Stream Materials Recovery Facility	- Recovered materials revenue sharing (i.e. single stream source separated recyclables)	- Annual operating fee - Operations & maintenance cost (including staffing, utilities, consumables, etc.) - Passthrough costs (including chemical reagents, if applicable) - Residue disposal - Purchase of land - Financing - Engineering -Procurement - Legal - Permitting - Testing - Revenue generation (see previous column)
Mixed Bulky Waste/Yard Trash/C&D	- Recovered materials revenue sharing (i.e. bulky metals, materials and C&D)	
Yard Trash	- Sale of mulch and compost	
Mixed Waste Processing Facility	- Additional recovered materials revenue sharing (i.e. single stream source separated recyclables)	
Wet Organics (food waste) Anaerobic Digester	- Biogas revenue sharing - Electrical generation revenue sharing - Sale of compost - Sale of nutrient-rich water (for agriculture)	
Waste-to-Energy	- Electrical Generation Revenue Sharing - Recovered Metals Revenue Sharing	

The next steps are to review and evaluate the financial impact of the different alternatives proposed and decide which scenario, or portion thereof, the Working Group and County are interested in pursuing. Once a scenario is selected, it is recommended to perform a full net present value (NPV) analysis and feasibility study for each facility proposed, including a detailed construction cost estimate, estimate of the additional costs listed above, as well as estimate the revenue that could be generated by the selected facility(ies).

EXHIBIT A

Comparison of Estimated Composition of Solid Waste Generated in Broward County to Composition Reported to FDEP for 2016 (percent by weight)

Exhibit A: Comparison of Estimated Composition of Solid Waste Generated in Broward County to Composition Reported to FDEP for 2016 (% by weight)

FDEP Categories	Estimated Composition – Current Analysis	Composition of Waste – Reported to FDEP for 2016
Newspaper	1%	4%
Glass	3%	2%
Aluminium cans	0.4%	0.5%
Plastic bottles	1%	1%
Steel cans	1%	1%
Corrugated cardboard	6%	8%
Office paper	1%	2%
Yard trash	10%	8%
Other plastics	5%	4%
Ferrous metals	5%	3%
White goods	1%	1%
Non-ferrous metals	1%	1%
Other paper	7%	8%
Textiles	2%	2%
C&D debris	44%	23%
Food	5%	6%
Miscellaneous	7%	24%
Tires	0.1%	1%
Total	100%	100%

EXHIBIT B

Population Projections by Zone and Municipality

EXHIBIT B: POPULATION PROJECTIONS BY ZONE AND MUNICIPALITY

		Population Based on TAZ 2018 Projections								Arcadis Team Population Projections		
	Municipality	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1	Coral Springs	121,354	124,949	128,454	127,830	129,733	135,440	139,305	142,751	146,282	148,208	149,212
	Coconut Creek	52,868	54,331	56,445	57,075	59,510	60,997	62,068	63,000	63,946	64,535	64,894
	Margate	52,776	54,602	55,021	58,309	60,976	63,456	65,405	67,441	69,539	71,252	72,871
	Parkland	23,876	27,576	33,292	32,854	32,634	32,822	32,875	32,913	32,951	32,894	32,795
	SUB TOTAL	250,874	261,458	273,213	276,069	282,853	292,715	299,653	306,105	312,719	316,888	319,772
Zone 2	Deerfield Beach	73,993	77,108	77,838	85,363	88,837	90,511	91,548	92,479	93,419	93,870	94,074
	Hillsboro Beach	1,875	2,249	2,291	2,233	2,199	2,166	2,142	2,126	2,110	2,102	2,102
	Lighthouse Point	10,229	10,373	10,244	10,096	10,267	10,317	10,320	10,282	10,244	10,161	10,038
	Pompano Beach	95,822	101,420	104,420	120,770	127,353	130,556	132,874	135,041	137,243	138,737	139,864
	SUB TOTAL	181,919	191,150	194,793	218,462	228,656	233,550	236,884	239,928	243,017	244,871	246,078
Zone 3	Lauderhill	66,661	69,059	71,816	73,464	76,280	78,405	79,906	81,181	82,475	83,224	83,612
	Plantation	84,705	86,761	89,355	92,262	94,032	98,465	101,736	104,470	107,276	108,935	109,745
	North Lauderdale	40,527	40,660	40,037	46,753	47,005	48,190	48,679	49,037	49,398	49,220	48,771
	Sunrise	83,675	89,639	96,834	98,524	98,962	101,369	103,336	104,818	106,321	107,318	107,784
	Tamarac	59,617	62,494	63,785	64,958	65,688	67,832	69,319	70,518	71,736	72,353	72,541
	SUB TOTAL	335,186	348,613	361,827	375,961	381,967	394,261	402,977	410,023	417,207	421,050	422,452
Zone 4	Fort Lauderdale	162,140	171,980	173,249	206,250	221,478	230,693	237,989	244,977	252,170	257,706	262,339
	Lauderdale-By-The-Sea	6,035	6,680	6,818	6,654	6,630	6,583	6,554	6,510	6,466	6,428	6,383
	Lauderdale Lakes	32,221	33,274	34,024	34,866	37,098	38,419	39,280	40,081	40,898	41,345	41,609
	Lazy Lake Village	25	26	25	27	29	30	31	32	33	34	34
	Oakland Park	41,248	42,978	45,609	46,554	49,209	50,840	52,043	53,049	54,075	54,701	55,036
	Sea Ranch Lakes	663	703	695	680	714	730	740	738	736	726	705
	Unincorporated	14,177	14,894	17,908	19,913	20,983	21,664	22,196	22,810	23,441	23,990	24,567
	Wilton Manors	11,374	11,628	11,558	12,862	13,993	14,691	15,321	15,883	16,465	16,959	17,359
	SUB TOTAL	267,883	282,164	289,886	327,806	350,134	363,651	374,155	384,080	394,285	401,888	408,031
Zone 5	Cooper City	28,503	32,877	32,880	32,513	32,234	32,499	33,123	33,733	34,354	35,229	36,191
	Davie	90,343	96,432	103,716	107,225	110,329	114,664	118,618	122,479	126,464	130,093	133,490
	Southwest Ranches	7,332	8,191	9,091	8,987	8,900	8,862	8,827	8,787	8,746	8,705	8,661
	Weston	65,559	65,693	64,717	64,961	64,165	63,677	63,414	63,198	62,983	62,929	62,960
	SUB TOTAL	191,738	203,193	210,404	213,687	215,628	219,702	223,982	228,196	232,547	236,957	241,303
Zone 6	Dania Beach	29,734	32,808	34,762	37,779	40,155	41,683	42,928	44,128	45,361	46,352	47,212
	Hallandale Beach	36,632	39,671	39,866	40,758	42,629	43,709	44,430	45,135	45,851	46,299	46,638
	Hollywood	139,599	147,214	151,428	157,428	165,723	171,464	175,614	179,722	183,927	186,900	189,369
	Indian Reservation	1,747	1,947	1,946	2,048	2,129	2,221	2,298	2,363	2,431	2,482	2,518
	Pembroke Park	6,028	6,335	6,301	6,179	6,516	6,666	6,718	6,770	6,822	6,805	6,765
	West Park	14,082	14,879	15,530	16,037	16,833	17,212	17,435	17,708	17,986	18,169	18,355
	SUB TOTAL	227,822	242,854	249,833	260,229	273,985	282,954	289,423	295,827	302,378	307,008	310,856
Zone 7	Pembroke Pines	153,585	154,365	156,365	157,472	156,564	158,900	162,188	165,321	168,515	172,341	176,291
	Miramar	122,228	125,616	128,525	138,291	141,668	144,409	146,482	148,650	150,850	152,603	154,260
	SUB TOTAL	275,813	279,981	284,890	295,763	298,232	303,309	308,670	313,971	319,365	324,944	330,551
	TOTAL	1,731,236	1,809,413	1,864,846	1,967,977	2,031,455	2,090,143	2,135,744	2,178,129	2,221,517	2,253,605	2,279,042

EXHIBIT C

Historical and Projected Waste Generation and Recycling

EXHIBIT C: HISTORICAL AND PROJECTED WASTE GENERATION AND RECYCLING

	Year	Population	Waste Generation Low (tons/year)	Waste Generation Probable (tons/year)	Waste Generation High (tons/year)	Recycling Generation Baseline (tons/year)
Historical	2010	1,731,236	2,130,965	2,130,965	2,130,965	590,165
	2011	1,753,162	2,336,767	2,336,767	2,336,767	617,801
	2012	1,771,099	2,722,769	2,722,769	2,722,769	1,007,382
	2013	1,784,715	3,285,645	3,285,645	3,285,645	1,497,794
	2014	1,803,903	3,600,257	3,600,257	3,600,257	1,566,398
	2015	1,827,367	3,694,997	3,694,997	3,694,997	1,579,177
	2016	1,854,513	3,598,692	3,598,692	3,598,692	1,206,934
Projections	2020	1,864,846	3,138,365	3,482,293	3,623,401	1,287,908
	2025	1,967,977	3,472,713	3,674,874	3,804,971	1,359,132
	2030	2,031,455	3,542,217	3,793,408	3,926,766	1,402,972
	2035	2,090,143	3,641,858	3,902,998	4,040,468	1,443,503
	2040	2,135,744	3,727,215	3,988,151	4,128,716	1,474,996
	2045	2,178,129	3,797,037	4,067,298	4,210,672	1,504,269
	2050	2,221,517	3,874,641	4,148,317	4,294,550	1,534,233
	2055	2,253,605	3,929,859	4,208,238	4,356,583	1,556,394
	2060	2,279,042	3,974,461	4,255,736	4,405,756	1,573,961

EXHIBIT D

Waste Generation and Recycling Projections by Zone

EXHIBIT D: WASTE GENERATION AND RECYCLING PROJECTIONS BY ZONE

		Historical Estimates [1]		Generation Projections (tons/year)								
	Year	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
Waste Generation Low	**WGR**	**6.74**	**11.07**	**9.22**	**9.66**	**9.55**	**9.54**	**9.56**	**9.55**	**9.55**	**9.55**	**9.55**
	Zone 1	308,799	528,678	459,792	487,154	493,207	510,026	522,942	533,619	545,426	552,593	557,656
	Zone 2	223,923	386,511	327,819	385,500	398,704	406,937	413,401	418,256	423,855	427,008	429,139
	Zone 3	412,578	704,907	608,921	663,426	666,030	686,959	703,259	714,775	727,668	734,231	736,721
	Zone 4	329,735	570,545	487,852	578,451	610,524	633,625	652,960	669,551	687,689	700,817	711,573
	Zone 5	236,009	410,864	354,091	377,074	375,988	382,808	390,885	397,804	405,595	413,208	420,812
	Zone 6	280,425	491,059	420,446	459,203	477,743	493,019	505,089	515,701	527,390	535,363	542,107
	Zone 7	339,496	566,130	479,444	521,907	520,022	528,485	538,678	547,332	557,017	566,640	576,453
	SCENARIO TOTAL	**2,130,965**	**3,658,693**	**3,138,365**	**3,472,713**	**3,542,217**	**3,641,858**	**3,727,215**	**3,797,037**	**3,874,641**	**3,929,859**	**3,974,461**
Waste Generation Probable	**WGR**	**6.74**	**11.07**	**10.22**	**10.22**	**10.22**	**10.22**	**10.22**	**10.22**	**10.22**	**10.22**	**10.22**
	Zone 1	308,799	528,678	510,180	515,513	528,182	546,598	559,553	571,600	583,951	591,736	597,122
	Zone 2	223,923	386,511	363,744	407,941	426,977	436,117	442,343	448,026	453,793	457,256	459,509
	Zone 3	412,578	704,907	675,652	702,046	713,261	736,217	752,493	765,650	779,066	786,241	788,859
	Zone 4	329,735	570,545	541,315	612,125	653,818	679,059	698,672	717,207	736,263	750,460	761,932
	Zone 5	236,009	410,864	392,895	399,024	402,650	410,257	418,250	426,118	434,243	442,479	450,593
	Zone 6	280,425	491,059	466,523	485,935	511,621	528,371	540,449	552,407	564,641	573,286	580,472
	Zone 7	339,496	566,130	531,985	552,289	556,899	566,380	576,390	586,289	596,361	606,779	617,249
	SCENARIO TOTAL	**2,130,965**	**3,658,693**	**3,482,293**	**3,674,874**	**3,793,408**	**3,902,998**	**3,988,151**	**4,067,298**	**4,148,317**	**4,208,238**	**4,255,736**
Waste Generation High	**WGR**	**6.74**	**11.07**	**10.64**	**10.59**	**10.58**	**10.59**	**10.59**	**10.59**	**10.59**	**10.59**	**10.59**
	Zone 1	308,799	528,678	530,853	533,763	546,750	565,850	579,275	591,749	604,536	612,596	618,171
	Zone 2	223,923	386,511	378,484	422,383	441,988	451,477	457,934	463,819	469,790	473,375	475,708
	Zone 3	412,578	704,907	703,030	726,900	738,335	762,148	779,015	792,640	806,528	813,957	816,667
	Zone 4	329,735	570,545	563,250	633,795	676,803	702,977	723,297	742,489	762,217	776,915	788,791
	Zone 5	236,009	410,864	408,816	413,151	416,806	424,707	432,992	441,139	449,551	458,076	466,477
	Zone 6	280,425	491,059	485,427	503,138	529,607	546,981	559,498	571,880	584,545	593,495	600,934
	Zone 7	339,496	566,130	553,542	571,841	576,477	586,329	596,705	606,956	617,383	628,169	639,008
	SCENARIO TOTAL	**2,130,965**	**3,658,693**	**3,623,401**	**3,804,971**	**3,926,766**	**4,040,468**	**4,128,716**	**4,210,672**	**4,294,550**	**4,356,583**	**4,405,756**
Recycling Baseline	**RGR**	**1.87**	**4.73**	**4.15**	**4.15**	**4.15**	**4.15**	**4.15**	**4.15**	**4.15**	**4.15**	**4.15**
	Zone 1	85,521	225,948	207,169	209,335	214,479	221,957	227,218	232,110	237,125	240,287	242,474
	Zone 2	62,015	165,188	147,706	165,653	173,383	177,094	179,623	181,930	184,272	185,678	186,593
	Zone 3	114,262	301,265	274,362	285,080	289,634	298,956	305,565	310,908	316,356	319,270	320,333
	Zone 4	91,319	243,841	219,812	248,566	265,496	275,746	283,710	291,237	298,975	304,740	309,398
	Zone 5	65,362	175,596	159,543	162,032	163,505	166,593	169,839	173,034	176,334	179,678	182,973
	Zone 6	77,663	209,870	189,441	197,324	207,754	214,556	219,461	224,317	229,284	232,795	235,713
	Zone 7	94,023	241,954	216,024	224,269	226,140	229,990	234,055	238,075	242,165	246,395	250,647
	SCENARIO TOTAL	**590,165**	**1,563,661**	**1,414,058**	**1,492,259**	**1,540,392**	**1,584,894**	**1,619,472**	**1,651,611**	**1,684,511**	**1,708,843**	**1,728,130**

EXHIBIT E

Market Drivers for Various Recyclable Materials

Exhibit E: Market Drivers for Various Recyclable Materials

Paper

The Chinese export market has been a significant driver of global corrugated containers (OCC) and mixed paper markets in the past 15 years. Export demand (including China) represented approximately 34 percent and 50 percent, respectively, of OCC and mixed paper demand in the United States in 2016.[1] Regardless of short-term conditions, international mills will continue to demand U.S. recovered paper.

In recent years, the North American mixed paper market became accustomed to strong export markets that tolerated lower quality. The combined impact of quality tolerance, strong demand, and relatively high prices made it difficult for traditional mixed paper consuming mills to survive in North America.

China's National Sword initiative, which is focused on improving the quality of imported recycled materials, is currently causing major market disruptions, reduced export demand, and price declines for both OCC and mixed paper. The consensus is that these market disruptions will continue in 2018, however Chinese paper mills are largely dependent on U.S. recovered paper. Increased focus on quality in the United States and revisions in the Chinese import standards will likely increase certainty and reduce market volatility.

The growth of e-commerce is changing the characteristics and generation of OCC. Commonly referred to as the "Amazon effect," OCC generation is shifting towards the residential sector and is comprised of smaller boxes than what are found in commercial waste. OCC demand for producing cardboard is still strong but with less OCC available in the commercial sector and more in the residential sector, some of the OCC that was previously low-hanging fruit is becoming high-hanging fruit. This is having the net effect of constraining supply and quality and placing upward pressure on domestic OCC prices.

Glass

Due to its weight and value, recycled glass markets are regional. Recycled container glass produced by MRFs must go through further processing (called beneficiation) to remove contaminants and produce consistent feedstock that meets end-user specifications. New glass containers and fiberglass insulation manufacturing represent the majority of demand for beneficiated recycled container glass.

Because recycled glass is a relatively heavy and low-value commodity, transportation costs are a primary factor affecting demand. In some cases, the distance and cost to haul recycled glass to a beneficiation facility can be greater than its value, which can represent an economic barrier and create an incentive to develop alternative uses for the recycled glass such as alternative daily landfill cover and other civil engineering applications. In response to limited demand and tip fees charged by beneficiation facilities for heavily contaminated glass, some MRFs are investing in glass clean-up systems to improve marketability by removing contaminants and producing glass cullet that meets quality specifications.

[1] American Forest & Paper Association, *Annual Statistical Summary of Recovered Paper Utilization*, June 2017.

Steel Cans, Aluminum Cans, and Bulk Metals

Recycled ferrous and non-ferrous metals have well-established domestic and international markets. Both industries are highly reliant on recycled feedstocks in the manufacturing process. Steel and aluminum cans are primarily recovered through municipal recycling, while the majority of bulk ferrous and aluminum scrap come from commercial/industrial sources.

Markets for ferrous and non-ferrous metals are well-established with consistent domestic and international demand. The intrinsic value of recycled metals is based on the fact that steel and aluminum are infinitely recyclable and cost-effective compared to virgin ores, so steel furnaces and aluminum smelters use recycled metals as a major source of raw material.

The construction, machinery, and transportation sectors together account for approximately 79 percent and 54 percent of steel and aluminum domestic consumption, respectively. Comparing this to consumer containers and packaging, which account for 4 percent and 18 percent respectively of steel and aluminum consumption, it is clear that trends in the construction and transportation sector can have a major impact on demand and pricing for scrap metals.

PET, HDPE, and Mixed Plastic Containers

The majority of post-consumer PET and HDPE containers come from residential recovery programs. Domestically, the majority of demand is for the production of recycled resins that are then used to manufacture products and packaging. Domestic markets consume more than 80 percent of recycled PET and HDPE with remainder being exported. For mixed plastic containers, domestic markets consume approximately 65 percent.[2]

Post-consumer plastics produced by MRFs need to go through additional processing before they can be used to manufacture new products. Plastic reclaimers fill this niche in the recovery supply chain – sorting, cleaning, and producing flakes or pellets to meet specific end-user applications. Domestically, recycled PET is used predominantly to produce fiber, sheet, film, and bottles while recycled HDPE is used primarily for non-food containers, pipe, and outdoor products.

Virgin resin accounts for the majority of total PET and HDPE resin production, so recycled resin demand is tied to the price of virgin resins derived from fossil fuels. Virgin production capacity is another market driver. For example, the fact that China overbuilt PET resin production capacity means oversupply of virgin PET and thus depressed prices for recycled PET.

The price and demand for mixed plastic containers can be impacted significantly by the export market as demonstrated by China's National Sword initiative. Currently, domestic reclaiming capacity for mixed plastic containers and non-bottle rigids is less than supply. However, in recent years, this domestic capacity has been increasing and there are informal reports that mixed plastic reclaimers are responding to the low prices and excess supply by planning investments to expand domestic reclaiming capacity.

[2] Sources: NAPCOR's *Report on Post-consumer PET Container Recycling Activity in 2016* and APC's *2016 US National Postconsumer Plastic Bottle Recycling Report.*

EXHIBIT F

Recycling and Related Processing Technologies Summary

EXHIBIT F: RECYCLING AND RELATED PROCESSING TECHNOLOGIES SUMMARY

1.Technology	Materials Handled	Products & By-Products	Commercial Scale
Physical Processing			
Intermediate Processing Facility (IPF)	Source Separated Recyclables	Recyclable commodities	Yes, mostly small or rural communities
Materials Recycling Facility (MRF)	Dual or Single Stream Recyclables	Recyclable commodities	Yes
Mixed Waste Processing Facility (MWPF)	Unprocessed MSW	Recyclable commodities, organics stream	Yes, mostly California
C&D & Bulky Waste Processing	C&D debris and/or bulky waste	Recoverable commodities (typically crushed or shredded)	Yes
Biological Processing			
Aerobic Composting			
Turned Windrow	Source Separated Recyclables	Recyclable commodities	Yes
Modified Static Aerobic Pile (MSAP)	Source-separated organics and/or biosolids with a bulky agent, typically ground	Finished compost (soil amendment)	Yes
Aerated Static Pile (ASP)	yard waste		Yes
In-vessel	Same as above, also MSW bulky waste	Finished compost (soil amendment) if only organics; volume-reduced waste stream, if MSW	Yes
Anaerobic Digestion			
High Solids Anaerobic Digestion	Source-separated organics, MSW	Biogas (energy); solid digestate (soil amendment), if only organics; volume-reduced waste stream, if MSW	Yes
Low Solids Anaerobic Digestion Pre-processed (liquified)	Pre-processed (liquified) food waste or other organic waste;	Biogas (energy); liquid digestate (fertilizer); some solid digestate (soil amendment)	Yes

1.Technology	Materials Handled	Products & By-Products	Commercial Scale
Fermentation		High-sugar or high-cellulose waste stream	Ethanol or other fuel, digestate
Thermal Processing			
Waste-to-energy	Mixed MSW with large, inert, or hazardous materials removed	Electricity, recovered ferrous metals	Yes
Gasification	Homogenous, prepared material high in combustibles with low moisture (<10%)	Syngas	Not for waste
Pyrolysis	Similar to gasification but more tolerance to moisture	Syngas, bio oil, biochar	No
Thermal depolymerization	Combustible material, high moisture is permissible (food waste, biosolids, etc.)	Bio oil	No
Hydrothermal carbonization	Same as above	Hydrochar	No

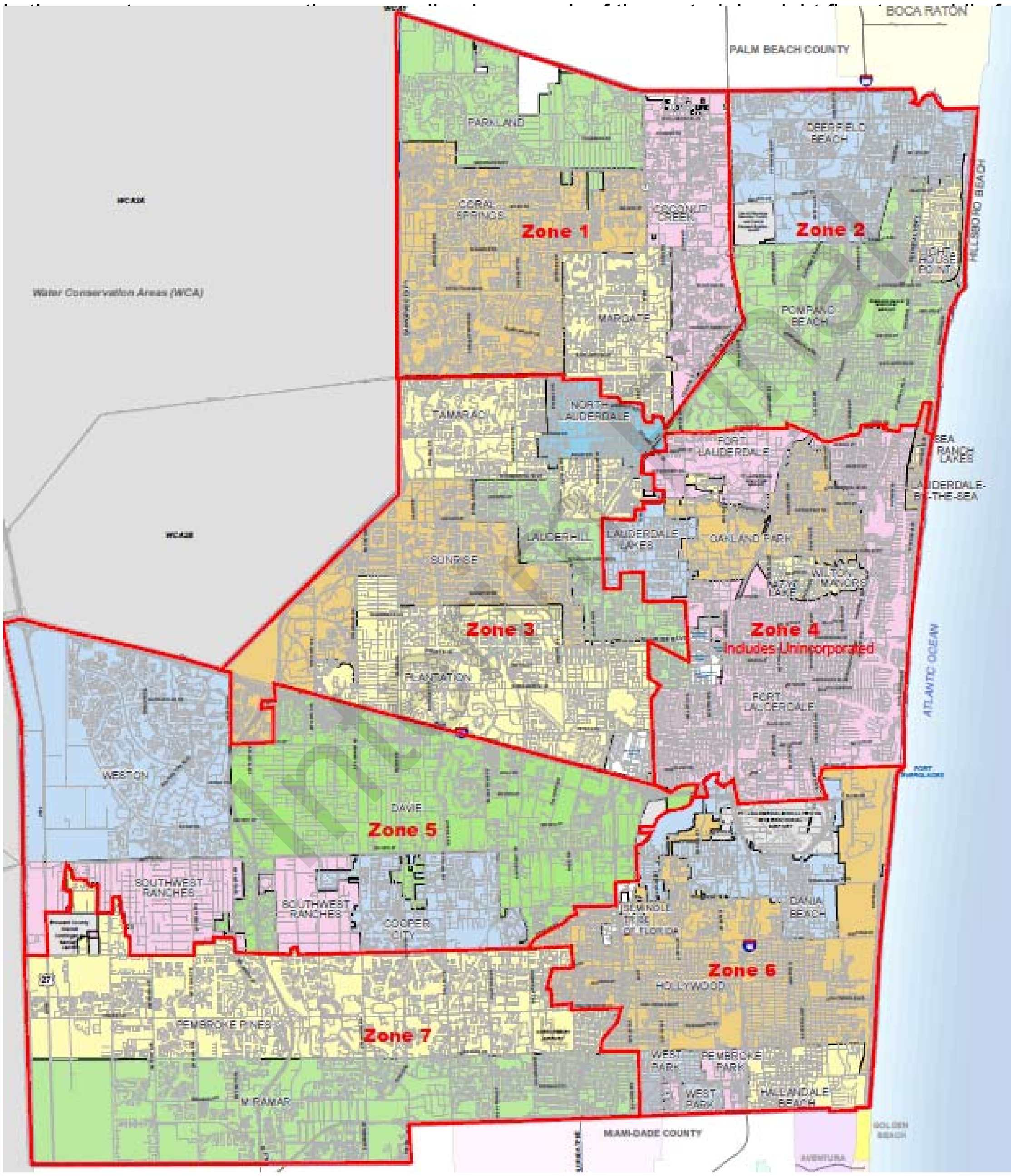
EXHIBIT G

Material Projections by Zone Based on Proposed Approach

Exhibit G: Material Projections by Zone Based on Proposed Approach

This exhibit provides a breakdown of estimated quantities of materials that might be collected for processing within each zone if the proposed approach herein is implemented. For reference, a map of these zones is provided below. These quantities are estimates to assist with sizing facilities that might be developed to manage these materials. Assumptions on which these estimates are based are discussed

cility.



Source Separated Recyclables (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	14,450	18,137	18,327	18,777	19,432	19,892	20,321	20,760	21,037	21,228
MF & Comm	20,422	34,834	38,938	39,895	41,286	42,265	43,174	44,107	44,695	45,102
Zone 2										
Residential	10,564	12,931	14,503	15,179	15,504	15,726	15,928	16,133	16,256	16,336
MF & Comm	14,931	24,836	30,813	32,251	32,941	33,411	33,841	34,276	34,538	34,708
Zone 3										
Residential	19,267	24,020	24,958	25,357	26,173	26,752	27,219	27,696	27,951	28,044
MF & Comm	27,230	46,132	53,027	53,874	55,608	56,838	57,832	58,845	59,387	59,585
Zone 4										
Residential	15,594	19,244	21,761	23,244	24,141	24,838	25,497	26,175	26,679	27,087
MF & Comm	22,040	36,960	46,235	49,385	51,291	52,773	54,173	55,612	56,684	57,551
Zone 5										
Residential	11,230	13,968	14,186	14,315	14,585	14,869	15,149	15,438	15,730	16,019
MF & Comm	15,871	26,826	30,139	30,413	30,988	31,592	32,186	32,800	33,422	34,035
Zone 6										
Residential	13,422	16,585	17,275	18,188	18,784	19,213	19,638	20,073	20,381	20,636
MF & Comm	18,969	31,853	36,704	38,644	39,909	40,822	41,725	42,649	43,302	43,845
Zone 7										
Residential	15,474	18,912	19,634	19,798	20,135	20,491	20,843	21,201	21,571	21,944
MF & Comm	21,869	36,323	41,716	42,064	42,780	43,536	44,284	45,045	45,832	46,622
Total	241,333	361,562	408,217	421,385	433,558	443,017	451,809	460,809	467,465	472,742

Source-Separated Bulk/YT/C&D to Processing (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	58,089	56,936	60,358	61,841	63,997	65,514	66,924	68,370	69,282	69,913
MF & Comm	135,540	134,070	142,066	145,557	150,632	154,202	157,522	160,926	163,072	164,556
Zone 2										
Residential	42,468	40,594	47,763	49,992	51,062	51,791	52,456	53,131	53,537	53,801
MF & Comm	99,092	95,588	112,421	117,667	120,186	121,901	123,468	125,057	126,011	126,632
Zone 3										
Residential	77,452	75,403	82,197	83,510	86,198	88,104	89,644	91,215	92,055	92,362
MF & Comm	180,721	177,554	193,471	196,561	202,888	207,373	210,999	214,696	216,673	217,395
Zone 4										
Residential	62,689	60,411	71,669	76,551	79,506	81,802	83,972	86,204	87,866	89,209
MF & Comm	146,274	142,252	168,690	180,180	187,136	192,541	197,649	202,900	206,813	209,974
Zone 5										
Residential	45,144	43,847	46,719	47,143	48,034	48,970	49,891	50,842	51,807	52,757
MF & Comm	105,335	103,249	109,964	110,963	113,059	115,262	117,430	119,669	121,939	124,175
Zone 6										
Residential	53,955	52,064	56,895	59,902	61,863	63,277	64,677	66,110	67,122	67,963
MF & Comm	125,896	122,597	133,915	140,993	145,609	148,938	152,233	155,604	157,987	159,967
Zone 7										
Residential	62,204	59,370	64,663	65,203	66,313	67,485	68,644	69,823	71,043	72,269
MF & Comm	145,142	139,800	152,201	153,471	156,084	158,842	161,570	164,346	167,217	170,102
Total	1,340,001	1,303,737	1,442,990	1,489,535	1,532,567	1,566,003	1,597,081	1,628,894	1,652,423	1,671,074

Yard Trash for Processing from Bulk/YT/C&D (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	0	8,216	9,332	9,561	9,894	10,129	10,347	10,571	10,711	10,809
MF & Comm	0	19,346	21,964	22,504	23,289	23,841	24,354	24,880	25,212	25,441
Zone 2										
Residential	0	5,858	7,384	7,729	7,894	8,007	8,110	8,214	8,277	8,318
MF & Comm	0	13,793	17,381	18,192	18,581	18,847	19,089	19,335	19,482	19,578
Zone 3										
Residential	0	10,881	12,708	12,911	13,327	13,621	13,860	14,102	14,232	14,280
MF & Comm	0	25,621	29,912	30,390	31,368	32,061	32,622	33,193	33,499	33,611
Zone 4										
Residential	0	8,717	11,080	11,835	12,292	12,647	12,983	13,328	13,585	13,792
MF & Comm	0	20,527	26,081	27,857	28,932	29,768	30,558	31,370	31,975	32,463
Zone 5										
Residential	0	6,327	7,223	7,289	7,426	7,571	7,713	7,861	8,010	8,157
MF & Comm	0	14,899	17,001	17,156	17,480	17,820	18,155	18,502	18,853	19,198
Zone 6										
Residential	0	7,513	8,796	9,261	9,564	9,783	10,000	10,221	10,377	10,508
MF & Comm	0	17,691	20,704	21,798	22,512	23,027	23,536	24,057	24,426	24,732
Zone 7										
Residential	0	8,567	9,997	10,081	10,252	10,434	10,613	10,795	10,984	11,173
MF & Comm	0	20,173	23,531	23,728	24,132	24,558	24,980	25,409	25,853	26,299
Total	0	188,128	223,095	230,291	236,944	242,114	246,919	251,837	255,475	258,359

Scenarios A & B: Mixed Waste to Processing (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	0	0	44,452	45,544	47,132	48,249	49,288	50,353	51,024	51,489
MF & Comm	0	0	93,139	95,428	98,755	101,096	103,273	105,504	106,911	107,884
Zone 2	0	0								
Residential	0	0	35,176	36,817	37,605	38,142	38,632	39,130	39,428	39,623
MF & Comm	0	0	73,704	77,143	78,794	79,919	80,946	81,988	82,614	83,021
Zone 3	0	0								
Residential	0	0	60,536	61,503	63,482	64,886	66,020	67,177	67,796	68,022
MF & Comm	0	0	126,841	128,867	133,014	135,955	138,332	140,756	142,053	142,525
Zone 4	0	0								
Residential	0	0	52,782	56,377	58,554	60,245	61,843	63,486	64,711	65,700
MF & Comm	0	0	110,594	118,127	122,688	126,231	129,580	133,023	135,588	137,660
Zone 5	0	0								
Residential	0	0	34,407	34,720	35,376	36,065	36,743	37,444	38,154	38,854
MF & Comm	0	0	72,093	72,748	74,122	75,567	76,988	78,456	79,944	81,410
Zone 6	0	0								
Residential	0	0	41,901	44,116	45,560	46,602	47,633	48,688	49,433	50,053
MF & Comm	0	0	87,795	92,436	95,462	97,645	99,805	102,015	103,577	104,876
Zone 7	0	0								
Residential	0	0	47,623	48,020	48,838	49,701	50,554	51,423	52,321	53,224
MF & Comm	0	0	99,784	100,617	102,330	104,138	105,927	107,746	109,629	111,520
Total	0	0	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860

Scenario A: Organics from MWP (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	0	0	6,241	6,394	6,617	6,774	6,920	7,069	7,164	7,229
MF & Comm	0	0	14,562	14,920	15,440	15,806	16,147	16,495	16,715	16,867
Zone 2										
Residential	0	0	4,939	5,169	5,280	5,355	5,424	5,494	5,536	5,563
MF & Comm	0	0	11,523	12,061	12,319	12,495	12,656	12,819	12,917	12,980
Zone 3										
Residential	0	0	8,499	8,635	8,913	9,110	9,269	9,432	9,518	9,550
MF & Comm	0	0	19,831	20,148	20,797	21,256	21,628	22,007	22,210	22,284
Zone 4										
Residential	0	0	7,411	7,915	8,221	8,458	8,683	8,913	9,085	9,224
MF & Comm	0	0	17,291	18,469	19,182	19,736	20,260	20,798	21,199	21,523
Zone 5										
Residential	0	0	4,831	4,875	4,967	5,063	5,159	5,257	5,357	5,455
MF & Comm	0	0	11,272	11,374	11,589	11,815	12,037	12,266	12,499	12,728
Zone 6										
Residential	0	0	5,883	6,194	6,397	6,543	6,688	6,836	6,940	7,027
MF & Comm	0	0	13,727	14,452	14,925	15,267	15,604	15,950	16,194	16,397
Zone 7										
Residential	0	0	6,686	6,742	6,857	6,978	7,098	7,220	7,346	7,473
MF & Comm	0	0	15,601	15,731	15,999	16,282	16,561	16,846	17,140	17,436
Total	0	0	148,296	153,080	157,502	160,939	164,132	167,402	169,820	171,737

Scenario A: Mixed Waste to WTE (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	0	0	32,200	32,991	34,142	34,951	35,703	36,475	36,961	37,298
MF & Comm	0	0	69,227	70,929	73,402	75,141	76,759	78,418	79,463	80,186
Zone 2										
Residential	0	0	25,481	26,670	27,241	27,630	27,985	28,345	28,561	28,702
MF & Comm	0	0	54,782	57,338	58,565	59,401	60,165	60,939	61,404	61,707
Zone 3										
Residential	0	0	43,851	44,552	45,986	47,002	47,824	48,662	49,110	49,274
MF & Comm	0	0	94,277	95,782	98,865	101,051	102,818	104,619	105,583	105,934
Zone 4										
Residential	0	0	38,235	40,839	42,416	43,641	44,798	45,989	46,875	47,592
MF & Comm	0	0	82,201	87,800	91,190	93,823	96,312	98,871	100,778	102,318
Zone 5										
Residential	0	0	24,924	25,150	25,626	26,125	26,616	27,124	27,638	28,145
MF & Comm	0	0	53,584	54,071	55,093	56,166	57,223	58,314	59,420	60,509
Zone 6										
Residential	0	0	30,353	31,957	33,003	33,758	34,505	35,269	35,809	36,258
MF & Comm	0	0	65,255	68,705	70,954	72,576	74,182	75,825	76,986	77,951
Zone 7										
Residential	0	0	34,497	34,785	35,377	36,003	36,621	37,250	37,901	38,555
MF & Comm	0	0	74,166	74,785	76,058	77,402	78,732	80,084	81,483	82,889
Total	0	0	723,033	746,355	767,917	784,671	800,243	816,183	827,973	837,318

Scenario B: Mixed Waste to WTE (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	0	0	38,441	39,386	40,759	41,725	42,623	43,544	44,125	44,527
MF & Comm	0	0	83,789	85,849	88,842	90,948	92,906	94,913	96,179	97,054
Zone 2										
Residential	0	0	30,420	31,839	32,521	32,985	33,409	33,839	34,097	34,265
MF & Comm	0	0	66,305	69,399	70,885	71,897	72,820	73,758	74,321	74,687
Zone 3										
Residential	0	0	52,351	53,187	54,899	56,112	57,093	58,094	58,629	58,824
MF & Comm	0	0	114,108	115,931	119,662	122,307	124,446	126,626	127,793	128,218
Zone 4										
Residential	0	0	45,645	48,754	50,636	52,099	53,481	54,902	55,961	56,816
MF & Comm	0	0	99,492	106,269	110,372	113,559	116,572	119,669	121,977	123,841
Zone 5										
Residential	0	0	29,755	30,025	30,592	31,188	31,775	32,381	32,995	33,600
MF & Comm	0	0	64,856	65,445	66,682	67,981	69,260	70,580	71,919	73,238
Zone 6										
Residential	0	0	36,235	38,151	39,400	40,301	41,192	42,104	42,749	43,285
MF & Comm	0	0	78,982	83,157	85,879	87,843	89,786	91,774	93,180	94,348
Zone 7										
Residential	0	0	41,183	41,527	42,234	42,981	43,719	44,470	45,247	46,027
MF & Comm	0	0	89,767	90,516	92,057	93,684	95,293	96,930	98,624	100,325
Total	0	0	871,330	899,435	925,419	945,609	964,375	983,585	997,793	1,009,055

Scenario C: Mixed Waste to WTE (TPY)	Current	2020	2025	2030	2035	2040	2045	2050	2055	2060
Zone 1										
Residential	56,355	44,514	44,452	45,544	47,132	48,249	49,288	50,353	51,024	51,489
MF & Comm	131,494	97,096	93,139	95,428	98,755	101,096	103,273	105,504	106,911	107,884
Zone 2										
Residential	41,200	31,737	35,176	36,817	37,605	38,142	38,632	39,130	39,428	39,623
MF & Comm	96,134	69,227	73,704	77,143	78,794	79,919	80,946	81,988	82,614	83,021
Zone 3										
Residential	75,140	58,952	60,536	61,503	63,482	64,886	66,020	67,177	67,796	68,022
MF & Comm	175,326	128,588	126,841	128,867	133,014	135,955	138,332	140,756	142,053	142,525
Zone 4										
Residential	60,817	47,231	52,782	56,377	58,554	60,245	61,843	63,486	64,711	65,700
MF & Comm	141,907	103,021	110,594	118,127	122,688	126,231	129,580	133,023	135,588	137,660
Zone 5										
Residential	43,796	34,281	34,407	34,720	35,376	36,065	36,743	37,444	38,154	38,854
MF & Comm	102,191	74,774	72,093	72,748	74,122	75,567	76,988	78,456	79,944	81,410
Zone 6										
Residential	52,345	40,705	41,901	44,116	45,560	46,602	47,633	48,688	49,433	50,053
MF & Comm	122,138	88,787	87,795	92,436	95,462	97,645	99,805	102,015	103,577	104,876
Zone 7										
Residential	60,347	46,417	47,623	48,020	48,838	49,701	50,554	51,423	52,321	53,224
MF & Comm	140,809	101,246	99,784	100,617	102,330	104,138	105,927	107,746	109,629	111,520
Total	1,300,000	966,573	980,827	1,012,464	1,041,713	1,064,441	1,085,565	1,107,189	1,123,182	1,135,860

EXHIBIT H

Estimated Solid Waste Facility Cost Projections Year 2025, 2040 and 2060

Table H-1: Estimated Solid Waste Facility Cost Projections Year 2025

Facility	Est. 2025 Public Capacity Required (tpy)	Current Actual Processing (tpy)	2025 Remaining Public Capacity Required (tpy)	2025 Required Daily Throughput (tpd)	2025 Required Hourly Throughput (tph)	2025 Operating Lines Required	Design Capacity (tpy) (5)	Rounded Cost per tpd (2020 dollars) (7, 8)	Rounded Estimated Facility Cost (2020 dollars) (6)	Percentage of Recycling Rate	Opportunity Cost: Rounded Est. Facility Cost per Percentage of Recycling Rate (2020 dollars)
Constants (all scenarios)											
Single Stream MRF (2, 4)	241,674	-	241,674	937	134	5	270,900	$ 60,000	$ 63,000,000	11%	$ 5,700,000
Mixed Bulky Waste/Yard Trash/C&D (2, 4)	430,264	-	430,264	1,668	238	10	451,500	$ 22,000	$ 39,000,000	23%	$ 1,800,000
Yard Trash (2, 4)	66,521	-	66,521	258	37	1	72,240	$ 11,000	$ 3,000,000	(note 9)	(note 9)
Other Materials Recycling										20%	
Constants Subtotal									$ 105,000,000	54%	
Scenario A											
Mixed Waste Processing Facility (2, 4)	980,827	-	980,827	3,802	543	10	1,083,600	$ 41,000	$ 172,000,000	3%	$ 58,000,000
Organics Processing Facility (excludes Yard Trash) (2, 4)	148,296	-	148,296	575	82	4	180,600	$ 74,000	$ 52,000,000	4%	$ 13,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	723,033	771,000	-	-	-	-	-	$ 240,000	$ -	14%	$ -
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	723,033	-	723,033	2,107	88	3	849,173	$ 300,000	$ 675,000,000	14%	$ 49,000,000
Scenario A (4th WTE Unit @ South Broward) TOTAL									**$ 329,000,000**	**75%**	
Scenario A (New WTE Facility) TOTAL									**$ 1,004,000,000**	**75%**	
Scenario B											
Mixed Waste Processing Facility (2, 4)	980,827	-	980,827	3,802	543	10	1,083,600	$ 41,000	$ 172,000,000	3%	$ 58,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	871,330	771,000	100,330	292	12	1	283,058	$ 240,000	$ 180,000,000	17%	$ 11,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	871,330	-	871,330	2,540	106	3	1,188,842	$ 300,000	$ 945,000,000	17%	$ 57,000,000
Scenario B (4th WTE Unit @ South Broward) TOTAL									**$ 457,000,000**	**74%**	
Scenario B (New WTE Facility) TOTAL									**$ 1,222,000,000**	**74%**	
Scenario C											
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	980,827	771,000	209,827	612	25	1	283,058	$ 240,000	$ 180,000,000	19%	$ 10,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	980,827	-	980,827	2,859	119	3	1,188,842	$ 300,000	$ 945,000,000	19%	$ 51,000,000
Scenario C (4th WTE Unit @ South Broward) TOTAL									**$ 285,000,000**	**73%**	
Scenario C (New WTE Facility) TOTAL									**$ 1,050,000,000**	**73%**	

Notes:

(1) Assumes capacity of Wheelabrator South Broward is approximately 771,000 tpy based on three 750 tpd boilers and a 94% efficiency and 100% of this capacity is reserved for county-supplied waste.

(2) Assumes 100% availability for non-WTE facilities and maintenance to be performed after hours and off-line days. Daily throughput is based on the following operating schedule:

Days per week	5
Days per year	258 (excluding Christmas and New Years)
Hours per shift	7

(3) Assumes daily throughput is based on 24-hour operation with the following availability:

WTE	94%

(4) Assumes the following throughput per operating line:

Single Stream MRF (tph)	30
Bulky Waste/Yard Trash/C&D (tph)	25
Yard Trash (tph)	40
Mixed Waste (tph)	60
Organic Waste (tph)	25
WTE - new per unit (tpd) Scenario A	750
WTE - new per unit (tpd) Scen. B & C	1050
WTE - expansion Broward per unit (tpd)	750

(5) Design capacity is calculated by multiplying the number of required operating lines by operating time (see note 2 above) and the design throughput (see note 4 above). Number of processing lines for WTE facilities allows for 10% over-rated capacity before requiring an additional boiler. It is assumed that other recycling efforts and/or diversion techniques will be identified to reduce the public capacity requirement for the long-term case of year 2060 estimates before adding an additional processing line.

(6) Facility costs are for construction capital costs of facilities only and are calculated using the design capacity. Costs do not include purchase of land, financing, legal, engineering, or operation and maintenance costs.
(7) Assume costs of reference facilities are escalated per year, based on the average ENR'S Construction Cost Index annual increase (1990-2017):
(8) Assumes costs of reference facilities are escalated based on ENR's Cost Index by 20 Cities as of April 2018.
(9) Percentage of recylcing rate comprised of yard trash is included in the percentage reported for the Bulky Waste/Yard Trash/C&D Facility.

Table H-2: Estimated Solid Waste Facility Cost Projections Year 2040

Facility	Est. 2040 Public Capacity Required (tpy)	Current Actual Processing (tpy)	2040 Remaining Public Capacity Required (tpy)	2040 Required Daily Throughput (tpd)	2040 Required Hourly Throughput (tph)	2040 Operating Lines Required	Design Capacity (tpy) (5)	Rounded Cost per tpd (2020 dollars) (7, 8)	Rounded Estimated Facility Cost (2020 dollars) (6)	Percentage of Recycling Rate	Opportunity Cost: Rounded Est. Facility Cost per Percentage of Recycling Rate (2020 dollars)
Constants (all scenarios)											
Single Stream MRF (2, 4)	262,276	-	262,276	1,017	145	5	270,900	$ 60,000	$ 63,000,000	11%	$ 5,700,000
Mixed Bulky Waste/Yard Trash/C&D (2, 4)	466,943	-	466,943	1,810	259	11	496,650	$ 22,000	$ 42,000,000	23%	$ 1,900,000
Yard Trash (2, 4)	72,192	-	72,192	280	40	1	72,240	$ 11,000	$ 3,000,000	(note 9)	(note 9)
Other Materials Recycling										20%	
Constants Subtotal									$ 108,000,000	54%	
Scenario A											
Mixed Waste Processing Facility (2, 4)	1,064,441	-	1,064,441	4,126	589	10	1,083,600	$ 41,000	$ 172,000,000	3%	$ 58,000,000
Organics Processing Facility (excludes Yard Trash) (2, 4)	160,939	-	160,939	624	89	4	180,600	$ 74,000	$ 52,000,000	4%	$ 13,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	784,671	771,000	13,671	40	2	-	-	$ 240,000	$ -	14%	$ -
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	784,671	-	784,671	2,287	95	3	849,173	$ 300,000	$ 675,000,000	14%	$ 49,000,000
Scenario A (4th WTE Unit @ South Broward) TOTAL									**$ 332,000,000**	**75%**	
Scenario A (New WTE Facility) TOTAL									**$ 1,007,000,000**	**75%**	
Scenario B											
Mixed Waste Processing Facility (2, 4)	1,064,441	-	1,064,441	4,126	589	10	1,083,600	$ 41,000	$ 172,000,000	3%	$ 58,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	945,609	771,000	174,609	509	21	1	283,058	$ 240,000	$ 180,000,000	17%	$ 11,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	945,609	-	945,609	2,756	115	3	1,188,842	$ 300,000	$ 945,000,000	17%	$ 57,000,000
Scenario B (4th WTE Unit @ South Broward) TOTAL									**$ 460,000,000**	**74%**	
Scenario B (New WTE Facility) TOTAL									**$ 1,225,000,000**	**74%**	
Scenario C											
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	1,064,441	771,000	293,441	855	36	1	283,058	$ 240,000	$ 180,000,000	19%	$ 10,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	1,064,441	-	1,064,441	3,102	129	3	1,188,842	$ 300,000	$ 945,000,000	19%	$ 51,000,000
Scenario C (4th WTE Unit @ South Broward) TOTAL									**$ 288,000,000**	**73%**	
Scenario C (New WTE Facility) TOTAL									**$ 1,053,000,000**	**73%**	

Notes:

(1) Assumes capacity of Wheelabrator South Broward is approximately 771,000 tpy based on three 750 tpd boilers and a 94% efficiency and 100% of this capacity is reserved for county-supplied waste.

(2) Assumes 100% availability for non-WTE facilities and maintenance to be performed after hours and off-line days. Daily throughput is based on the following operating schedule:

Days per week	5	
Days per year	258	(excluding Christmas and New Years)
Hours per shift	7	

(3) Assumes daily throughput is based on 24-hour operation with the following availability:

WTE	94%

(4) Assumes the following throughput per operating line:

Single Stream MRF (tph)	30
Bulky Waste/Yard Trash/C&D (tph)	25
Yard Trash (tph)	40
Mixed Waste (tph)	60
Organic Waste (tph)	25
WTE - new per unit (tpd) Scenario A	750
WTE - new per unit (tpd) Scen. B & C	1050
WTE - expansion Broward per unit (tpd)	750

(5) Design capacity is calculated by multiplying the number of required operating lines by operating time (see note 2 above) and the design throughput (see note 4 above). Number of processing lines for WTE facilities allows for 10% over-rated capacity before requiring an additional boiler. It is assumed that other recycling efforts and/or diversion techniques will be identified to reduce the public capacity requirement for the long-term case of year 2060 estimates before adding an additional processing line.

(6) Facility costs are for construction capital costs of facilities only and are calculated using the design capacity. Costs do not include purchase of land, financing, legal, engineering, or operation and maintenance costs.

(7) Assume costs of reference facilities are escalated per year, based on the average ENR'S Construction Cost Index annual increase (1990-2017):

(8) Assumes costs of reference facilities are escalated based on ENR's Cost Index by 20 Cities as of April 2018.

(9) Percentage of recylcing rate comprised of yard trash is included in the percentage reported for the Bulky Waste/Yard Trash/C&D Facility.

Table H-3: Estimated Solid Waste Facility Cost Projections Year 2060

Facility	Est. 2060 Public Capacity Required (tpy)	Current Actual Processing (tpy)	2060 Remaining Public Capacity Required (tpy)	2060 Required Daily Throughput (tpd)	2060 Required Hourly Throughput (tph)	2060 Operating Lines Required	Design Capacity (tpy) (5)	Rounded Cost per tpd (2020 dollars) (7, 8)	Rounded Estimated Facility Cost (2020 dollars) (6)	Percentage of Recycling Rate	Opportunity Cost: Rounded Est. Facility Cost per Percentage of Recycling Rate (2020 dollars)
Constants (all scenarios)											
Single Stream MRF (2, 4)	279,873	-	279,873	1,085	155	6	325,080	$ 60,000	$ 76,000,000	11%	$ 6,800,000
Mixed Bulky Waste/Yard Trash/C&D (2, 4)	498,272	-	498,272	1,931	276	12	541,800	$ 22,000	$ 46,000,000	23%	$ 2,200,000
Yard Trash (2, 4)	77,036	-	77,036	299	43	2	144,480	$ 11,000	$ 6,000,000	(note 9)	(note 9)
Other Materials Recycling										20%	
Constants Subtotal									$ 128,000,000	54%	
Scenario A											
Mixed Waste Processing Facility (2, 4)	1,135,860	-	1,135,860	4,403	629	11	1,191,960	$ 41,000	$ 189,000,000	3%	$ 63,000,000
Organics Processing Facility (excludes Yard Trash) (2, 4)	171,737	-	171,737	666	95	4	180,600	$ 74,000	$ 52,000,000	4%	$ 13,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	837,318	771,000	66,318	193	8	1	283,058	$ 240,000	$ 180,000,000	14%	$ 13,100,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	837,318	-	837,318	2,440	102	4	1,132,230	$ 300,000	$ 900,000,000	14%	$ 65,300,000
Scenario A (4th WTE Unit @ South Broward) TOTAL									**$ 549,000,000**	**75%**	
Scenario A (New WTE Facility) TOTAL									**$ 1,269,000,000**	**75%**	
Scenario B											
Mixed Waste Processing Facility (2, 4)	1,135,860	-	1,135,860	4,403	629	11	1,191,960	$ 41,000	$ 189,000,000	3%	$ 63,000,000
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	1,009,055	771,000	238,055	694	29	1	283,058	$ 240,000	$ 180,000,000	17%	$ 11,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	1,009,055	-	1,009,055	2,941	123	3	1,188,842	$ 300,000	$ 945,000,000	17%	$ 57,000,000
Scenario B (4th WTE Unit @ South Broward) TOTAL									**$ 497,000,000**	**74%**	
Scenario B (New WTE Facility) TOTAL									**$ 1,262,000,000**	**74%**	
Scenario C											
Waste-to-Energy (WTE)					(assumes 24-hr operation)						
Add 4th train to Wheelabrator South Broward (1, 3, 5)	1,135,860	771,000	364,860	1,063	44	1	283,058	$ 240,000	$ 180,000,000	19%	$ 10,000,000
				OR							
Separate County-owned Facility at BIC Landfill or Broward North (3, 5)	1,135,860	-	1,135,860	3,311	138	4	1,585,122	$ 300,000	$ 1,260,000,000	19%	$ 67,000,000
Scenario C (4th WTE Unit @ South Broward) TOTAL									**$ 308,000,000**	**73%**	
Scenario C (New WTE Facility) TOTAL									**$ 1,388,000,000**	**73%**	

Notes:

(1) Assumes capacity of Wheelabrator South Broward is approximately 771,000 tpy based on three 750 tpd boilers and a 94% efficiency and 100% of this capacity is reserved for county-supplied waste

(2) Assumes 100% availability for non-WTE facilities and maintenance to be performed after hours and off-line days. Daily throughput is based on the following operating schedule:

Days per week	5	
Days per year	258	(excluding Christmas and New Years)
Hours per shift	7	

(3) Assumes daily throughput is based on 24-hour operation with the following availability:

WTE	94%

(4) Assumes the following throughput per operating line:

Single Stream MRF (tph)	30
Bulky Waste/Yard Trash/C&D (tph)	25
Yard Trash (tph)	40
Mixed Waste (tph)	60
Organic Waste (tph)	25
WTE - new per unit (tpd) Scenario A	750
WTE - new per unit (tpd) Scen. B & C	1050
WTE - expansion Broward per unit (tpd)	750

(5) Design capacity is calculated by multiplying the number of required operating lines by operating time (see note 2 above) and the design throughput (see note 4 above). Number of processing lines for WTE facilities allows for 10% over-rated capacity before requiring an additional boiler. It is assumed that other recycling efforts and/or diversion techniques will be identified to reduce the public capacity requirement for the long-term case of year 2060 estimates before adding an additional processing line.

(6) Facility costs are for construction capital costs of facilities only and are calculated using the design capacity. Costs do not include purchase of land, financing, legal, engineering, or operation and maintenance costs.

(7) Assume costs of reference facilities are escalated per year, based on the average ENR'S Construction Cost Index annual increase (1990-2017):

(8) Assumes costs of reference facilities are escalated based on ENR's Cost Index by 20 Cities as of April 2018.

(9) Percentage of recylcing rate comprised of yard trash is included in the percentage reported for the Bulky Waste/Yard Trash/C&D Facility.

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