Reimagined and Renewed

Mayor's Advisory Task Force Draft Plan

Arredondo, Zepeda & Brunz, LLC | New Gen Strategies & Solutions, LLC | Risa Weinberger, & Associates | EnFocus Strategies | Tetra Tech

PART I – EXECUTIVE SUMMARY

PART II – BACKGROUND & ANALYSIS

PART I

Executive Summary

"*We are here to protect the health of all Houstonians. We are also here to enhance the community's environment and respond to the needs of the community in times of emergency. The staff of the Houston Solid Waste Management Department (SWMD) understand the critical nature of the service we provide and the need to assure that over the long-term, the City of Houston has a reliable and comprehensive program to address our municipal solid waste needs.*" - Director Harry Hayes speaking on the SWMD's critical role in protecting the health and environment of the Houston community.

Without much thought, Houston residents place their carts filled with either municipal solid waste (MSW) or recyclables at the curbside. Residents may also be placing their junk waste or tree waste at the curb. At the end of the day, the carts are empty. At the end of the week, the tree waste or junk waste is gone. Few understand the nature of collecting and managing their trash or recyclables as it is, indeed, a complex process. A process that requires constant evaluation and planning in order to provide the level of service Houstonians expect.

The MATF was responsible for developing plan goals and objectives; prioritizing programs and policies; reviewing and approving the Integrated Resource Recovery Management Plan.

In late 2018, the City selected a consulting team to assist the City prepare a long-term solid waste management plan. The "Project Team" includes the firms of Arredondo, Zepeda & Brunz LLC, New Gen Strategies and Solutions, Tetra Tech, Risa Weinberger and Associates and EnFocus Strategies. In 2019, Mayor Turner appointed a Mayor's Advisory Task Force (MATF) to help prepare a long-term solid waste management plan. The Integrated Resource Recovery Management Plan ("Plan") is intended to identify the City's needs, resources, and approaches to addressing waste management through the year 2040. One of the MATF's primary responsibilities was to develop goals and objectives for the Plan. Specific goals of the Plan, as approved by the MATF, are presented below, and detailed in Part III, Section 7 of the Plan.

- Achieve financial sustainability for solid waste services;
- Increase source reduction, material reuse, recycling and organics diversion while also decreasing environmental risks of waste disposal in landfills;
- Continue to provide quality solid waste services to the residents and businesses of Houston;
- Ensure long-term disposal capacity and sustainable solid waste infrastructure;
- Provide solid waste management services in a safe, equitable, responsive, and environmentally responsible manner.

Background

Houston is the 4th largest city in the country. With a population of 2.3 million people, the City has grown dramatically over the past ten years. It has a vibrant economy that generates over 1.8 million jobs. As a growing city, it faces serious challenges in meeting basic infrastructure needs. Major construction projects can be seen across the City to resolve issues related to transportation, water service and other needs. The City's close proximity to the Gulf of Mexico places it in the path of strong storms and hurricanes – becoming more prevalent in recent years. Each of these factors – a growing population, a strong economy, traffic congestion and storm events - impact the City's solid waste management needs as detailed in Section 3.

City of Houston

4th largest city in the U.S.

2.3 million people

671 square miles

Waste Management Needs & Facilities

To understand current and future solid waste management needs, the Project Team prepared a Waste Generation Report and a Facilities Report. These reports are summarized in Part II, Sections 4 and 5 of the Plan. In one year, City residents and businesses generate 4.2 million tons of MSW that has to be collected, transported, and disposed. By 2040, with no changes in waste management practices, generation is estimated to increase to 5.3 million tons per year.

It might surprise Houstonians to know how much material is being recycled in the City.

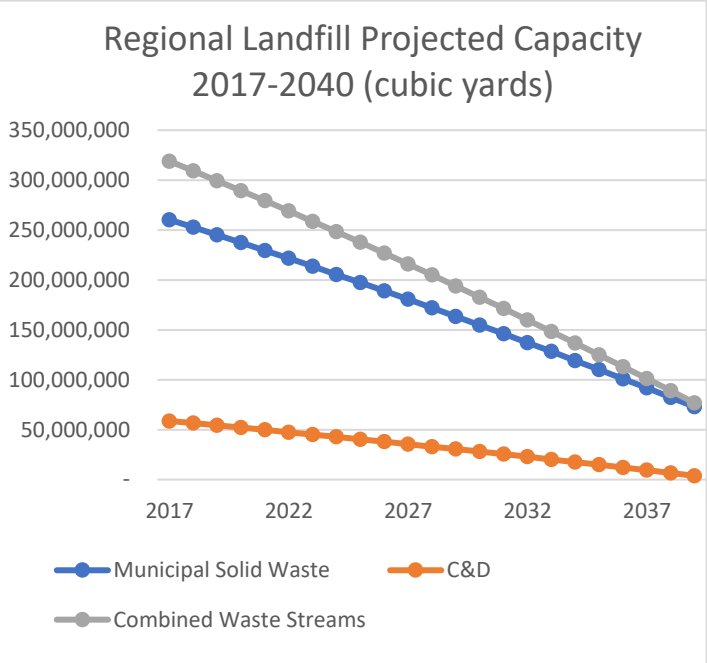
A review of a variety of sources and interviews with local businesses indicates that approximately 2 million tons of materials, organics and construction and demolition (C&D) material are recycled each year – the majority of which is C&D material.

Once collected, recyclable materials are either taken directly to market or a materials recovery facility (MRF). In the case of the recyclables set out at the curb, these materials are taken to the FCC MRF located in northeast Houston. Organic materials are processed into either mulch or compost at privately owned facilities. In order to efficiently transport waste and materials to the appropriate facilities, the City owns three transfer stations that are used to transfer MSW from collection vehicles to more efficient transfer trailers.

Forecast Waste Generation

FCC Material Recovery Facility opened in 2019 to process Houston residential recyclables

MSW is disposed at one of the region's 12 MSW landfills or 15 C&D landfills. Landfill capacity in the region is a major issue in terms of meeting future disposal needs. Currently, there is approximately 30 to 40 years of remaining capacity in the region. **By the year 2040, unless there are major landfill expansions, only 5 of the 12 MSW sites will still be in operation. Landfills in the region are privately owned and operated. By 2040, all C&D landfill capacity is projected to be consumed.** This assumes that as landfills reach capacity, the waste normally accepted at the closed facility must go to an alternate site. As more landfills reach capacity, greater quantities must go to fewer landfills, thereby accelerating the time they would reach capacity. For example, if a landfill currently has 60 years of capacity, the additional waste could reduce its capacity by 30 years. Without major expansions or new sites, landfill capacity will shrink from over 350 million cubic yards (267 million tons) to less than 100 million cubic yards (75 million tons) by 2040. Each year, the Houston-Galveston Area Council (H-GAC) region disposes approximately 10 million tons, which is anticipated to increase with increases in population.



City Services

The City has a state mandated obligation to provide for the proper collection and management of MSW. By law, MSW has to be collected at least once per week. The City provides direct collection service to over 396,730 households; approximately 55,000 households receive collection service through sponsorship programs. The City has ordinances in place that require owners of multi-family buildings and businesses to arrange for collection of MSW at least once per week.

SWMD provides…

- Public Education
- Weekly MSW collection
- Every two week recyclables collection
- Weekly collection of yard waste
- Storm debris collection
- Collection of junk waste and tree waste
- Operation of depositories & recycling centers
- Illegal dump site clean-up
- Assuring disposal capacity
- Tire recovery program

Managing MSW also means providing services that reduce the overall environmental impact of its generation. The City's program focuses on ways to encourage residents and businesses to reduce MSW, increase recycling and manage yard waste and tree waste properly. Some of the key services provided by the City are presented on the right. A more detailed description of these services is presented in Part II, Section 2.

Options & Recommendations

The Project Team presented to the MATF an analysis of the City's current waste and resource management program and identified a range of options designed to achieve their goals and objectives. Part II, Section 6 of the Plan identifies a range of options. Part III, Section 7 provides specific goals and objectives and Part III, Section 8 presents Plan-specific recommendations. The key recommendations of the Plan related to these goals are presented below.

1. Achieve Financial Sustainability for Solid Waste Services

The program is also significantly under funded by an estimated $20-$40 million. **The recommended solution is for the City to establish an Enterprise Fund, similar to the City's water and wastewater utility. The Enterprise Fund would provide a more secure funding mechanism for the City. The Enterprise Fund should be funded through a monthly service fee and an environmental fee. The monthly service fee would apply to all single-family residents receiving City services. It is estimated that the monthly service fee would be in the range of $20 to $25 per household per month. The actual fee would be determined by evaluating capital needs including fleet, labor costs, disposal costs and the City's needs to improve overall service and implement several of the recommendations made in this Plan to extend landfill capacity through source reduction, recycling and organics management.**

Unlike almost every other large city in the country, the City of Houston's waste and resource management program is funded through the General Fund.

An environmental fee would apply to all single and multi-family households, as well as businesses and institutions in the City. The environmental fees would vary depending on whether the payer is a single-family household, multi-family household, or business. For single family residents receiving City services, the fee is estimated to be approximately $5.61 per month. ***The total environmental fee from all sectors is proposed to generate $44 million annually to pay for:***

- ***illegal dumping clean-up,***
- ***increased enforcement of City-codes,***
- ***homeless camp clean-ups,***
- ***more depositories,***
- ***education,***
- ***equipment readiness,***
- ***container lease and management, and***
- ***future disposal capacity.***

Residents receiving City services would pay monthly fees of $21 to $26 per month for both the monthly service fee and the environmental fee. A review of other major Texas cities shows that their combined fees range between $16 and $51.80 per household per month; the average for 16 major metro areas in the country is $36 per household per month.

The MATF expressed concern for the financial burden that the fees would place on low-income individuals. The City currently has in place the W.A.T.E.R. Fund Program. This Program is funded entirely through donations but is administered by the City. The program's purpose is to provide financial assistance to low-income individuals who need assistance paying their water bills. Such a program could potentially be expanded to include solid waste fees.

The combined funds would increase the SWMD budget to a level that would provide the SWMD the resources to improve the quality of services provided and meet the future challenges. These challenges include the following.

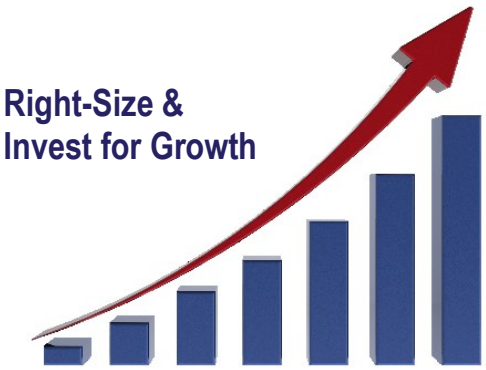
- **Increased population**
- **Replacement of collection vehicles on a regular basis**
- **Future storm events**
- **Illegal dumping & homeless camp clean-up**
- **Need to increase resource recovery**
- **Diminishing landfill capacity**

2. Increase source reduction, material reuse, recycling and organics diversion while also decreasing environmental risks of waste disposal in landfills

To preserve landfill space and to reduce the environmental impacts of MSW disposal, the MATF recommends a number of new initiatives for the City to implement. These programs are designed to reduce MSW generation, encourage more recycling and assist in the development of markets for recyclable materials and recovered organics. **It is critical that multi-family residences and commercial businesses be part of this solution as they represent 82% of the waste generated in the City. The Plan envisions a long-term partnership between the public and private sectors to work together to address this issue.**

3. Continue to provide quality solid waste services to the residents and businesses of Houston

As discussed above, the City provides a wide range of services that are designed to provide reliable and efficient service to Houston residents. **The SWMD's program needs to be RIGHT-SIZED.** An analysis of the City's program in comparison to other cities shows that Houston employees serve nearly twice as many households per employee than the cities of Dallas, Austin, and San Antonio. **The City's program needs to continue to replace older trucks, hire more staff and add routes to meet the needs of residents as the City grows.**



4. Ensure long-term disposal capacity and sustainable solid waste infrastructure

Currently, there is no silver bullet for making waste go away. Technologies continue to evolve to help move toward a future of zero waste, but it is unlikely that during the planning period, the City's reliance on landfills will come to an end. Securing new disposal capacity is increasingly more difficult to achieve. Under the best of circumstances, securing a new landfill will take between 10 and 15 years to site, permit and construct. The City should continue to monitor landfill capacity in the region. **The City should begin the process of identifying potential sites for future disposal facilities and move to permit and construct its own landfill. Once established, the City can operate with City staff or contract operations as it does with its transfer stations.**

5. Provide solid waste management services in a safe, equitable, responsive, and environmentally responsible manner

The City is committed to providing service in a safe, equitable, and responsive manner. The Plan addresses issues related to improved safety and the need to be equitable as demonstrated by recommending new depositories throughout the City with **recognition that any new facilities take environmental justice into consideration. The MATF also recommended additional actions be taken to address the City's illegal dumping problem. More resources need to be made available including equipment, crews, and depositories to reduce illegal dumping and improve the way illegal dumping ordinances are enforced.**

Covid-19 and Solid Waste Management

The preparation of this Plan was initiated long before Covid-19 was an issue. Our focus was to develop strategies that are designed to provide quality services to Houston's residents in a cost-effective manner while addressing future solid waste management needs. The implications of Covid-19 for the SWMD are dramatic, especially for a department where the safety of SWMD staff has always been a high priority. SWMD staff have not been immune from the virus or its consequences.

Covid-19 has significantly affected the entire solid waste industry. Maintaining a safe working environment for essential service providers has required a significant shift in operations. For example, the SWMD's facilities such as the Environmental Service Department must operate in a manner that promotes social distancing and worker safety. Safety meetings take on a whole new importance as SWMD management addresses staff concerns regarding Covid-19 and how best to avoid becoming infected. Without a vaccine for the virus available, the City and other solid waste service providers will have to develop innovative ways to be able to continue to provide vital solid waste services while protecting the health of their staff.

PART II – BACKGROUND & ANALYSIS

1.0 Introduction & Purpose

"A long-range plan is good governance for today and tomorrow. It provides the City's leadership, citizens, environmental groups and businesses with a best practices roadmap to Houston's future and its array of solid waste services, programs and regulations. ***This Plan addresses our most pressing needs, including the need for financial stability for the valuable services provided to residents by the City, a more aggressive program to reduce waste going to landfills and assuring long-term disposal options for the City's residents and businesses.*** I want to personally thank the members of the Mayor's Advisory Task Force for their assistance in preparing this important plan."

Harry Hayes
Solid Waste Management Director

Houston residents rely on the City to provide quality solid waste management services to protect the health and environment of the community. To fulfill this obligation, the City provides a range of services to residents including the collection and proper management of recyclables, organics, and residential waste. The City also requires the business community to act responsibly in the management of its waste. Because of the complex nature of municipal solid waste (MSW) management, it is necessary to periodically evaluate the City's waste management system and develop action plans to ***improve services, enhance the City's environment and assure long-term disposal capacity. This Plan includes a move towards sustainable materials management as recommended by the US EPA.***

The **Integrated Resource Recovery Management Plan ("Plan")** presents a comprehensive program that is intended to accomplish the following.

- Reduce the amounts of waste generated.
- Encourage greater material recycling.
- Reduce food waste and increase organics diversion.
- Improve the quality of service to residents.
- Combat illegal dumping.
- Assure long-term disposal capacity for municipal solid waste.
- Encourage the development of new technologies for reducing waste and recovering materials.
- Establish a sustainable fiscal program to provide SWMD services.

The planning period is 2020 through 2040. The Plan provides the City with recommended strategies that address City solid waste management needs through the planning period.

RESPONSIBILITIES: On a daily basis, Houston residents and businesses generate over 11,500 tons of MSW (a.k.a. trash), or 4.2 million tons per year. The management of MSW requires an integrated system that includes the following tasks:

- Collection of household garbage, recyclables, yard waste, tree waste, junk waste, tires, and household hazardous wastes;
- Enforcement of City policies that require apartment owners, businesses, and institutions to properly collect, process and dispose their waste;

- Utilization of transfer stations to reduce costs and the number of trucks traveling from collection points to final disposal and processing sites;
- Recovery of recycled materials at materials recovery facilities (MRFs) or one of several Houston businesses providing recycling services;
- Operation and maintenance of recycling centers, depositories, and environmental services centers to provide additional collection and recycling opportunities;
- Production of useful mulch and compost at one of several local facilities that process yard waste, brush, and a small amount of food waste;
- Management of wastes that are generated as a result of major storm events such as Hurricane Harvey and Tropical Storm Imelda;
- Disposal of MSW in one of the region's 27 permitted operating landfills;
- Collection and proper disposal of waste illegally dumped at dump sites located throughout the City.

Working Towards Zero Waste

Some local solid waste management plans seek to eliminate all waste generated within its community. This Plan is intended to identify pathways towards zero waste. **The plan presents realistic strategies that will require a blend of public policies and programs that will encourage actions throughout the Houston community. These actions include a blend of education, incentives, and enforcement.**

CHALLENGES: It must be recognized that to meet future challenges, the City must maintain a high degree of flexibility and responsiveness to these challenges. Some of the challenges associated with future waste management can be readily predicted, such as the expectation that the Houston region will continue to grow in population and Houston will continue to experience major storm events. Other factors such as those listed below are less certain.

- Potential storm events that are significantly greater than normal - similar to the magnitude of Hurricane Harvey
- Long-term economic conditions, specifically the availability of markets, and revenue for recycled materials
- Changes in the way products are manufactured and packaged that may affect the amount of waste generated and the types of waste generated
- The competitive nature of the local workforce affecting the availability and cost of collection crews and other SWMD staff
- Advances in technologies for processing materials including MSW
- Federal, State, or local laws that could affect collection or disposal
- Decisions by local solid waste businesses that could either increase or decrease regional landfill capacity

FINANCES: Houston's FY 2021 solid waste management program is currently budgeted at $88.9 million. The City also has a Recycling Revenue Fund to pay for materials processing, recycling collection vehicles, intradepartmental transfers and other efforts, which has a budget of $4.9 million. The Plan evaluates the City's financial resources in comparison to its core services and the need to enhance the local environment which may require an expansion of core services.

In comparison to other large cities and across the US, Houston's solid waste budget is extremely underfunded.

In May 2020, the City adopted a cart lease program. This program is anticipated to raise approximately $5.0 million per year.

The Project Team prepared comprehensive documents that were presented to the MATF as part of the planning process. These documents are considered appendices to the Plan and include the following.

- Waste Generation Report
- Facilities Report
- Waste Management Activity Analysis – Part 2

- Waste Management Activity Analysis – Part 1 Source Reduction, Recycling, Organics, Illegal Dumping
- Waste Management Activity Analysis – Part 2 Collection, Transfer Stations, Resource & Energy of Recovery, Landfill Disposal
- Strategic Analysis Report

History of Solid Waste Planning in Houston

Since 1988, the City has prepared a range of solid waste management plans and program reviews. Below is a summary of the key prior planning initiatives.

1988: Solid Waste Department published a 20-year plan for Houston Solid Waste Services.

1990: Mayor Kathy Whitmire commissioned the Citizens Advisory Committee on Solid Waste Disposal Solutions. The City also contracted with a consulting team to guide the committee and write the plan. Some of the key recommendations of this plan include the following.

- The City should initiate an integrated system to meet the City's long-term waste disposal needs. The integrated approach includes source reduction, recycling (including composting), waste incineration and landfilling.
- The City should implement an aggressive source reduction and recycling program. These are the preferred methods of waste management because these programs conserve natural resources and reduce the need to combust or landfill waste.
- The City should initiate actions to acquire and permit its own landfill for waste generated by the City's residential sector. *At that time, the City did not own a landfill; therefore, it relied on privately owned sites to meet its disposal obligations.*
- The City should continue to examine incineration, either in the form of waste-to-energy or for volume reduction specifically. (The economic conditions at that time - low landfill costs and low energy prices, did not favor implementation at that time.)
- The City should establish a dedicated waste management enterprise fund for collection and disposal of solid waste.

2006: Mayor Bill White commissioned the Solid Waste Task Force to review Houston's solid waste management programs and services. The Task Force was chaired by then Controller Annise Parker and Sanifill CEO Lorne Bain. Recommendations from this effort have been adopted or implemented, with the exception of a proposed enterprise fund.

2016: Mayor Sylvester Turner authorized procuring services for this Integrated Resource Management Plan (Zero-Waste Plan) to guide the City's decisions for the next several years. A contract was approved in late 2018. This Plan is the outcome of that contract.

Other Plans Affecting Solid Waste

Climate Action Plan

In 2017, Mayor Turner made the commitment that Houston would adopt, honor, and uphold the goals of the Paris Climate Agreement. The Houston Climate Action Plan is designed to identify measures that can be adopted by the City to achieve these goals. The Integrated Resource Recovery Management Plan considers the material management recommendations developed for the City as part of the Climate Action Plan.

Disaster Debris Management Plan

The City of Houston Emergency Management Plan provides strategic guidance for City departments in the event of an emergency. The plan, which consists of a Basic Plan and functional annexes, is evaluated every five years on a rotating schedule. Annex W of the Emergency Management Plan is the Debris Management Plan. The City also maintains contracts for the management of disaster events and for the supplemental collection services that may be required during and immediately following a disaster event.

Houston Resiliency Plan

Resilient Houston is based on five themes that emerged from the "discovery areas" identified in the Resilience Assessment and used by Resilient Houston working group members to organize their approach to increasing resilience in Houston. These themes include the following:

- A Healthy Place to Live
- An Equitable and Inclusive City
- A Transformative Economy
- A Leader in Climate Adaptation
- A City That Grows Up, Not Out

Planning Process

Project Team Selection

In 2016, Mayor Turner recommended to the City Council that the City needed to evaluate the current solid waste management program and develop a long-term waste management plan. The Houston Solid Waste Management Department (SWMD) is the lead City agency responsible for managing the planning process. In late 2018, the City selected the consulting team of Arredondo, Zepeda & Brunz LLC, NewGen Strategies and Solutions, Risa Weinberger & Associates, Tetra Tech and EnFocus Strategies (the Project Team) to develop the Plan.

Plan Development

Development of a long-range plan required the following steps:

1. Examining the City's current solid waste program;
2. Evaluating factors that could influence needs in the future;
3. Understanding the available, current resources for managing waste and recyclables;
4. Developing, with community input, goals and objectives for the future solid waste management program;
5. Identifying strategies that will move the City toward achieving stated goals and objectives;

6. Securing public input into the Plan's preliminary approach; and
7. Finallizing the Plan and securing Mayor and City Council approval of the Plan.

Community Input

Mayor's Advisory Task Force
To provide sufficient public input into the process, the Mayor formed the Mayor's Advisory Task Force (MATF). The MATF is comprised of individuals representing neighborhood groups, academia, recycling interests, environmental groups, regional organizations and the solid waste industry. Members of the MATF included the following individuals.

MATF Task Force Members

Academic
Abate T. Wolde-Kirkos PhD

Apartment Industry
Andy Teas

Community Representatives
Becky Edmunson
Jessica Hulsey
Allen Goodlow
Debbie White
Rogene Calvert
Vincent Sanders
Amy Boyers

Composting Industry
Lora Hinchcliff
Justin DuBose

Construction / Demolition
Joe Rizzo

HARC
Andra Wilcox

H-GAC
Cheryl Mergo

Non-Profit Organization
Rachel Powers

Recycling Industry
Andrea Rodriquez

Solid Waste Industry
Brandon Rogers
Shanna Lopez
Brett Sarver

The MATF met at various times throughout the planning process. The input from the MATF has been extremely valuable to the development of this Plan. The MATF accomplished the following tasks:

- Developed goals and objectives;
- Assisted with the development of a public input survey;
- Provided input into community policies;
- Reviewed the findings of community input efforts including presentation at public meetings; and
- Reviewed and approved the draft and final Integrated Resource Recovery Management Plan.

Public Input

The SWMD anticipated implementing a number of in-person public meetings to gain input from the citizens regarding the direction of the Plan. However, Covid-19 has had an impact on the ability to hold large-scale public events. Online public meetings, sponsored by SWMD, will be held virtually to receive public feedback about the DRAFT Plan.

In addition, a variety of online survey and web applications will be used to gather and analyze public input. The SWMD will evaluate all input and update the Plan as necessary. The website created for the Plan provides information about the Plan including the project approach, documents and overall transparency to the public. A report on the public comments will also be presented as an appendix to the FINAL Plan.

2.0 Current Solid Waste Management Program

Key Points

1. The City relies on the General Fund to pay for solid waste management services. *The 2021 SWMD Budget is $88.97 million. In comparison to other large-scale Texas cities, this amount is significantly less than what other cities spend per household for solid waste management services.*
2. The use of General Fund revenues is uncharacteristic of most large cities. *Most large-scale cities in Texas and across the country recover the cost of service through a user fee or a special assessment, funding an enterprise fund.* For the four cities that were evaluated for comparison as part of this Plan, San Antonio, Dallas, Austin and Fort Worth, the range of monthly fees, including environmental fees, were $22.75 (Fort Worth), $27.26 (Dallas), $29.00 (San Antonio) and $50.80 (Austin).
3. ***A comparison to other cities in Texas shows that Houston's staffing level is approximately ½ of what other communities have to provide similar services.*** The City's collection program is staffed at a rate of 908 households per employee compared to 400 to 500 households per employee in the four comparison cities identified above. This places extreme stresses on the current staff and is a major contributor to the high rate of turnover in the Department. ***There is a significant need to right-size the Department for current and future services provided.***

4. ***The City's collection program relies on equipment that is in need of replacement.*** Approximately 50% of the trucks (side load, recycling and rear load) are over seven years old. Older trucks generally break down more often, require higher costs to maintain, and generate more emissions than newer trucks.
5. The City provides solid waste and recycling collection services to 390,786 households each week. In 2019, the City collected a total of 802,585 tons of MSW, bulky waste, recyclables and organics.
6. The City provides collection services to Houston residents designed to reduce the amounts of waste requiring disposal. These services include every other week collection of recycable materials at the curb, operation of depositories and recycling centers, and the separate collecton of yard waste and tree waste. Because 2018 included Hurricane Harvey, recycling efforts were curtailed for a portion of the year. In CY 2019, a total of 99,550 tons of recyclables, yard waste and wood were collected for recovery, or 12% of the waste collected.
7. The City's solid waste facilities include 6 depositories, 3 recycling centers, 2 environmental service centers, 4 service centers and 3 transfer stations. There are plans to design, permit and construct a 4th transfer station.
8. The City does not own a landfill and instead relies on contracts with private sector landfills.
9. The City provides for the collection of illegal dump sites. Both enforcement and resources available for cleaning up illegal dump sites are issues.

Summary of Services

The SWMD is primarily focused on providing service to single family households. Below is a summary of key services the City provides. Table 2-1 presents a summary of the collection services that are provided by the City, frequency of collection, and types of materials selected. Table 2-2 presents a summary of the tonnages collected from these various programs. The City's solid waste ordinance (Chapter 39 of the City Code) defines the services the City must provide as well as regulations related to solid waste management provided by both the public sector and the private sector.

Table 2-1
Houston Single-Family Residential Solid Waste Collection Services

Service	Frequency	Materials	Container
Residential Garbage	Weekly	Municipal Solid Waste	96-gallon carts
Yard Waste	Weekly	Grass clippings / leaves, brush	Compostable bags (not to exceed 50lbs) and small branches (less than 4' in length)
Residential Recyclables	Every two weeks	Paper and cardboard, glass, plastics #1-5 and 7, metals	96-gallon carts
Bulky ("junk") waste	Every other month	Junk Waste" is defined as items such as furniture, appliances, and other bulky material.	No more than 8 cubic yards may be placed at the curb at once
Tree waste	Every other month	"Tree Waste" is defined as "clean" wood waste such as tree limbs, branches, and stumps. Lumber, furniture, and treated wood are not accepted.	No more than 8 cubic yards may be placed at the curb at once
Dead animal collection	On-call service	For a fee, the City will collect large dead animals	NA
Neighborhood Depositories & Recycling Centers	Up to 4 times per month Hours of operation are Wed-Sunday 9:00 am – 6:00 pm (non-daylight savings time)	Junk waste, tree waste recyclables, used motor oil, and wood fencing	Vehicles larger than two tons and trailers longer than 16 feet are not permitted to use facilities.
Environmental Service Centers	South -Tuesdays and Wednesdays 9 am to 3 pm North - 2nd Thursday of each month 9 am – 3 pm	A variety of household hazardous wastes, batteries, paints and electronic wastes	There are specific limits on various materials that the City will accept.
Mobile Collection	Periodic collection dates throughout the City	Batteries, oil, paint, antifreeze, appliances and scrap metal	15-gallon limit on oil 15-gallon limit on paint 15-gallon limit on antifreeze

Other services provided by the SWMD include the following:

- Collection of illegally dumped waste tires. These tires are sent to tire processors;
- Collection of useable construction material at the City's Reuse Warehouse;
- Emergency response to disaster events such as Hurricane Harvey;
- Collection of waste disposed illegally at illegal dump sites throughout the City; and
- Participation in Keep Houston Beautiful events that are designed to collect litter and illegally dumped waste from communities.

Table 2-2
2019 Houston Waste Collections

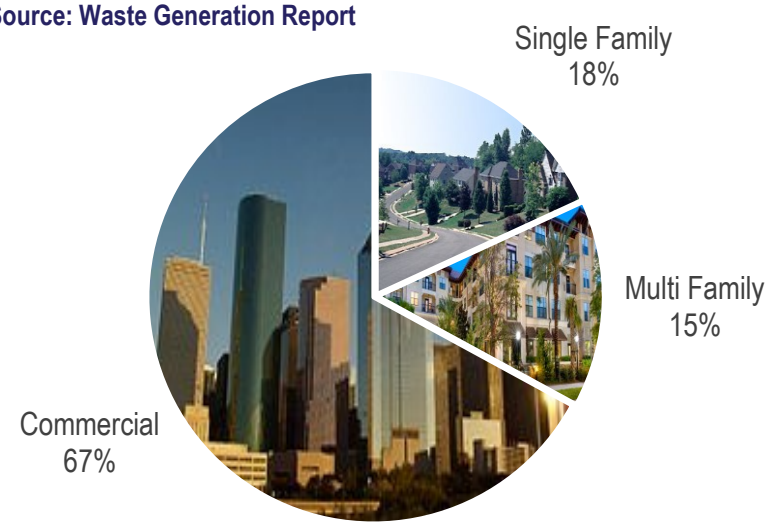
Waste Stream	Tons
Municipal Solid Waste	**433,851**
Bulky Waste (junk waste)	**269,183**
Yard Waste	**11,000**
Tree Waste	**37,360**
Traditional Recyclables	**51,191**
Total	**802,585**

Multi-family and Non-Residential Waste Collection & Management

Multi-family and Non-residential waste accounts for approximately 82% of the waste generated in Houston. This includes waste from apartments, commercial establishments, and institutions such as schools, hospitals, and industries.

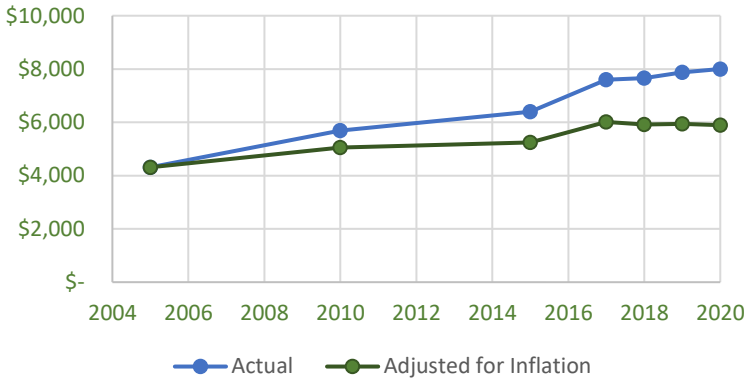
The City's Solid Waste Ordinance (Chapter 39) states that *"Property owners shall ensure that solid waste collection services are provided on a regularly scheduled basis to collect all solid waste generated or accumulated on their property. Such schedule will be established to ensure that solid waste is collected at least one time per week or more frequently if required..."* Waste generated by non-residential sources and multi-family residences are collected by the private sector and taken to one of the several facilities identified in this report for either recycling, processing, or disposal.

Figure 2-1
Sources of Waste (2019) -
Source: Waste Generation Report



Businesses in the City are responsible for arranging for the collection and proper disposal of MSW. Typically, businesses contract with a private hauler to collect their waste, and recyclables if applicable. It is a competitive market. Rates for collection of materials from multi-family and non-residential sources in Houston are determined by the size of collection container and the frequency of collection.

Figure 2-2
Historic Solid Waste Franchise Fees ($1,000)



Private haulers providing services to businesses in the City must pay a franchise fee to the City. This franchise fee is to compensate the City for the cost associated with the haulers impacts to City streets and other City infrastructure. The fee is set at 4% of gross revenues from transporting commercial solid and industrial wastes that originate within the City limits. The estimated FY 2019 total solid waste franchise fees collected was $8 million. Assuming a 4% rate, the total gross revenues generated by the 142 active solid waste haulers is $200 million. In addition to the franchise fee, companies are required to secure annual dumpster permits that vary in proportion to the size of the containers.

Figure 2-2 illustrates the franchise fees that have been generated over the past several years. The figure illustrates that since FY 2005, the fees have increased by 85% in actual value from $4.1 million to $8.0 million in FY 2020. When adjusted for inflation, these revenues increased 36% from $4.1 million to $6.0 million. Based on a review of employment and inflation data over this timeframe, the data suggest that per employee generation rates for businesses and institutions during this period have increased, not decreased. Compliance with the franchise fee should be monitored to assure the City recieves proper reimbursement.

Program Funding

The SWMD is funded through the General Fund. This is unlike most other large cities across the country who rely on a Monthly Residential Service Fee and in some cases an Environmental Fee to pay for the cost of solid waste management services. These cities established an Enterprise Fund to pay for the cost of collection, processing, and disposal. The use of an Enterprise Fund would allow the SWMD to function similar to a private enterprise. Environmental Fees are established to pay for services that do not benefit only single family residential households, including clean-up of illegal dump sites, construction and operation of regional depositories and recycling centers, and public information programs that address residential, commercial, multi-family and institutional sectors.

The SWMD FY 2021 budget is $88.97 million. This budget supports the contracts for services, salaries and benefits associated with employees from the General Fund who are involved in SWMD community outreach efforts.

There is also a special revenue fund referred to as the "Recycling Revenue Fund" that was created to allocate dedicated funds to be used for the expansion and implementation of the City's Recycling Programs. The majority of these funds are used to pay for processing single stream recycled materials. Other programs include citywide tree waste recycling, additional neighborhood depository sites, and increased education and outreach. For FY 2021, the Recycling Revenue Fund amount is budgeted at $4.9 million. The portion of the budget allocated for education is funded through the education contribution fee paid by the recyclable materials processor, per the processing contract. The Recycling Revenue Fund pays the salaries of 4 FTE positions to manage recycling contracts, education and outreach programs.

Enterprise Fund – A fund that is established for the sole purpose of providing a municipal service. The Houston Water Department is an example of a service funded through an Enterprise Fund.

Monthly Residential Service Fee – A fee that is charged to all residents receiving solid waste services such as weekly collection of garbage.

Monthly Environmental Fee – A fee that is charged monthly to all residents and businesses. For certain communities, the Environmental Fee is referred to as a Clean Community Fee or similar name that reflects the use of the funds. Environmental Fees are often designed to pay for those services that affect the entire City, such as clean-up of illegal dump sites and operation of depositories.

Table 2-3 presents the SWMD's budget from 2005 to 2020. The table shows that the SWMD's budget has increased from $61.1 million in 2005 to a combined $90 million in 2020 (including SWMD General Funds and Recycling Revenue Funds). Three factors have had an impact on the SWMD budget since 2005.

- Since 2005, the number of households has increased from approximately 288,000 to over 390,000.
- The cost of providing service over the 15 years is approximately 15% higher than 2005. ***The budget per household has actually decreased from 2005*** due to inflation and fuel price increases***.***
- The level of services provided since 2005 has increased significantly with the addition of single stream recycling, the addition of depositories and increased demands on the SWMD for storm debris management.

Table 2-3 SWMD Budget								
Year	2005	2010	2015	2016	2017	2018	2019	2020
SWMD Budget ($ million)	$61.1	$71.7	$73.7	$76.6	$83.7	$80.5	$87.7	$93.1
Recycling Revenue Fund ($ million)	NA	$2.2	$2.6	$3.3	$6.6	$5.0	$5.3	$4.2
Total	**$61.1**	**$73.9**	**$76.1**	**$79.9**	**$90.5**	**$85.5**	**$92.8**	**$97.3**
FTE	NA	644	438	452	438	428	432	436

Texas Cities – Key Metrics

Table 2-4 provides a comparison of some of the key operational metrics for larger municipal solid waste utilities within Texas, including Houston. It is difficult to compare one municipal solid waste utility to another due to the various services provided, contracting out of certain services, etc. However, there are several factors that are worth noting in a review of the statistics.

- First, the City of Houston provides service to the largest number of households with the least number of employees. The City of Austin has 464 employees versus Houston with 437. Houston provides services to nearly double the number of households as the City of Austin (Austin does provide street and bike lane sweeping in its solid waste program). This has created the need for significant overtime expenses and employee stress.
- Secondly, the City of Houston's per household budget is approximately 51% of the other cities. Regardless of the certain service differences, and frequency of services, etc., this calculation signifies a significant underfunding regarding the City of Houston and its Solid Waste Management Department versus its peer cities.

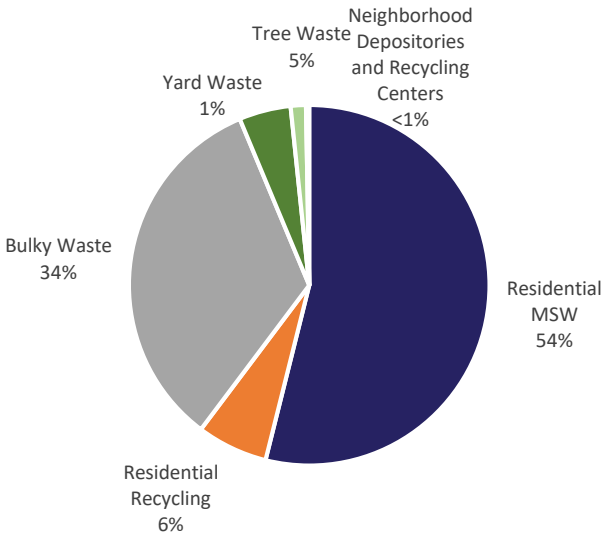
Table 2-4 Texas Cities – Key Metrics (					
	Houston	San Antonio	Dallas	Fort Worth	Austin
Households Served	396,730	356,000	240,000	225,049	200,550
FTEs	437	619	619	116	464
Households Served per FTE	908	575	388	NA	432
Annual Budget (Millions)	$92.8	$145.0	$113.8	$67.7	$97.1
Budget $/Household	$233	$407	$474	$301	$484

1. Does not include private haulers collecting waste
2. Houston's budget includes General Fund and recycling reserve fund
3. Based on FY 2019 budget comparison

Collection Program

The City is responsible for collecting approximately 802,585 tons of recyclables, organics and MSW from single-family residences per year. To provide these services, the City maintains a fleet of collection vehicles, three transfer stations, several depositories and recycling centers and environmental service centers. Figure 2-3 illustrates the distribution of materials collected by the City. The figure illustrates that approximately 12% is collected and sent to either FCC for recyclable material processing or to a Living Earth/LETCO facility for wood and yard waste processing into mulch or compost. Eighty-six percent of MSW and bulky waste is sent to one of the City's three transfer stations (a small amount is sent to private transfer stations). Twenty-five percent of the bulky waste and MSW is sent directly to one of four landfills without using a transfer station. The commercial sector, businesses and institutions including apartments, have the responsibility to provide for their own collection, recycling, and disposal services.

Figure 2-3
Single-Family Residential Waste, Recyclables & Organics Collection



Collection Equipment

To collect waste and recyclable materials, the City operates and maintains a fleet of collection vehicles and other equipment. The City uses the same type of truck for the collection of solid waste as recycling.

Currently, the City is operating trucks that have been purchased between 2005 and 2019. Interviews with solid waste managers in other cities show that it is generally desired to maintain a solid waste fleet of vehicles which have the vehicles replaced on average after 7 years of use.. A review of the City's collection fleet shows that over 50% of the City's operating collection fleet is over 7 years old. Figure 2-4 shows the distribution of truck purchases since 2005. Ideally, a fleet replacement program results in a consistent replacement of trucks over the years. If this had been done since 2005, the City would have replaced 16 to 18 trucks per year. This level of replacement can only be achieved in the future once the fleet has eliminated a large number of the older trucks. For the next five years, it will be necessary to replace between 30 and 40 trucks per year to get to a point where no trucks are more than 7 years old; then the City can start replacing 18-20 trucks per years on a "normal" rotation.

The number of collection vehicles purchased by the City varies from year to year, often determined by the City's fiscal condition. This has resulted in a series of years that experienced unfavorable budget conditions when few or no replacement trucks were purchased. In favorable economic times, the City has tried to catch up and purchase a large number of trucks in one year. For example, in 2007, a total of 68 trucks were purchased. This was also the year the City took back solid waste collection following managed competition. However, in 2013, 0 trucks were purchased for the Solid Waste Management Department. A preferred method is to have a consistent year-to-year program where older trucks are replaced with newer trucks annually. As of 2018, a total of 24 new trucks have been delivered. Another 31 trucks were purchased in 2019.

A consistent fleet placement program yields the following advantages:

- Lower annual capital outlays necessary for collection vehicles;
- Reduced maintenance costs associated with maintaining older trucks. A review of fleet operating costs shows that trucks older than 7 years cost approximately $1 per mile (approximately 30%) more to maintain than trucks less than 7 years old. Total solid waste and recyclables collection miles driven by older trucks was 1.0 million miles of the total 2.6 million miles (does not include brush and bulky collections);
- Greater opportunities to take advantage of technological advances;
- Lower emissions from newer vehicles; and
- Availability of newer technologies.

Table 2-5 presents a comparison of San Antonio's fleet composition and age to Houston's fleet.

Table 2-5
Service & Fleet Comparison to San Antonio (FY 2019)

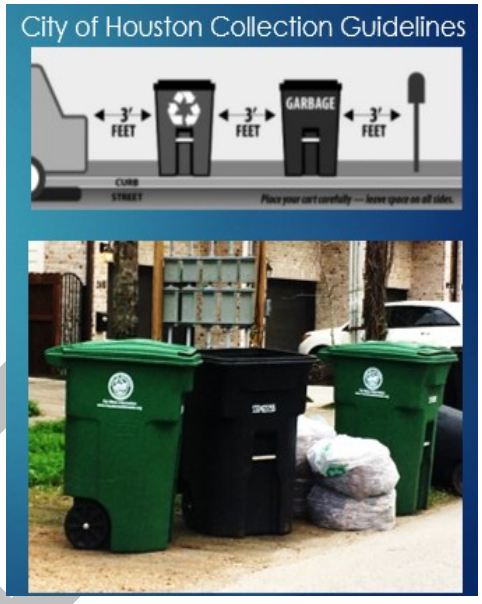
Service	Houston	San Antonio
Residential Customers	390,786	356,000
Age of Residential Collection Fleet	Oldest operating trucks are 17 years old	Oldest operating trucks are 8 years old
Residential Services		
Residential Waste	Weekly	Weekly
Residential Recyclables	Bi-weekly	Bi-weekly
Residential Yard Waste	Weekly	Weekly
Residential Food Waste	Not provided	Weekly
Brush/Tree Waste	Bi-monthly	Semi-annually
Bulky Waste	Bi-monthly	Semi-annually
Number of Side Loaders	208 (42% are older than 7 years old)	185
Number of Rear Loaders	50 (90% are older than 7 years old)	49
Number of Grapple Trucks	42** (70% are over 7 years old)	44
Collection Rate (households / route)	1100	1250
Residential Collection Cost per Household	$18.16 / month – based on City total solid waste budget / number of households	Variable Household Fee averaging $27/month, not including environmental fee.

Staffing

The City currently has an overall staff of 437 in the SWMD. Most of these staff provide collection services. Table 2-4 presented a comparison to other city solid waste staffing. On a per-household basis, Houston employees serve 937 households per Full Time Equivalent (FTE), while the average for San Antonio, Dallas and Austin is 456 households per FTE position. Fort Worth relies on private sector haulers, so its FTE positions do not provide a meaningful comparison. It should be noted that each city differs in the types of services provided; however, there is a clear difference in the level of staffing between these four cities. In 2019, the City budgeted for the equivalent of 38 FTE positions in overtime costs. The following are issues affecting full staffing:

- Non-Competitive salaries;
- Perceived working conditions in solid waste business; and
- Low unemployment (during development of the plan).

Figure 2-5
Container Placement



Increased Density and Its Impact on Collection Services

There is an increasing trend of converting neighborhoods that once were primarily single family households to higher density housing. This trend has created unique problems for Houston's solid waste collection crews. The City's guidelines require proper placement of collection containers to allow for efficient collection. However, due to the density of housing in certain neighborhoods, these requirements are not adhered to, causing problems for automated collection crews. Figure 2-5 illustrates how increased density has presented issues. In the future, the City will have to develop specific strategies for providing efficient collection services in these areas.

Sponsorships

Section 39-64 of the City's code of ordinances allows Homeowners Associations (HOA) and one civic association (CA) to arrange for their own solid waste management services and be reimbursed at a fixed rate by the City. "Sponsorship agreement means a reimbursement agreement between the City and an HOA or CA or other qualified entity for the purpose of partially offsetting the cost incurred by the association or qualifying entity in assuming the responsibility for all basic garbage collection service to residential units eligible for such service pursuant to Chapter 39 in certain defined areas of the city." A total of 50,511 households are currently served through sponsorships in 164 HOAs or CAs.

HOA's or CA's with sponsorship programs act as independent entities and are responsible for the supervision and day-to-day administration of the collection service contracts. Private collection companies contract with the homeowners' associations to provide service, and the City reimburses the associations for the cost of solid waste services provided, not to exceed an amount established by City Council. The communities served through homeowners' associations are responsible for costs above the amount allocated by Council. Currently, the maximum amount reimbursable is $6.00 per month per service unit authorized in the sponsorship agreement.

If the City adopts a monthly solid waste management fee, new policies will have to be adopted regarding the City's relationship with homeowners who live in sponsorship areas.

Curbside Recycling Program

The City provides residential curbside collection to 390,786 households within its service area, including weekly garbage collection, weekly yard waste collection, every other week recycling collection, and once per month tree waste/junk waste collection (in alternating months). These residential customers are provided with automated collection of garbage and single-stream (i.e. paper and containers comingled) collection of recyclables. Each residential customer is provided with a black 96-gallon roll cart for garbage and a green 96-gallon roll cart for recyclables collection. While the City has provided residential curbside recycling since the early 1990s, the transition to automated, single-stream recycling began in 2009.

Recyclable materials included in the City's program ("program materials") include the following:

- Paper: Newspaper, magazines, catalogs, junk mail, office paper;
- Plastic: Containers No. 1 through 5, and 7; examples include water and soda bottles, milk jugs, yogurt cups, detergent bottles;
- Aluminum cans and foil;
- Steel and tin cans;
- Glass;
- Cardboard (flattened); and
- Cartons: gable top and shelf stable cartons, juice cartons, soup cartons, soymilk/alternative milk cartons.

As shown in Table 2-6, the curbside recycling rate has declined in recent years. It should be noted that glass was removed from the single-stream curbside recycling program in March of 2016 due to cost concerns, and glass drop-off locations were offered instead through a partnership with Strategic Materials Inc. Along with a new processing contract with FCC, glass was reinstated into the curbside program in April of 2019. In Fiscal Year 2018, the curbside collection programs for both recycling and yard waste were briefly suspended due to Hurricane Harvey, which may account for some of the decline in tons collected through curbside programs and, therefore, recycling and diversion rates in FY 2018. ***Quantities projected for FY 2019 are anticipated to increase back to prior year levels.***

The City collects recyclable materials once every two weeks as discussed in the recycling section of this report. Key issues related to recyclables collection include the following:

- High levels of contamination in the material;
- As participation rates in the recycling program increase, more trucks and staff must be directed to the recycling program. This could result in reductions in available MSW collection vehicles and staff.
- Distances that recyclables now have to be hauled as the City relies completely on the FCC facility which is located in northeastern Houston; and
- In order to supplement City collection vehicles and crews, the City contracted for a private firm to provide recycling collection services in the northwest quadrant of the City. This is anticipated to be a short-term contract, with the City providing services as soon as fleet and staffing needs are addressed.

Recycling & the Circular Economy

"Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- **Design out waste and pollution**
- **Keep products and materials in use**
- **Regenerate natural systems"**

https://www.ellenmacarthurfoundation.org/circular-economy/concept

	FY 2016	FY 2017	FY 2018 [2]
SF Curbside Recycling (Tons)	62,287	51,497[1]	36,595
SF Yard & Wood Waste (Tons)	54,479	54,569	30,612
SF Bulky Waste (Tons)	287,064	174,742	195,829
SF Curbside Garbage (Tons)	385,660	431,717	445,397
Total Tons[3]	789,490	712,525	708,433
Curbside Recycling Rate	7.89%	7.23%	5.17%
Curbside Yard & Wood Waste Diversion Rate	6.90%	7.66%	4.32%
Total Curbside Diversion Rate	14.79%	14.89%	9.49%

1. **Glass was removed from the curbside recycling program in March of 2016.**
2. **The curbside collection program for recycling and yard waste was briefly suspended in FY 2018 after Hurricane Harvey.**
3. **This only includes tonnage collected by the City of Houston's Solid Waste Management Department.**

All recyclables collected by the City are processed and marketed by FCC with whom the City recently signed a 20-year contract. The City owns the $23 million plant under the contract, although FCC manages operations and maintenance. Curbside recyclables are delivered to the FCC MRF, which has an annual capacity of 145,000 tons.

Tree Waste and Bulky Waste Collection Service

Houston provides residents receiving City collection service with collection of both tree waste and junk waste. Collection of tree waste occurs in January, March, May, July, September, and November. Bulky waste is collected February, April, June, August, October, and December. The City maintains one fleet of trucks for collection and transport of both tree waste and bulky waste. Some of the same issues related to age of fleet are true for these trucks as well. The SWMD has tree grapple trucks that were purchased in 2001. The median age of the 42 tree grapple trucks is ten years. Table 2-7 shows the tons of tree waste and bulky waste collected in recent years.

Table 2-7
Tree Waste and Bulky Waste Collection

Fiscal Year	Tree Waste Collected	Bulky Waste Collected
FY 16	38,611	287,064
FY 17	39,157	174,742
FY 18	22,215 *	195,829

*** Tonnages affected by Hurricane Harvey**

Collection of Waste During Storm Events

Hurricane Harvey had a significant impact on the City's solid waste management program. Since 2005, there have been an increasing number of storm events in the Gulf Coast area. Since 2000, there have been 9 major flooding events in Harris County.

In addition to expected major storm events, weather forecasters are projecting that Texas temperatures are going to climb in future years due to climate change. *"The U.S. government's National Climate Assessment recently warned that, by the late 21st century, temperatures in Texas could climb by more than 8 degrees, with an additional 30 to 60 days of 100-degree-plus temperatures and extreme heat that could result in hundreds of more heat-related deaths and greater risks to outdoor agricultural workers."* The significance of this to Houston's solid waste program is that as temperatures climb, safety of workers becomes increasing more challenging, while the likelihood increases that additional workers will be required to collect waste.

In 2017, the City of Houston experienced one of its greatest natural disasters in history. Hurricane Harvey brought unprecedented amounts of rain – 50 inches total. Some 208,000 homes were impacted, causing nearly $16 billion in

residential damage within the city limits alone. It is estimated that City of Houston crews worked a total of 379,000 hours of (equivalent to 188 full time workers) to clear storm-related debris.

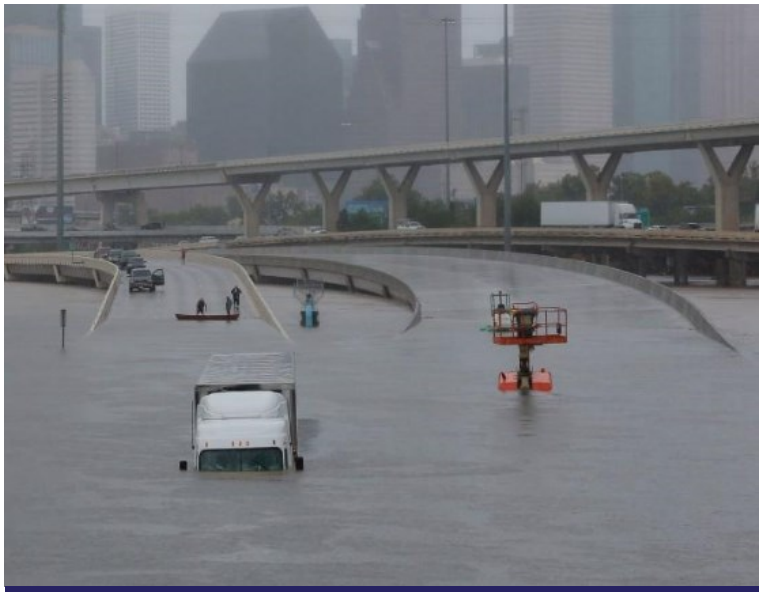


Photo Source: https://qz.com/1239654/hurricane-harvey-woke-houston-up-now-things-have-to-change/

Hurricane Harvey Key Facts – Debris Removal

1. 575,000 tons of debris removed from Harvey-impacted neighborhoods
2. 67,600 truckloads of debris collected citywide
3. 21,000 tons of debris removed from Lake Houston
4. 379,000 hours worked by City employees on Harvey debris removal
5. 3 Mutual aid jurisdictions came to assist – City of San Antonio, City of Austin and TxDOT
6. Debris removal took 15 months
7. Estimated $259 million for debris removal activities in Houston debris sites and landfills used for disposal

https://www.houstontx.gov/postharvey/public/documents/11.28.2018_progress_report_updated.pdf

Multi-family service

The number of Houstonians living in multi-family households is anticipated to increase from 1.0 million in 2019 to 1.6 million in 2040. This means that by 2040, over half the population will live in multi-family households. Multi-family complexes are treated as a business, where the owner of the business is responsible for securing any solid waste or recycling collection services for residents. Waste projections from this sector are addressed in Part II, Section 3.0 of this Plan.

Only a small percentage of multi-family complexes have recycling services available to their residents. The City does maintain drop-off recycling centers to provide recycling services to residents of multi-family units, but residents must deliver their recyclables to the recycling centers. Therefore, locating future recycling centers or depositories should take into consideration the concentration of apartment complexes now and in the future. The need for additional drop-off centers could decrease if the City were to adopt a regulation that requires apartment owners to provide on-site recycling services to their tenants. Similar ordinances are either planned or adopted in San Antonio, Austin, and Dallas.

City Facilities

Transfer Stations

Table 2-8 presents a summary of the waste accepted by the City's three transfer stations. The table shows the amounts of waste the City of Houston delivers to each transfer station (includes both MSW and bulky waste), the amount of waste delivered by Republic Services which is the operator of the transfer stations, and the amounts of waste delivered to the site by other "third party" haulers. A total of 57% of the waste delivered to the transfer stations is from City haulers. Each of the City's transfer stations has a capacity of 2000 tons per day. In 2017, the average throughput was approximately 700 to 750 tons per day, assuming 310 days of operation per year.

Under the current contract for transfer station operations, the City is charged by Republic Services a fee of $26.50 per ton, which includes acceptance of the waste and the haul and disposal of waste. Under the Republic Services agreement, if the City wants to direct haul waste to Republic Services' McCarty Road Landfill, the fee is also $26.50 per ton. Republic Services is authorized to accept waste from its own fleet as well as waste from outside its operations. In consideration of the fact that the City owns the facility, Republic Services is required to pay a "host fee" of $2.00 per ton for all Republic

waste and $3.00 per ton for all third party waste entering the facility. In 2017, Republic accepted a total of 232,653 tons of waste from its fleet and 67,663 tons from other sources. Total host fees generated in 2017 were approximately $670,000.

Table 2-8
2017 City Transfer Stations – Throughput by Hauler Type (Tons)

	City of Houston	Republic Services	All Other Privates	Total Tonnage
Houston Northwest TS	86,988	117,418	18,212	222,619
Houston Southeast TS	194,057	34,927	11,053	240,039
Houston Southwest TS	113,734	80,306	38,397	232,438
Total	**394,779**	**232,653**	**67,663**	**695,096**
% of Total	**57%**	**33%**	**10%**	**100%**

Aging Facilities

All three of the City's transfer stations were registered with TCEQ in 1999. They have been in steady operation for over 18 years. These facilities also take on a considerable amount of structural stress as they accept a large number of heavy trucks per day and material is continuously pushed with large front-end loaders. In order to maintain the integrity of these facilities and allow for continued operation, the City will likely have to make periodic investments to upgrade the facilities, especially floors and roadways in and out.

The City had a study of the facilities conducted in 2012. The study evaluated the condition of the three transfer stations and made several recommendations on improving the sites. Some of these recommendations included the following:

- Roof repairs
- Overhead door replacement
- Repair concrete pavement
- Repair sprinklers, support beams
- Repair buildings
- Relocate electrical panel and conduit
- Repair/replace push walls to provide column protection
- Repair concrete ramps and guardrails
- Replace lighting fixtures
- Add armor plate to loadout chutes/hopper
- Increase building ceiling height in original building
- Expand building to add tipping floor and chute for recyclables

The estimated budget for these improvements is shown in Table 2-9.

Table 2-9 2012 Capital Improvement Recommendations for City Transfer Stations	
Transfer Station	**Summary of Improvement Capital Costs**
Houston Northwest TS	$4,143,000
Houston Southeast TS	$3,319,000
Houston Southwest TS	$561,000
Total	**$8,023,000**

Recyclable Material Long-Haul

Prior to the FCC contract for processing recyclable material, the City was using three different material recovery facilities. One of those facilities was the Waste Management Brittmore facility which is located in close proximity to the South Environmental Service Center. The City now must haul its recyclable materials from the southwest region of the City to the northeast region where FCC is located. Due to the configuration of the Southwest Transfer Station it is not practical to transfer recyclable materials from collection vehicles to long-haul vehicles there. This means that recyclable collection vehicles in the southwest quadrant have to haul their materials from the point of collection to the FCC facility, thereby requiring more collection vehicles for this part of town. The City owns the building for the Brittmore facility but has two years remaining on a lease of the building to Waste Management. Possible remedies are listed below.

1. Add more collection vehicles to the Southwestern region for collecting recyclables as it takes more time to haul materials from that location to FCC.
2. Convert the Brittmore facility, once the lease has expired, to a recyclable material transfer facility.
3. Construct a temporary transfer facility for recyclable materials at the South Environmental Service Center. Permitting may be an issue.
4. Identify a warehouse that could be utilized temporarily for transferring recyclable materials. Permitting may be an issue.

Neighborhood Depository/Recycling Centers

The City operates six neighborhood depositories that also collect recyclables, and three recycling centers to provide Houston residents a convenient opportunity to drop off junk, tree, and recyclable materials. City of Houston residents may use the facilities up to four times per month; however, contractors and commercial businesses are prohibited from using the facilities. Citizens are required to unload their own materials.

Accepted materials include:

- Junk waste: appliances, up to five tires, heavy trash, tree waste
- Aluminum and tin cans
- Household plastic containers No. 1 through 5, and 7
- Glass bottles and jars
- Paper
- Cardboard
- Used motor oil

Clothes and shoes are accepted at the North, Southeast, and Northeast Depositories. A list of all neighborhood depositories and recycling centers are listed in Table 2-10.

Table 2-10 Neighborhood Depositories and Recycling Centers	
Facility	**Location**
Neighborhood Depositories[1]	
North	9003 N Main, 77002
Northwest	14400 Sommermeyer, 77041
Northeast	5565 Kirkpatrick, 77028
South	5100 Sunbeam, 77033
Southwest	10785 SW Freeway, 77074
Southeast	2240 Central Street, 77017
City Recycling Centers	
Westpark Recycling Center[2]	5900 Westpark, 77057
Clear Lake/Ellington Airport[3]	246 Loop Rd., 77034
Kingwood Recycling Center[4]	3210 W Lake Houston Pkwy., 77339

1. Hours of Operation: 9 am – 6 pm, Wednesday – Sunday.
2. Hours of Operation: 8 am – 5 pm, Monday – Saturday
3. Open 7 days a week
4. Open on weekends only, Friday – Sunday

Houston Depository / Recycling Facility Summaries

Table 2-11 provides a summary of the quantities of materials that are accepted at the City's Environmental Service Centers, depositories, and recycling centers.

Table 2-11 Facility Collections (2017)	
Reuse Warehouse Donations	988,727 pounds
Chemical Swap Shop & Restore	313,854 pounds
ESC Electronics Reused/Recycled	60,855 pounds
Drop-off locations	3,332 tons

The Environmental Service Centers (ESC) provide drive-through drop-off locations for Houston residents to bring their household hazardous waste (HHW) such as anti-freeze, batteries, fuel, oil, paint, paint thinner, pesticides, herbicides, and household cleaners. Residential electronic scrap items are accepted (monitors, televisions, printers, keyboards, mice, scanners, fax machines, telephone handsets, VCRs, CPUs, cellular phones, and other small consumer electronics). These items should not be placed on the curb for collection with garbage or tree waste / junk waste pickup. Clean, white Styrofoam blocks (plastic #6) are also accepted at the ESC-South location; however, packing "peanuts" are not accepted.

The increased adoption and use of electronic products have led to a stream of new products with relatively short life spans. Electronic products are made from precious and special metals, including gold, silver, palladium, and platinum, as well as potentially toxic substances such as lead, mercury, cadmium, and beryllium. Therefore, responsible end-of-life management of e-waste is vital in order to recover valuable components and properly manage hazardous and toxic components. End-of-Life management of e-waste includes the reuse of functional electronics, refurbishment and repair of electronics, recovery of electronic components, recycling e-waste, and disposal.

The City's curbside recycling collection service is limited to apartment communities containing eight or fewer units. For residents residing in multi-family complexes with greater than eight units, recycling services through the City are limited to use of the Neighborhood Depository/Recycling Centers described above (Table 2-10). Otherwise, multi-family complexes could contract directly with a private hauler for recycling collection. No data are available regarding the number of multi-family complexes that may contract with a private provider for recycling collection services.

Public Education & Information Program

The Solid Waste Department has a Public Information Officer to assist in promoting current programs and practices. There is also a Community Outreach Division with individuals who attend community events and communicate public services information on behalf of the Solid Waste Department, among other topics. Public Information Officers are tasked with promoting the neighborhood depositories and environmental service centers managed by the Solid Waste Department, providing general information to the public concerning trash and recycling. It should be noted that Solid Waste Management Department Public Information Officer and Community Outreach teams provide information to the public on all City solid waste services including disaster information; program changes; addressing illegal dumping concerns; litter abatement and regular collection schedule changes due to holiday or weather delays. These responsibilities are in addition to the following services provided by the SWMD.

The City's public information and community outreach program is also active within the City of Houston's Independent School District, and they host an annual "Growing Up Recycling" Cart decorating contest.

- Responding to requests for public information under Texas Public Information Act requests;
- Responding to requests for presentations and assistance to the Mayor's Office of Special Events for trash and recycling collection for things like 4th of July fireworks, the Houston marathon, and various parades; and
- Partnering with Keep Houston Beautiful on community clean-up efforts *There are currently no employees dedicated solely to recycling education.*

Funding for the City's Public Information Programs include private sector partners contributing to education. Specifically, Living Earth pays the City $0.10 per bag of mulch sold, which contributes to recycling education. The FCC contract explicitly states that FCC will provide a financial contribution of $100,000 per year to support education efforts to increase awareness about recycling in the City and will fund $20,000 per year in educational programs operated by FCC. The SWMD has also been successful in securing grants from the Houston Galveston Area Council (H-GAC), which is a region-wide voluntary association of local governments in the 13-county Gulf Coast Planning region of Texas, and other agencies to sponsor public information and other waste minimization and recycling programs.

According to a U.S. Chamber of Commerce Foundation report, published in May 2018, cities should expect to spend about $1 per household on educational campaigns, or $3 to $4 per household if the campaign addresses changes to an existing recycling program.[1] The Project Team researched the marketing/public outreach budgets for the following communities.

- Dallas, Texas: Based on their FY 2019 budget, transfer community outreach activities related to their Zero Waste program from Sanitation Services is budgeted at $1,042,971. This amounts to approximately $4.34 per household.
- Fort Worth, Texas: According to the City of Fort Worth's FY 2019 budget, the Solid Waste fund has 5 functional areas, one of which is community education which delivers public education and outreach. Although the budget did not indicate total costs associated with solid waste specific outreach, it is worth noting that the City also maintains a separate Community and Public Engagement Department that is tasked with public outreach on behalf of all City departments.
- Austin, Texas: Austin Resource Recovery Department maintains a Waste Diversion program for activities associated with strategic initiatives. The FY 2019 budget for their Waste Diversion program is budgeted at approximately $2.5 million. This amounts to approximately $12.38 per household.

Waste Minimization & Reuse Programs

In the full lifecycle of any product, there are three main segments: up-stream, mid-stream, and down-stream. The up-stream segment of a product's lifecycle involves the manufacturing process itself, where manufacturers determine which materials and how much material will be used to manufacture and package the product. The mid-stream segment of a product's lifecycle focuses on the longevity of the product, including reuse and repurposing of products. The down-stream segment of a product's lifecycle focuses on recovery, including recycling or energy recovery. By nature of the role of local government, the down-stream segment of a product's lifecycle is the point of greatest direct impact. However, local governments can, to some degree, influence the up-stream and mid-stream segments of a product's lifecycle, before the materials arrive at a local government facility, by promoting waste prevention, reduction, and reuse.

Reducing waste generation is by far the most environmentally beneficial action Houston residents and businesses can do to reduce environmental impacts. It is also by far the most cost-effective for the City. Waste that is not generated, does not have to be collected, processed, or disposed. For the commercial sector, waste minimization improves profit margins.

Grasscycling programs are one of the simplest ways to divert organic materials from the MSW stream. Grasscycling programs encourage residents to leave grass clippings on their lawns instead of bagging and disposing of them. Grasscycling diverts a portion of the waste stream and provides an excellent source of nutrients for the lawn. Yard waste makes up more than 30% of the total residential waste stream in Houston. Research has shown that lawns generate approximately 300 pounds of grass clippings per 1,000 square feet annually, which amounts to 6.5 tons per acre each year.[1]

Green Building Resource Center

The GBRC offers over 50 educational displays, a library of information, samples of recycled materials for green building and in-home energy conservation and also highlights the impacts of recycling.

Building Materials Reuse Warehouse

The Building Materials Reuse Warehouse, located at 9003 North Main St., opened in April 2009 as a program of the City's SWMD. The Reuse Warehouse is funded in part by a waste reduction grant from the H-GAC. It benefits the community by providing space for excess building materials that would otherwise be disposed in local landfills, while also fostering a culture of reuse and expanding partnerships between community stakeholders. In 2018, the Reuse Warehouse collected a total of 998,000 pounds of bitumen, cardboard, ceramics, concrete, doors, glass, masonry, metals, wood, plastics, and other construction materials.

Chemical Swap Shop & ReStore

The City's Chemical Swap Shop and ReStore are operated by the SWMD and are located at the Environmental Service Center (ESC) South location. Every Friday, between 9 am and 12 pm, household chemicals and paint that were brought to the ESC South location for disposal but appear to be in good condition, are made available for citizen reuse. Citizens may take away these items at no charge; however, there is a limit of six chemical items and five gallons of paint per week. The ReStore serves as a book swap, a recycling information library, as well as a repository for craft items and post-consumer and post-industrial scrap; and also makes items available to the public during the Reuse Chemical Take-Away.

[1] https://www.calrecycle.ca.gov/organics/grasscycling

Recycling & Organics

Residential Yard Waste and Tree Waste Collection

The City collects yard waste (grass clippings, leaves, small branches) in City-approved compostable plastic bags, weekly. The City also collects large tree debris curbside in odd numbered months. Both services are provided to the single-family residents served by the SWMD. These materials are hauled to a private contractor for mulch and composting. The current vendor is Living Earth/LETCO, which has several compost and mulch processing facilities across Houston. In FY 2018, the City reported collecting approximately 9,397 tons of yard waste and 21,215 tons of tree waste from single-family residences. Table 2-12 provides green waste collected by the City in 2016-2018. FY 2018 quantities are about a 44% reduction from the previous year because the City discontinued green waste collection for most of the year in the aftermath of Hurricane Harvey. The 2018 data represent approximately 0.8 tons of yard waste and tree waste per single family household per year. The City Parks Department reported hauling 990 Tons of vegetative material from parks during the six months between December 2019 and May 2019, the only months for which data were collected. Yard waste and tree waste generated in the City in areas not served by City collection may be hauled by landscapers or contract haulers to landfills or compost/mulch facilities.

Table 2-12
Green Waste Collected by City of Houston (Tons)

Year	Yard Waste	Tree Waste	Total
FY 2016	14,159	38,611	52,770
FY 2017	15,412	39,157	54,569
FY 2018	9,397	21,215	30,612
FY 2019	10,756	35,474	46,230
FY 2020	11,208	45,928	57,136

Neighborhood Depository Green Waste Drop-Off

Residents may drop off yard waste and tree waste at any of six neighborhood depositories.

Backyard Composting and Grasscycling

The City promotes on its website that residents may avoid the expense of compostable bags for grass clippings by practicing grasscycling. The City also supports a Master Composter Certification program which trains residents in proper backyard composting techniques and provides certification to those who complete the training and promote backyard composting in the community. In 2018 the City certified 13 Master Composters. The City also began selling backyard compost bins to residents in 2015.

Food Residual Recovery

The City does not provide the collection of either pre-consumer or post-consumer food residuals for recovery. It participated in a study of pre-consumer food residual collection through H-GAC and is supportive of efforts by H-GAC to facilitate food residuals collection for recovery. This program has not yet been fully implemented.

Biosolids Diversion

The City contracts with FCC Environmental Services to haul approximately 30% of its biosolids, or approximately 32,000 tons per year, to landfills for disposal. The remainder is processed into a fertilizer-like product by a private entity.

Overall Diversion Rate

Per the 2019 Waste Generation Report, total tonnage generated within the City was estimated using a combination of data sources provided by the City, as well as data from H-GAC. It is important to note that the total tonnage amount generated includes MSW, recycling, yard waste, and construction & demolition (C&D) tonnage. Based on the data summarized in 2019, the City has a total estimated diversion rate of approximately 32.4%. The diversion rate is significantly higher than the residential curbside diversion rate of 14.83% largely due to diversion of C&D waste, which is described in greater detail in Part II, Section 5.

Table 2-13 states the City's recycling rate with the recycling rates for other Texas cities, which was aggregated using FY 2019 budget information for the City and each of the benchmark communities. The City's residential sector generates comparable amounts of MSW compared to similar major cities. Table 6-13 provides a comparison of the tons of MSW, recyclables and brush/bulky waste collected by other cities.

- With the exception of Austin, Houston residents generate comparable amounts of MSW per household.
- The amount of material collected per household as part of the City's residential recycling program is lower than other cities. The City's recycling program was interrupted by Hurricane Harvey.
- Houston's budget per household for solid waste services is roughly half of the amounts budgeted by San Antonio, Dallas, and Austin. The levels of service may vary but, in general, the City's budget is significantly underfunded in comparison to these other cities.
- Houston also has approximately half the number of solid waste workers per household than the cities referenced above, with the exception of Fort Worth, which has a private firm provide collection services.

Table 2-13
Waste & Recycling Collection Comparison to Other Cities (FY 2018)

City	Houston	San Antonio[1]	Dallas	Fort Worth[3]	Austin
Households Served	390,798	356,000	240,000	225,049	200,550
Annual MSW (Tons)	445,397 [2]	384,000	246,000	247,333	128,829
Annual Bulky Waste (Tons)	195,800	32,574	132,000	22,600	11,179
Annual Recyclables (Tons)	36,595	61,186	57,600	42,978	48,080
Annual Organics (Tons)	69,769	135,629	40,000	37,778	42,825
Total Tons	747,561	613,389	475,600	350,689	230,913
Annual MSW/HH (pounds)	2263	2153.5	2044	2190	1277.5
Annual Bulky Waste/HH (pounds)	985.5	182.5	1095	219	109.5
Annual Recyclables / HH (pounds)	182.5	328.5	474.5	365	474.5
Annual Daily Organics/HH (pounds)	365	766.5	328.5	328.5	438
Total	3759.5	3431	3978.5	3102.5	2299.5
Annual Budget ($ MM)	84.9	145	112.6	67.7	97.1
Annual Budget $ / HH	214	407	469	301	484

1. San Antonio only provides 2 per year bulky waste collection service events
2. Bulky waste numbers for Houston reflect Hurricane Harvey impacts
3. Fort Worth relies on private sector collection contractor for residential collection

Energy & Resource Recovery

Existing Program

There are technologies available to convert MSW to useful energy. The technologies used today are much more sophisticated in terms of environmental protection compared to incinerators of the past. Incineration of waste without

energy recovery was once a preferred method of significantly decreasing the volume of waste that requires disposal. In fact, there was an incinerator operating in Houston for solid waste management. This facility closed many years ago.

Many MSW landfills in the region convert landfill gas to energy. Landfill gas is generated as a result of decomposition of the organic portion of the waste in a landfill. Landfill gas is about half methane which can be used as a fuel, either directly or indirectly through the generation of electricity. Landfills in the state of Texas are required to have a landfill gas management plan that addresses how these gases will be managed. Landfills are also required to implement gas control measures as part of their operating plans. As presented in the Facilities Report, there are seven regional landfills with energy recovery programs shown in Table 2-14. Landfills that have landfill gas energy recovery systems include the following.

Table 2-14
Energy Recovery from LFG Projects (Source TCEQ MSW Annual Report)

Facility	County	Gas Processed (million cubic ft.)	Gas Distributed Off-Site (million cubic ft.)	Power Generated and Sold (million kWh)	Power generated and used onsite (million kWh)
Security Landfill Gas to Energy Facility	Montgomery			22.4	22.7
Blue Ridge Landfill Gas Compressor Station	Brazoria	1,347	0	42.3	2.2
Fort Bend Landfill Gas Treatment Facility	Fort Bend	410	225	0	0
Coastal Plains Landfill Gas to Energy Facility	Galveston	0	0	25	26.7
McCarty Road Landfill Gas Recovery Facility	Harris	2,493	1,401		
Atascocita Landfill Gas to Energy Facility	Harris				
Ameresco McCarty Energy Landfill Gas to Energy Facility	Harris	1,045	1,045		
Total		5,295	2,671	89.7	51.6

There are alternative technologies to landfill disposal of waste. These options are at various stages of technological development and have varying environmental impacts and financial feasibility.

Disposal

In March 2020, the City signed two agreements for transfer station services and landfill disposal. Republic Services/BFI will provide operational management of the city's 3 transfer stations as well as landfill disposal of Type I (MSW) and Type IV (C&D material) solid waste. The landfills are McCarty Road in Northeast Houston; Blue Ridge Landfill in Fresno/South Houston on FM 521; and Whispering Pines Landfill in Northeast Houston (as necessary). Based on current routing and ease of disposal, Republic/BFI will receive about 90% of waste via transfer station or direct haul.

Waste Management will provide Type I and IV landfill and transfer station services at the following sites: Atascocita Landfill in Far North Houston near Kingwood; Hawthorne Park landfill in Northwest Houston on Tanner Road at Beltway 8; and the Koenig Street Waste Management Transfer Station in Pasadena, Texas. Based on current routing and ease of disposal, Waste Management will receive about 10% of waste via transfer station or direct haul.

Both contracts are for 5-year terms with one 5-year renewal for a 10-year potential total term (Table 2-15).

- The Waste Management contract is worth an estimated $43 million for the 10-year term (10% of waste).
- The BFI/Republic contract is worth an estimated $240 million for the 10-year term (90% of waste).

Table 2-15 Negotiated Landfill and Transfer Station Rates		
Sites Reported per day	Old Rate (per ton)	Negotiated Rate (per ton)
WM Landfill ATAS Comp	$26.49	$26.80
WM Transfer Station	-	$34.50
COH Trans Stations Comp	$26.47	$25.11
BFI/RWS Landfills Comp	$26.47	$25.11

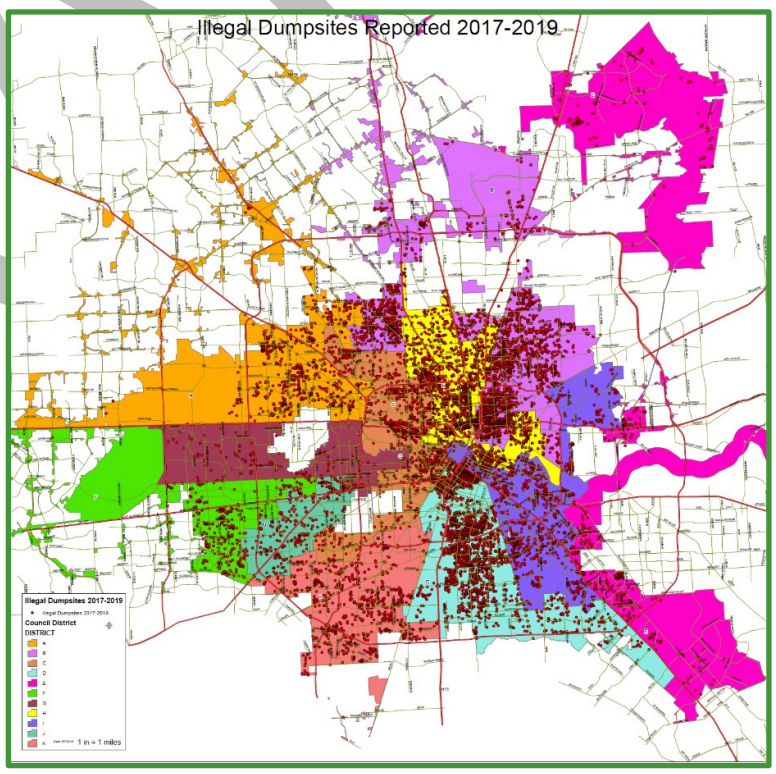
Illegal Dumping

Illegal dump sites are cleaned up by the junk waste collection crews which operate illegal dump clean-up activities only in odd-numbered months. The two agencies that cooperatively identify and report illegal dumping activity to the City for clean-up are the Department of Neighborhoods Inspection and Public Service Division and the Houston Police Department (HPD).

When the public calls the 311 call center to report illegal dump sites, the call center directs them to the Department of Neighborhoods. Illegal dump sites identified by the HPD are also forwarded to the Department of Neighborhoods. The Department of Neighborhoods refers the information collected by both agencies to the SWMD who cleans up the illegally dumped material. The Harris County Environmental Crimes Unit may also enforce Class B misdemeanors and above inside the City.

Figure 2-6 is a map prepared by Neighborhood Services of illegal dump sites reported between the beginning of 2017 and May 7, 2019. The SWMD removed 230 tons from illegal dumps reported to HPD from March 2018 through June 2019.

Figure 2-6
Locations of Illegal Dump Sites Reported 2017-May 7, 2019



The HPD Environmental Investigation Unit may write citations or refer cases to municipal Court (<5 lb.) or the District Attorney (>5 lb.). Many illegal dumps occur on a resident's own property and are reported to Code Enforcement who issues a fine. Frequently, the resident then moves the material off of his or her property to another location where it is considered an illegal dump site. Illegally dumped wastes on vacant lots or other public areas attract more dumping at that location by additional violators.

The number of illegal dump sites within the City is high for several reasons.

1. Many residents do not know how to legally dispose of municipal solid waste either through the regular residential collection system or special collections for excess wastes, tree waste and heavy trash. In many cases this is due to the lack of appropriate public information reaching immigrants who come from cultures where wastes are handled differently, those who do not speak English and those who are illiterate in any language. It is not possible to provide public information regarding how to legally dispose of municipal solid waste using billboards because there is a City ordinance prohibiting the City from using billboards for any purpose.

2. Many residents are not able to access one of the six depositories during the four days per week that they are open. Some residents may be turned away for lack of proper documentation.

3. Enforcement mechanisms are slow, and cases are frequently dismissed in the Courts. When fines are issued by the courts, it is often long after the illegal dumping occurred. It is difficult to link cause (dumping) and effect (fines or imprisonment). Opportunities to issue immediate citations are limited.

Effective enforcement is lacking. When Class A and Class B misdemeanors are referred to the District Attorney, the City has typically cleaned up the dump site by the time the matter is seen by a judge. At that time, judges typically dismiss cases because the illegal dump site is no longer creating a public nuisance. Judges are more willing to issue fines for hazardous waste violations and dump truck tires than for dumping municipal solid waste. Although Code Enforcement can issue fines for code violations, they cannot issue fines for illegal dumping even though the responsible parties are often identified.

The HPD has Differential Response Teams who perform community policing using both traditional and non-traditional policing methods to address community crime. This team could get more involved in preventing illegal dumping. The HPD Community Liaison could also address illegal dumping; however, this position is currently vacant.

The HPD Environmental Investigation Unit manages and monitors cameras to identify environmental crimes. This program has been successful at identifying illegal dump sites and identifying responsible parties. They currently have 25 cameras but more cameras and staff to monitor them are needed. Instead, cases are currently referred to the District Attorney.

Table 2-16
Comparison of Illegal Dumping (Houston & Fort Worth)

City	Sites Reported per day	Average Time to Clean Up	Dedicated Trucks	Enforcement	Fine
Houston	34	84 Days	0 (Tree Crews, only odd numbered months)	District Attorney for >5 lb.; JP or Muni Court for < 5 lb.	Typically, $250 by D.A. for 1st offence
Fort Worth	18	80% <48 working hours	5 (2-man crews)	Code Enforcement Officer Citation	$554 for <1000 lb.

The Department of Neighborhoods database, as of May 7, 2019, included 17,283 illegal dump sites reported over a period of 508 days, averaging 34 reports per calendar day (some of which are duplicate reports). The sites that have been addressed and closed averaged 84 days from the date they were reported to the Department of Neighborhoods until they were cleaned up, or 54 days beyond the target of 30 days.

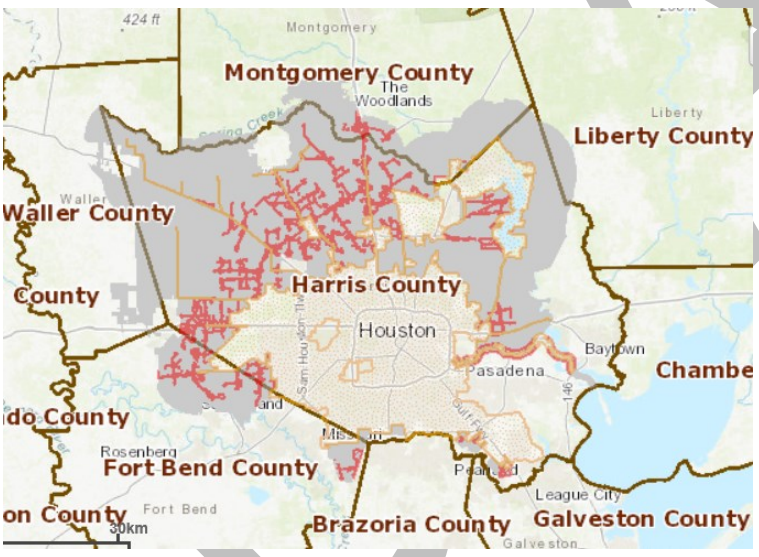
3.0 Houston Background

Background Key Points

- The City's boundaries incorporate a total area of 671 square miles, meaning the City's solid waste collection system provides service to an extremely broad service area.
- The City's land use is diverse, lacking major concentrated areas of residential housing; affecting the efficiency of waste collection.
- Houston's climate and weather conditions have had a dramatic impact on solid waste management resources in recent years – Hurricane Harvey generated approximately 1.1 million tons of disaster debris affecting regional landfill capacity and placing a significant strain on Houston's collection services.
- The City's transportation system is one of the most congested in the country. This increases the time required to haul waste from points of collection to either a transfer station or a landfill.
- Houston is the 4th largest City in the U.S., with a population of 2.38 million people. The City's population is anticiapted to increase to 3.04 million by 2040.
- Housing trends show an increased percentage of Houston residents living in multi-family households versus single family households.
- Current employment is approximately 1.9 million and projected to increase to 2.4 million by 2040.

Geography & Land Use

Figure 3-1 City of Houston & Extra Territorial Jurisdiction
Source: City of Houston Planning & Development Department

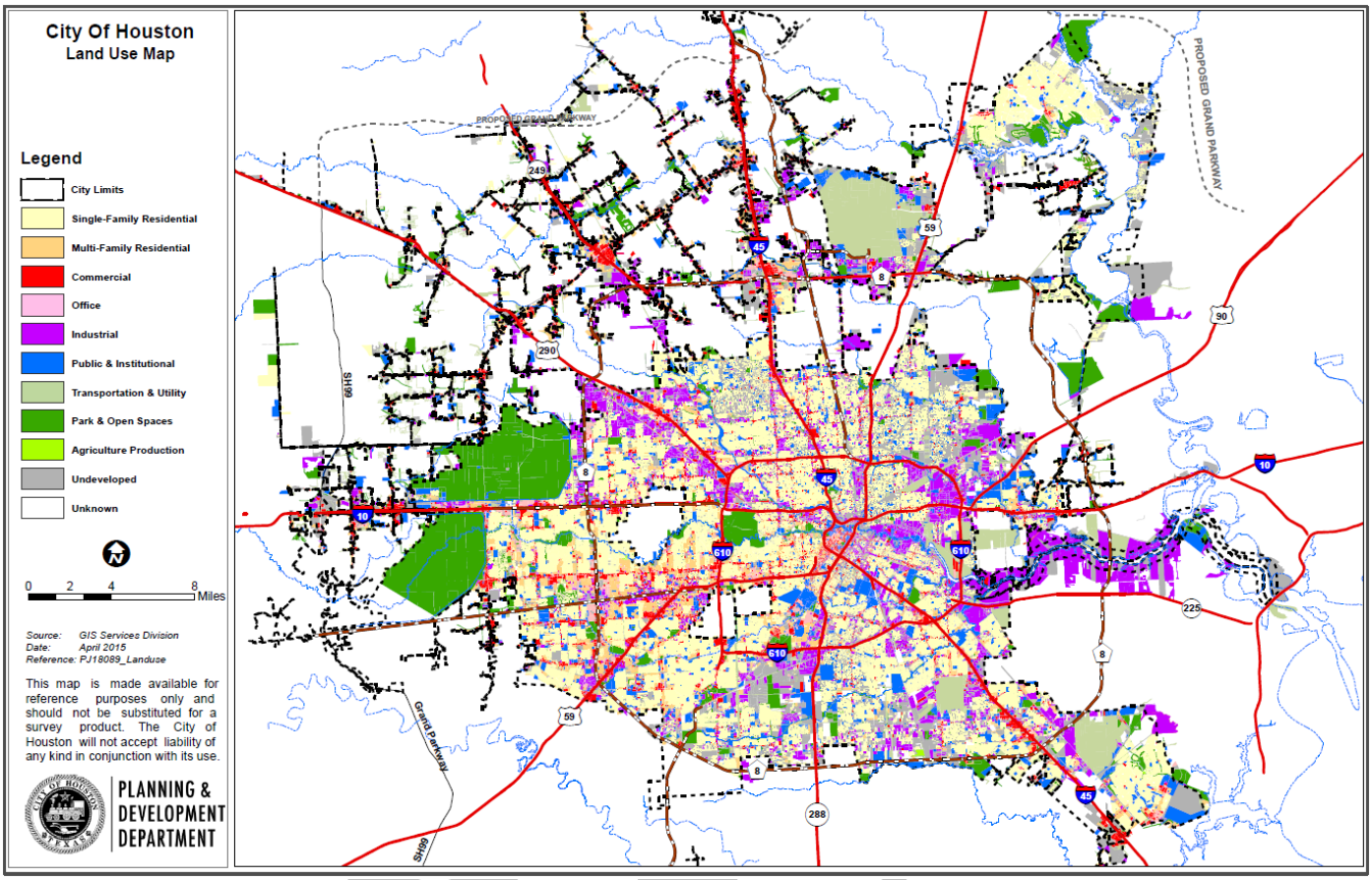


At 671 square miles, the City of Houston could contain the combined land area of the cities of New York, Washington DC, Boston, San Francisco, Seattle, Minneapolis, and Miami.

Houston is located on the Gulf Coast of Texas. The City's boundaries include a total area of 671 square miles. (Figure 3-1). This expansive area impacts the distances that solid waste collection crews must travel to collect waste and recycling and haul to either transfer stations, recycling facilities or landfills, and then return to their collection routes. Houston is primarily located in Harris County. Portions of the City are also located in Fort Bend and Montgomery Counties.

Houston's Land Use Map (Figure 3-2), prepared by Houston Planning and Development Department, illustrates a city that has a distribution of residential, commercial, institutional, and public spaces throughout the City. The lack of concentration of residential housing creates an additional strain on the City's collection program.

Figure 3-2 Houston Land Use Map



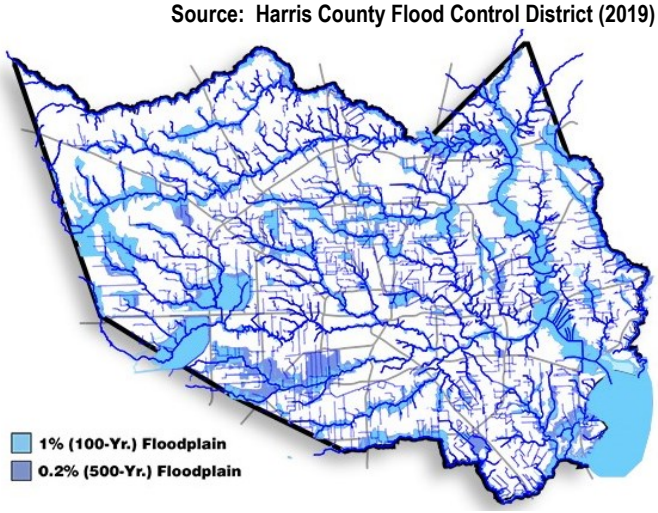
Source: City of Houston Planning & Development Department (2019)

Climate & Topography

The City's climate is predominantly marine. The terrain includes numerous small streams and bayous. Prevailing winds are from the southeast and south, except in January when frequent high pressure areas bring invasions of polar air and prevailing winds are from the north. (Source: Soil Survey of Harris County U.S. Department of Agriculture, 1996.)

"The Harris County Flood Control District's drainage and flood control infrastructure is extensive, including more than 1,500 channels totaling about 2,500 miles in length (about the distance from Los Angeles to New York). Nature also challenges us with flat terrain, clay soils that do not absorb water very well and an average annual rainfall of 48 inches. The flooding problems in the community are severe. Flooding is Harris County's most significant natural disaster. Several hundred thousand homes and businesses are in the identified floodplain (not all flooding areas are identified), and projects to reduce the risk of flooding are estimated to cost in the billions of dollars." (Source: Our Infrastructure & Area Challenges Harris County Flood Control District, 2019).

Figure 3-3 Harris County Floodplains
Source: Harris County Flood Control District (2019)



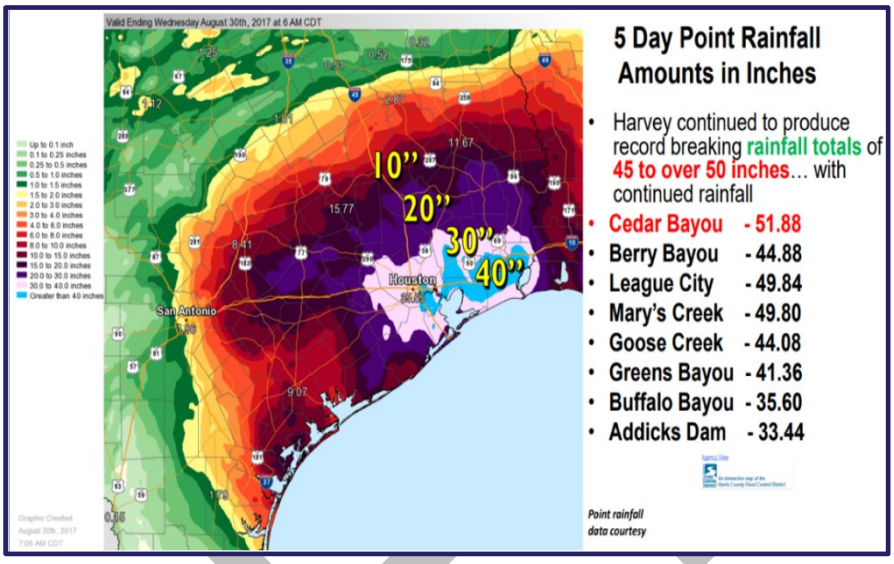
The City has experienced numerous severe storm events over the past several years, including the following. (Source: "Our Soaked History" Harris County Flood Control District, 2017)

Table 3-1 Major Houston Area Storms		
1990s	**2000s**	**2010s**
1992 March- major storm floods more than 1,500 structures and many bayous are out of banks. Much of I-10 is underwater.	2001 June – Tropical Storm Allison strikes first on June 5, then returns three days later for a second round of storms. Texas Medical Center essentially shut down. North Downtown Houston decimated. Two million people impacted. 22 lives lost. More than 70,000 structures flood. Damages top $5 billion.	2012 July – High water rescues along Cypress, Little Cypress and Willow Creeks after several days of heavy rainfall beginning July 9. More than 70 structures flood in northern Harris County.
1996 October – Major storm hits Harris County. Twice as many structures flood than in the 1992 storm. Most bayous are out of banks.	2006 June 19 – Rainfall on already saturated ground floods 3,370 homes 561 apartments and one nursing home. Mostly along Berry and Sims bayous. Rainfall 8-10 inches in three hours.	2014 August – Slow-moving rains drench portions of Harris County with 3.5-4.5 inches. In the Greens Bayou watershed 109 structures flood.
1998 September – Tropical Storm Frances causes extensive flooding along White Oak Bayou and other bayous. More than 1,300 structures flood.	2008 September Hurricane Ike, 3rd costliest in US history, strikes Galveston Island. Eleven deaths in Harris County. Storms surge swamps 2,500 structures; rainfall causes 1,200 more structures to flood. More than $29 billion in damage	2015 May 25-27 – Memorial Day Flood. More than 6,000 structures flood. Seven fatalities. Highest rainfall recorded in Buffalo and Brays watersheds. Nearly 11 inches in 3 hours on Brays Bayou.
1998 October & November Adding insult to injury, two more major storms flood hundreds more structures damaged in Harris County.	2009 April 17-29 bring extensive flooding; five children drown when a car goes into a Greens Bayou tributary. Some highways close. Record high water on Bear, Langham, Mayde Creeks. 2,305 structures flood on Langham Creek and Buffalo Bayou.	2016 April 17-18 – Tax Day Flood. Historic flood over northern and western Harris county results in seven fatalities. Average 12-16 inches of rain in 12 hours county-wide – record pool levels in Addicks and Barker reservoirs. Estimated 9,820 structures flood in Harris County
		2016 May 25-26 Memorial Day Flood. North and northwest Harris County hit with 8-13 inches of rain. Overbanked and structural flooding on Cypress Creek and the San Jacinto River. More than 400 structures flood in Harris County.
		2017 August 23 – September 15 Hurricane Harvey. A category 5 Hurricane dumped 50 inches of rain on the City of Houston. Caused significant flooding throughout the City and was declared a national emergency.

Hurricane Harvey

Hurricane Harvey impacted the Houston area between August 23 and September 15, 2017. The storm dumped approximately 50 inches of rain on the City of Houston and caused significant damage. The City is still recovering from this hurricane event. According to FEMA, the hurricane resulted in approximately 13 million cubic yards of debris over its entire area. In the H-GAC region, the impact on landfills was approximately 1.1 million tons of debris (10% of a year's total generation for the region).

Figure 3-4 Hurricane Harvey Rainfall
Source: National Weather Service (2019)



Transportation System

Roadways

There are over 16,000 lane-miles of streets in Houston that are the responsibility of the City's Public Works Department. The City's transportation system includes major highways including IH 45, IH 610, IH 10, IH 69/US 59 (Source: Urban Mobility Report Texas A&M Transportation Institute, 2019).

A recent Texas A&M study estimated that drivers in Houston spent 75 hours of delay time on Houston's roadways annually. These delays contribute significantly to the amount of time required to haul waste and resources from the point of collection to transfer stations, recycling facilities or landfills. Houston ranks 9th in the U.S. for delay time on roadways.

Truck Congestion Cost—The value of increased travel time and other operating costs of large trucks is estimated at $52.14 per hour of truck time. The extra diesel consumed using state average cost per gallon associated with Houston is estimated to be $548 million per year. As congestion increases, there will be a need for both additional routes and additional transfer stations within SWMD.

Congestion along Houston's roadways adds considerable time for the SWMD.

Figures 3-5 and 3-6 present the projected congestion maps as presented in the H-GAC 2045 Mobility Plan. The City's Extra Territorial Jurisdiction (ETJ), miles traveled are expected to increase by 84%.

Figure 3-5 2020 Congestion
Source: HGAC 2045 Regional Transportation Plan (2019)

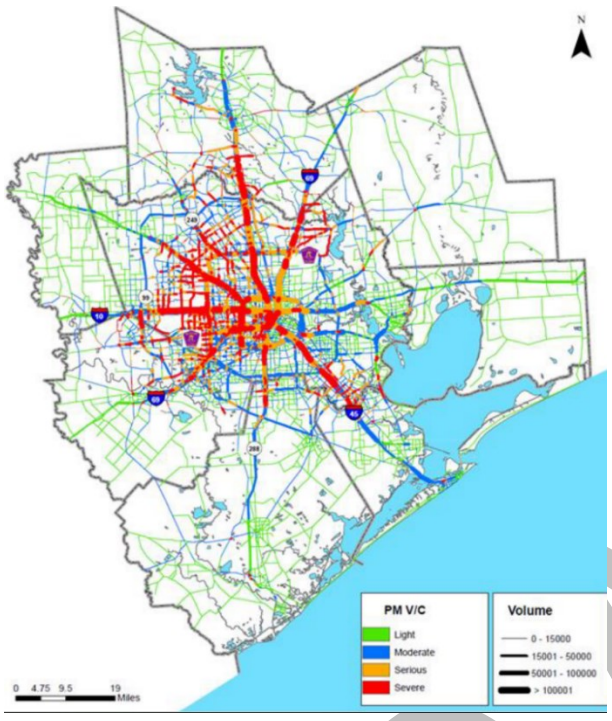
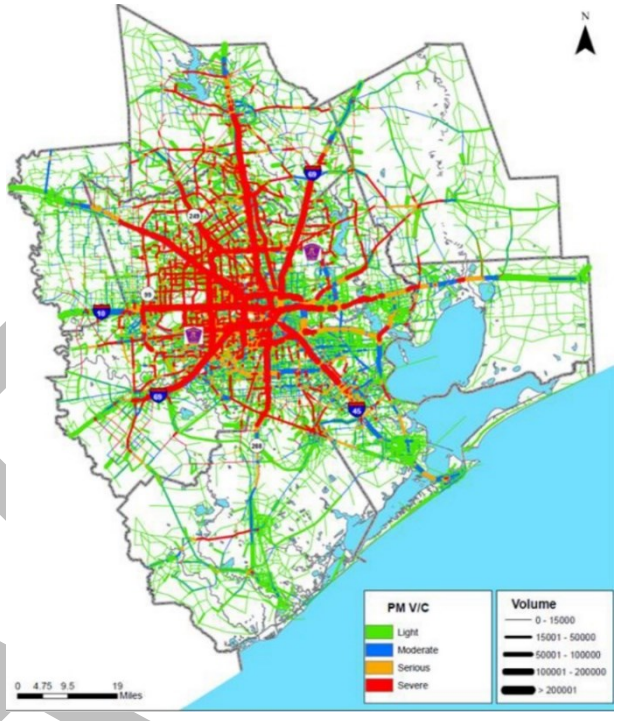


Figure 3-6 2045 Congestion
Source: HGAC 2045 Regional Transportation Plan (2019)



Rail Network

Houston is a Union Pacific Railway hub for six lines, linking the region with the Louisiana Gulf Coast, Midwest, West Coast, and Mexico. BNSF Railway primarily serves the north and east portions of Texas and connects them to the more northern Gulf ports, including Houston, Galveston, and Beaumont. The Kansas City Southern system has 908 miles of track operating in the state (including the Tex Mex, which KCS acquired in 2004), and is limited to other rail connections in Laredo, Corpus Christi, Houston, Dallas/Ft. Worth, and Beaumont. (Source: TxDOT)

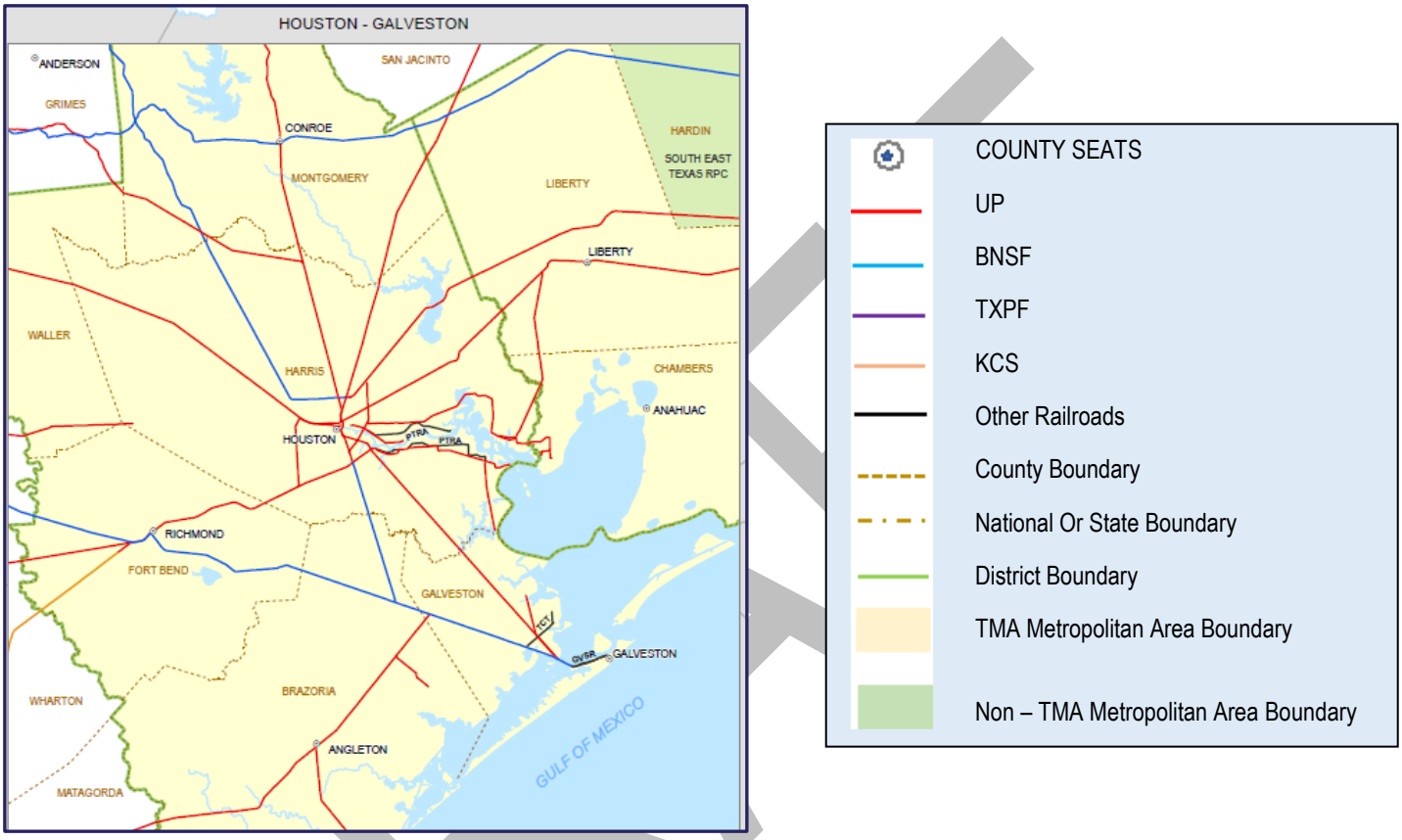
Intermodal connectors link rail yards, seaports, airports, trucking and distribution facilities where the transfer of freight is completed on-site. Access to and from these intermodal facilities is along local roadways that connect to the state's highway freight corridors and serve as the last mile for freight movement. Freight intermodal connectors in Texas include 23 airport/truck, 39 port/truck, 18 truck/pipeline and 20 truck/rail connectors. Rail lines in Texas, together with trucking, support the intermodal freight transportation system for the state. Both UP and BNSF have rail lines located in the City of Houston. Intermodal facilities located in Houston are shown in Table 3-2.

Table 3-2
NHS Truck / Rail Intermodal Facilities (2013)

Facility	Connector Description
Empire Truck lines Container Yard, Houston	Wallisville Road (IH 610 to Oates)
Howard Industries, Inc.	Served by an existing NHS Route / Industrial Blvd
Maurice Pincoffs Co. Inc.,	Served by an existing NHS Route / Jacinto Port Blvd.
UP Settegast Yard	Kirkpatrick Blvd between the Terminal and I-610
UPS Sweetwater Lane Facility	2 Canino (IH 45 to Sweetwater Ln)
Source: 2016 Texas Rail Plan Update TXDOT	

Figure 3-7 presents the Texas State Rail map for 2016. The map illustrates major freight lines located in the Houston-Galveston area.

Figure 3-7 Houston-Galveston Areas Rail Lines
Source: Texas State Road Map TxDOT (2019)



Houston Port

Houston is also home to The Houston Ship Channel, one of the nation's largest seaports which is experiencing tremendous growth. The Houston region is the country's number one region for exports and is home to the largest petrochemical manufacturing complex in the Americas. Energy production and the export of crude oil, along with the increasing global demand for chemicals produced in the region, are major drivers of the Port's success.

Largely because of petrochemical activity along the 52-mile ship channel, the nearly 200 private companies that make up the Greater Port of Houston have helped make the port the **No. 1 U.S. port in foreign waterborne tonnage**. Petroleum and petroleum products are leading import and export commodities.

More than 200 million short tons of international cargo were handled in 2018 alone. The economic impact of the Greater Port nationally includes **3.2 million jobs**, **$801.9 billion in economic value** and more than **$38.1 billion in tax revenue.** (Source: Port Houston) The activity at the Port represents a major source of waste, including special wastes that require special handling and disposal.

Demographics

Population

The City of Houston is the fourth largest city in the US. With a population of over 2.38 million people, the City has grown steadily over the past 60 years. In 1960, the City's population was 938,219. By 1990, the time when the last major solid waste management plan was completed for the City, the population was 1.63 million people. This growth rate has affected the amounts of waste generated in the City and the need for more waste and resource management infrastructure. The City's population is anticipated to continue to inrease at a signficant pace over the next 20 years. By 2040, the estimated population is anticipated to be 3.04 million.

Table 3-3 summarizes population projections for the City of Houston using H-GAC's forecast.

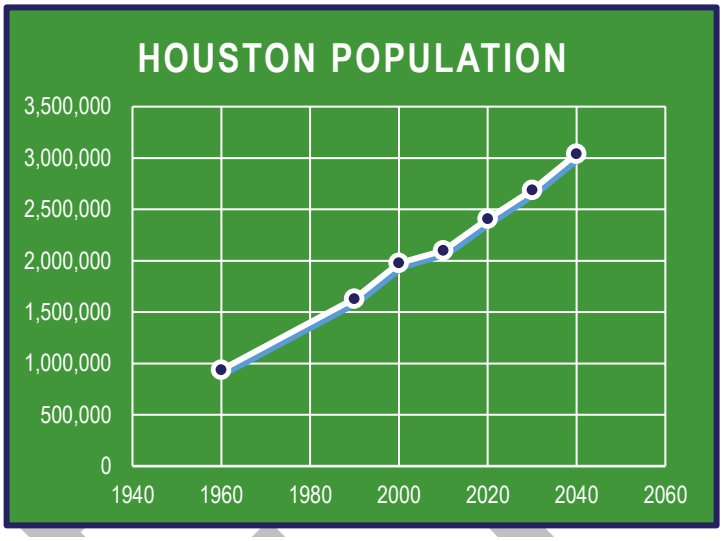


Figure 3-8 Houston Population Projections
Source: U.S. Census & H-GAC

Table 3-3
City of Houston Population Forecast

	2019	2020	2025	2030	2035	2040
Population						
Single-Family	1,313,556	1,316,795	1,336,256	1,362,049	1,383,652	1,395,743
Multi-Family	1,070,119	1,090,697	1,199,631	1,326,114	1,503,522	1,649,287
Total Population	2,383,675	2,407,492	2,535,887	2,688,163	2,887,174	3,045,030

The compounded annual growth rates applied in each 5-year increment of the population forecast are noted below:

- 2015 – 2020: 1.00%
- 2020 – 2025: 1.04%
- 2025 – 2030: 1.17%
- 2030 – 2035: 1.44%
- 2035 – 2040: 1.07%

Households

H-GAC estimates the annual demand for housing units and non-residential space based on the forecasted change in the number of households and jobs. H-GAC also projects the future percentage of single-family and multi-family housing units (both current and future construction). For instance, the percentage of multi-family housing is projected to increase in future years, as a percentage of total housing units. Currently, the ratio between single-family (SF) and multi-family (MF) housing is approximately 1:1; however, H-GAC predicts that housing will reflect a SF:MF Ratio of 2:3 for the City of Houston by 2040. Table 3-4 summarizes household projections for the City of Houston using H-GAC's forecast.

Table 3-4 City of Houston Household Forecast						
	2019	2020	2025	2030	2035	2040
Households						
Single-Family	462,736	464,696	474,620	484,756	495,109	505,683
Multi-Family	478,538	488,601	540,884	599,117	682,942	758,524
Total Households	941,274	953,297	1,015,504	1,083,873	1,178,051	1,264,207

Source: H-GAC

The compounded annual growth rates applied for each 5-year increment of the total household forecast are noted below:

1. 2015 – 2020: 1.28%
2. 2020 – 2025: 1.27%
3. 2025 – 2030: 1.31%
4. 2030 – 2035: 1.68%
5. 2035 – 2040: 1.42%

Employment

Table 3-5 summarizes employment projections for the City of Houston using H-GAC's forecast. Figure 3-9 illustrates the changing nature of employment from 2000 to 2017. H-GAC forecasts employment based on residential population, the unemployment rate, and a third parameter that controls labor force participation (i.e. age, disability, family responsibilities, etc.). In the base year of the forecast (2015), jobs were linked to specific locations (i.e. individual buildings) by matching companies and parcel addresses. H-GAC additionally utilizes a Real Estate Development Model to generate forecasts associating specific construction projects to specific parcels of land, given the physical availability of land, as well as the economic feasibility of each construction project in forecasting future employment.

Figure 3-9 Houston Employment Occupation
Source Houston Planning and Development Department (2017)

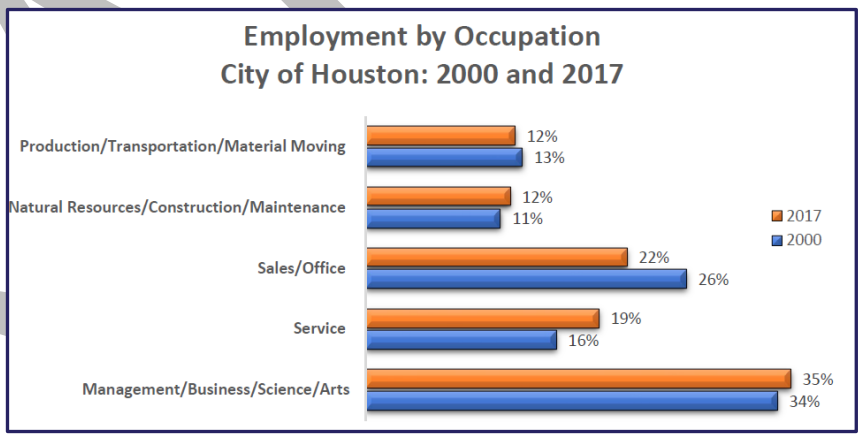


Table 3-5 City of Houston Employment Forecast						
	2019	2020	2025	2030	2035	2040
Employment	1,882,233	1,903,278	2,037,272	2,187,204	2,306,186	2,368,224

Source: H-GAC

The compounded annual growth rates applied for each 5-year increment of the employment forecast are noted below:

2015 – 2020: 1.12%

2020 – 2025: 1.37%

2025 – 2030: 1.43%

2030 – 2035: 1.07%

2035 – 2040: 0.53%

4.0 Waste Generation & Diversion Assessment

Key Points:

1. It is estimated that City-wide, **the recycling rate is approximately 32%** which includes private sector recycling activities, organics processing and construction/demolition waste recovery and recycling. The 32% is equal to approximately **2 million tons per year**.
2. The FY 2019 recovery rate for City residential programs is estimated to be 137,500 tons per year through single stream recycling, recycling centers and tree and yard waste collection and processing.
3. The City provides direct collection service to 390,786 residences. In 2019, the amount of waste collected was 643,000 tons, or 1,760 tons per day. This is equal to 8.9 pounds per household per day, or 1.6 tons per year.
4. Over 65% of the waste stream is generated by businesses and institutions, not including multi-family complexes.
5. Multi-family waste generation is equal to 626,600 tons per year. Housing patterns in Houston point to a greater percentage of individuals living in apartments and other multi-family dwellings in the near future.
6. In 2018, the City's residents, businesses, and institutions, generated approximately 4.2 million tons of MSW that was disposed in landfills. This is equal to 11,500 tons per day.
7. Storm events such as Hurricane Harvey can have a significant impact on the quantities of waste generated in any given year. It is estimated that on a regional basis, Hurricane Harvey generated approximately 1.1 million tons of waste that went into regional landfills.

Disposal Forecast

As a starting point in the planning process, the Project Team evaluated the findings of the H-GAC 2017 Study – A Municipal Solid Waste Generation and Diversion Forecast for the H-GAC Region ("2017 H-GAC Study"). A portion of the City's single-family household population is not currently served by SWMD. Approximately 84% of all single-family households located within the City of Houston are currently served by the SWMD. The remaining 16% are collected through subscription services. Waste generation tonnage (i.e. garbage, bulky waste, yard waste, and recycling) collected by the SWMD was provided for FY 2016 through FY 2018 and is summarized in Table 4-1.

Table 4-1
City of Houston Single-Family Waste Generation[1]

	FY 2016[2]	FY 2017	FY 2018[3]
# of Single-Family (SF) Households Served	**386,232**	**386,531**	**386,830**
SF Garbage (tons/year)	385,660	431,717	445,397
SF Bulky Waste (tons/year)	287,064	174,742	195,829
SF Yard Waste (tons/year)	54,479	54,569	30,612
SF Recycling (tons/year)	62,287	51,497	36,595
Total	**789,490**	**712,525**	**708,433**

1. This is tonnage that is collected by the SWMD.
2. FY 2016 metrics, from the 2017 H-GAC Study, concerning the number of single-family homes and curbside recycling tonnage were modified slightly based on more accurate data that were provided by the City as part of this report.
3. The recycling and yard waste tonnage decreased in FY 2018 due to Hurricane Harvey and the City of Houston having to suspend these specific collection services for several months to focus on debris clean up.

Table 4-2 identifies the City's single-family per-capita rates for both disposal and diversion. Due to slight differences in population and household forecasts between H-GAC's current forecast and 2017 H-GAC Study, the FY 2016 per-capita calculations for the City are adjusted slightly downward from those noted in the 2017 H-GAC Study. It is also worthwhile

to note that after Hurricane Harvey impacted the City in August 2017 (FY 2018), the City of Houston's Solid Waste Management Department briefly suspended curbside collection of yard waste, and single-stream recycling. Therefore, the per capita metrics for FY 2018 were not representative of a typical year, and the per-capita ratios used to forecast waste disposal for FY 2019 – FY 2040 are based on the averages of FY 2016 and FY 2017.

Table 4-2
Single-Family Per-Capita Disposal and Diversion (Tons/Person)[1]

	FY 2016 Per Capita	FY 2017 Per Capita	FY 2018 Per Capita	Average per Capita[2]
SF Disposal				
SF Garbage	0.3540	0.3942	0.4049	0.3741
SF Bulky Waste	0.2635	0.1596	0.1780	0.2115
SF Disposal Sub Total	0.6175	0.5538	0.5829	0.5856
SF Diversion				
SF Recycling	0.0572	0.0470	0.0333	0.0521
SF Yard & Wood Waste	0.0500	0.0498	0.0278	0.0499
SF Diversion Sub Total	0.1072	0.0968	0.0611	0.1020
Total Generation	**0.7247**	**0.6506**	**0.6440**	**0.6876**

1. Example: 385,660 tons (Table 3-1, 2016, Single-Family MSW / 1,089,544 SF Population (Table 3-2) = 0.3540 tons per person per year
2. The average per-capita generation rates used to forecast waste disposal in this analysis are based on the averages of FY 2016 & FY 2017.

Residential Disposal Forecast

The single-family waste disposal forecast for 2019 through 2040 is based on the calculated disposal rates and single family population forecasts. The per capita disposal rate is held constant for the entire forecast, which is a similar approach utilized in the 2017 H-GAC Study. Due to limitations in the availability of multi-family specific data, the same per-capita disposal rate for single-family and multi-family units were used. This is a conservative approach that is also consistent with the approach used in the 2017 H-GAC Study.

Table 4-3 summarizes the single-family and multi-family residential waste disposal for the City of Houston.

Table 4-3
City of Houston Residential Disposal Forecast (Tons)

	2019	2020	2025	2030	2035	2040
Residential Disposal						
Single-Family	769,218	771,115	782,512	797,616	810,267	817,347
Multi-Family	626,662	638,712	702,504	776,572	880,462	965,823
Total Residential Disposal	1,395,880	1,409,827	1,485,016	1,574,188	1,690,729	1,783,170

Commercial Disposal Forecast

The commercial disposal forecast for the City of Houston is based on an average annual disposal rate of 1.51 tons per employee. This is then applied to the employment forecast. This metric was derived from the 2017 H-GAC Study and is consistent with other studies that evaluate disposal rates on a per-employee basis. The disposal rate was assumed to be constant for the entire 2019 through 2040 forecast. Table 4-4 summarizes the commercial disposal forecast for the City of Houston.

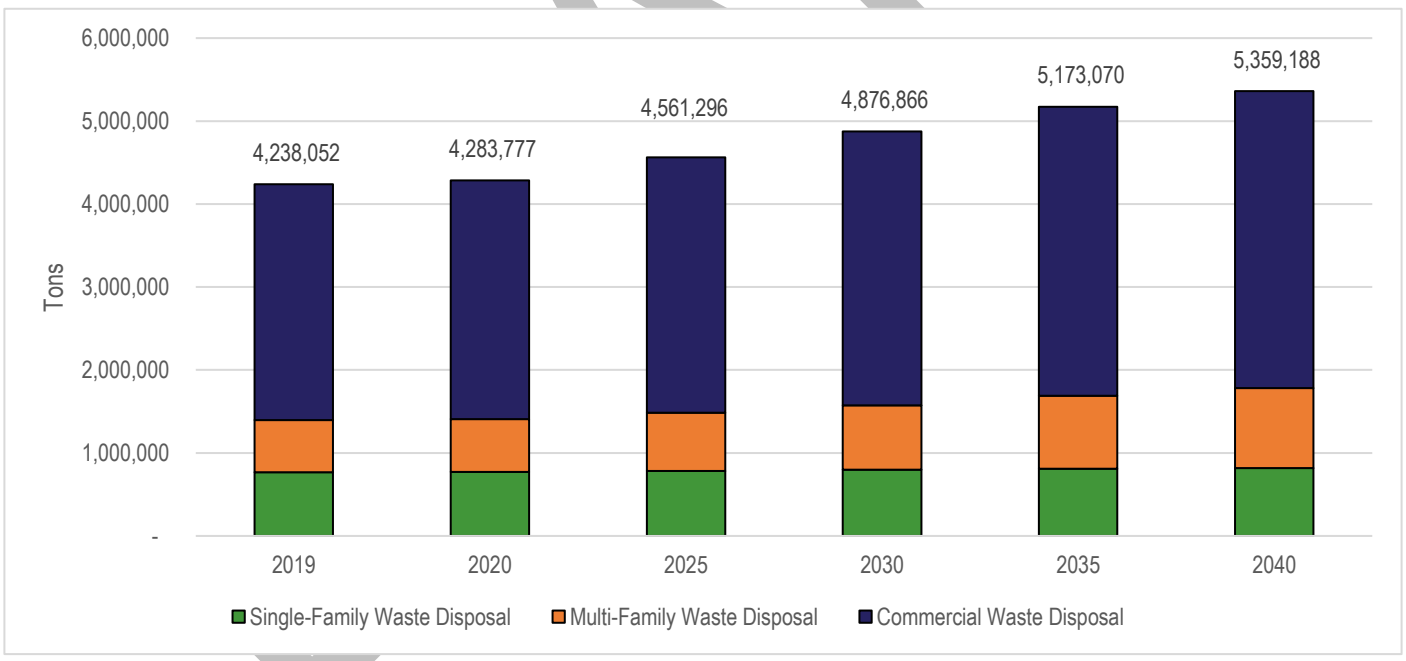
Table 4-4 City of Houston Commercial Disposal Forecast (Tons)						
	2019	2020	2025	2030	2035	2040
Commercial Disposal	2,842,172	2,873,950	3,076,281	3,302,678	3,482,341	3,576,018

Total Disposal Forecast

Table 4-5 and Figure 4-1 summarize the total disposal forecast, which is comprised of waste disposed by both the residential and commercial sectors.

Table 4-5 Forecast (Tons)						
	2019	2020	2025	2030	2035	2040
Residential Disposal						
Single-Family	769,218	771,115	782,512	797,616	810,267	817,347
Multi-Family	626,662	638,712	702,504	776,572	880,462	965,823
Commercial Disposal	2,842,172	2,873,950	3,076,281	3,302,678	3,482,341	3,576,018
Total Disposal	**4,238,052**	**4,283,777**	**4,561,296**	**4,876,866**	**5,173,070**	**5,359,188**

Figure 4-1
City of Houston Total Disposal Forecast



Diversion Forecast

City-wide Diversion Quantities

Estimated diversion efforts within the City are based on the quantities of yard and wood waste, recyclables, construction & demolition (C&D), and other recyclables diverted annually within the City of Houston.[2] The survey-based "Study on the Economic Impacts of Recycling" commissioned by Texas Commission on Environmental Quality (TCEQ) and released in 2017 (2017 TCEQ Study) was used to quantify the amount of these materials diverted. According to the 2017 TCEQ Study, approximately 9.17 million tons of material were diverted from landfills statewide in 2015. These 9.17 million tons are based on data collected through the 2017 TCEQ survey, as well as supplemental data received from other sources.

The data do not include the extrapolation of recyclables and is, therefore, a conservative estimate. Table 4-6 summarizes the diverted material per the results of the 2017 TCEQ Study.

Table 4-6
State of Texas 2015 Diverted Material per 2017 TCEQ Study (Tons)

	Total	% of Total
Typical Recyclable Material[1]	3,129,530	34.1%
Organics[2]	2,747,128	30.0%
Construction & Demolition Material[3]	3,136,727	34.2%
Other Recyclables[4]	158,322	1.7%
Total	**9,171,707**	**100%**

1. Includes glass, metals, paper, and plastics.
2. Includes biosolids, food and beverage materials, yard trimmings, brush, and leaves.
3. Includes concrete aggregate and others.
4. Includes electronic materials, household hazardous waste, textiles, tires, and other uncategorized materials.

Curbside and Drop-Off Recyclables

Approximately 8.17% of all Texas residents reside within the City of Houston. Therefore, it is assumed that 8.17% of all reported diverted material (approximately 749,328 tons of the 9,171,707 total tons) was generated within the City in 2015.[3] Table 4-7 presents the quantities of materials recovered in Houston based on the 2017 TCEQ study. However, a review of Houston's specific data shows significantly more C&D and organics being recovered.

The SWMD currently maintains metrics for their single-stream curbside recycling operation. Table 4-8 presents historic metrics for the residential recycling, yard waste, and tree waste.

Table 4-7
Estimated 2015 Diverted Material in Houston (Tons)

	Total	% of Total
Typical Recyclables[1]	255,683	34.1%
Organics[2]	224,440	30.0%
Construction & Demolition Material[3]	256,271	34.2%
Other Recyclables[4]	12,935	1.7%
Total	**749,328**	**100%**

1. Includes glass, metals, paper, and plastics.
2. Includes biosolids, food and beverage materials, yard trimmings, brush, and leaves.
3. Includes concrete aggregate.
4. Includes electronic materials, household hazardous waste, textiles, tires, and other uncategorized materials.

[2] The amount of material estimated to be diverted includes both material collected by the City of Houston Solid Waste Management Department, as well as the private sector.
[3] Per the U.S. Census (reported as of July 2017): 2,312,717 Houston population / 28,304,596 Texas population = 8.17%

In addition to single-family curbside recycling, the SWMD operates six neighborhood depositories/recycling centers and four neighborhood recycling drop-off locations. Tonnage collected at these ten sites are forecasted in Table 4-9. Private companies in the City also offer commercial recycling services, although the specific tonnages associated with commercial recycling collection are not publicly available. Table 4-10 and Figure 4-2 are based on the extrapolated metrics derived from the 2017 TCEQ Study and reflect the impact of the continued population growth within the City of Houston.

Table 4-8
Single Family (SF) Per-Capita Diversion (Tons/Person))

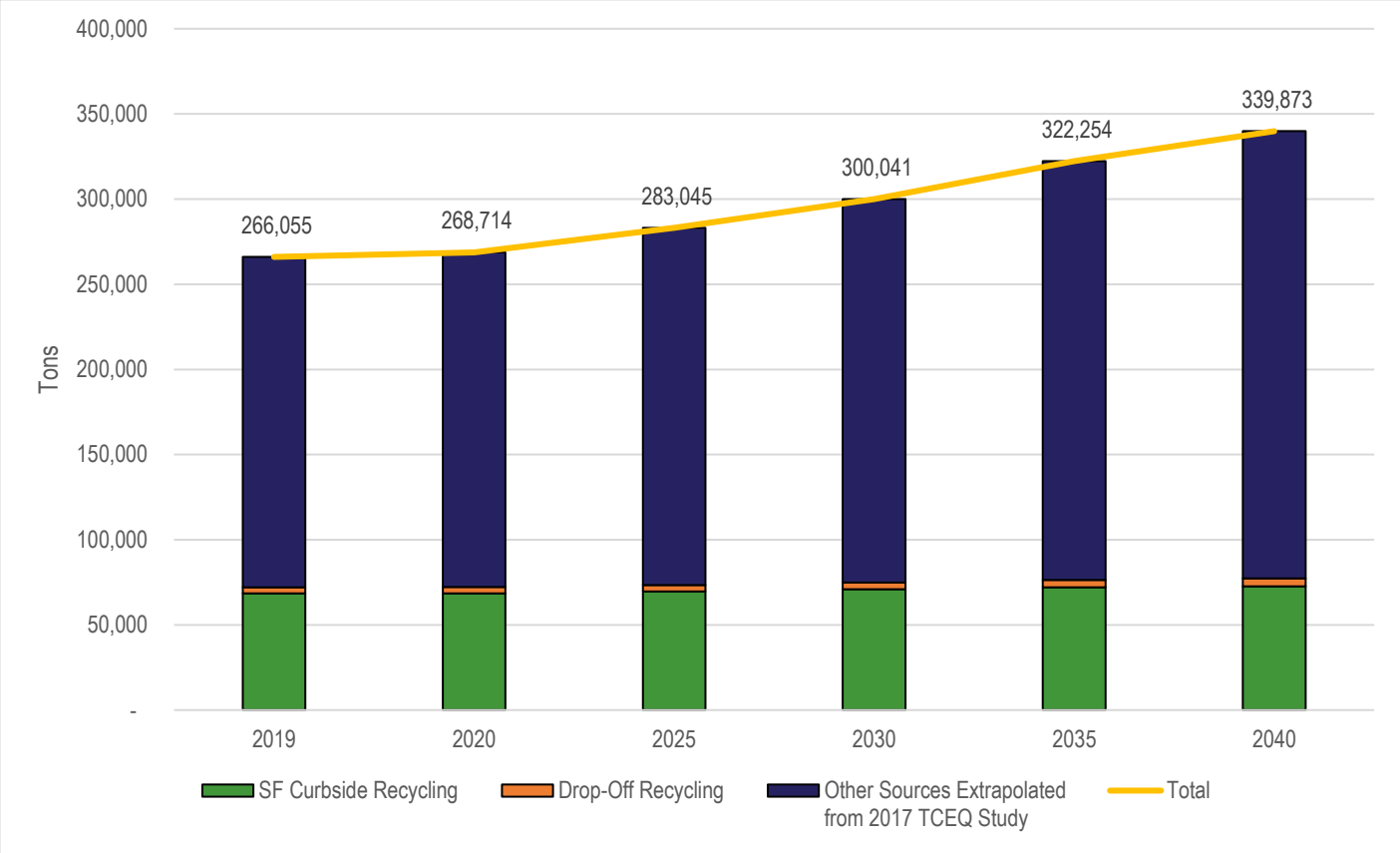
	2016	2017	2018
SF Diversion			
SF Recycling	0.0572	0.0470	0.0333
SF Yard & Wood Waste	0.0500	0.0498	0.0278
SF Diversion Total	**0.1072**	**0.0968**	**0.0611**
Total Diversion (Tons/Year)			
SF Yard Waste (tons/year)	54,479	54,569	30,612
SF Recycling (tons/year)	62,287	51,497	36,595
SF Diversion Total	**116,766**	**106,006**	**67,207**

Table 4-9
City of Houston Typical Recyclable Material Forecast (Tons)

	2019	2020	2025	2030	2035	2040
SF Curbside Recycling[1]	68,436[1]	68,605	69,619	70,963	72,088	72,718
Drop-Off Recycling[2]	3,567	3,603	3,795	4,023	4,321	4,557
Glass, Metals, Paper & Plastics Diversion from Other Sources[3]	194,052	196,506	209,631	225,055	245,845	262,598
Total	**266,055**	**268,714**	**283,045**	**300,041**	**322,254**	**339,873**

1. Typical recyclables collected via curbside recycling for single-family units.
2. Tonnage sourced from the City of Houston depositories/recycling centers and drop-off locations.
3. Tons of recyclables from other sources is extrapolated per the 2017 TCEQ Study.
4. 0.0521 * 1,313,556 (single-family population per Table 2-1) = 68,436 tons of single-family (SF) curbside recyclables.
5. This includes projected recycling tonnage for all single-family homes, both those collected by the City, and the 16% of single-family households collected by contracted service providers.

Figure 4-2
City of Houston Typical Recyclable Material Forecast



Organics

Table 4-10 summarizes the single-family yard and wood waste forecast for the SWMD curbside program, using the 0.0499 per capita rate identified in Table 4-2, and applying that rate to the estimated single-family population.

Table 4-10 City of Houston Single-Family (SF) Wood & Yard Waste (Tons)[2]

	2019	2020	2025	2030	2035	2040
SF Wood & Yard Waste	65,546[1]	65,708	66,679	67,966	69,044	69,648

1. 0.0499 * 1,313,556 = 65,546 tons of single-family (SF) wood and yard waste.
2. This includes projected wood and yard waste tonnage for all single-family homes, both those collected by the City, and the 16% of single-family households collected by contracted service providers.

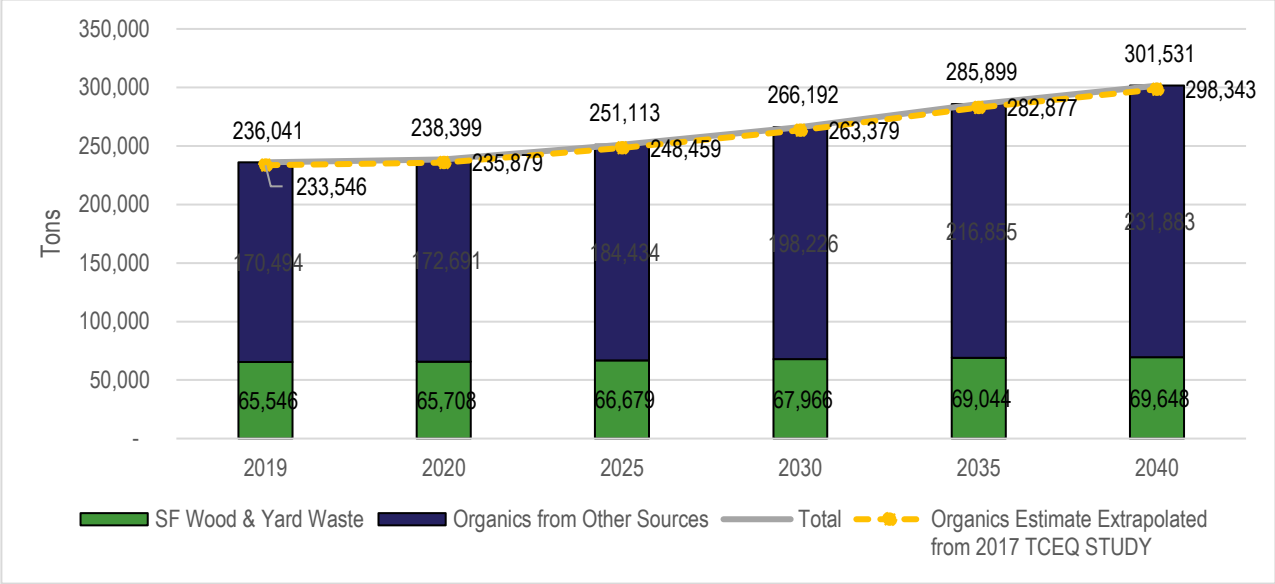
Table 4-11 summarizes the organics diversion forecast for the City of Houston and incorporates the impact of the continued population growth within the City.

Table 4-11 City of Houston Organics Diversion Forecast (Tons)						
	2019	2020	2025	2030	2035	2040
SF Wood & Yard Waste[1]	65,546	65,708	66,679	67,966	69,044	69,648
Organics Diverted from Other Sources[2]	170,494	172,691	184,434	198,226	216,855	231,883
Total	**236,041[3]**	**238,399**	**251,113**	**266,192**	**285,899**	**301,531**

1. Yard waste and wood waste collected from single-family homes.
2. Forecast for organics tracks with population growth. See Section 2.1.
3. Values differ slightly from Table 4-5 because Table 4-7 was adjusted for growth. Table 4-5 was based on tonnage reported for 2018.

Figure 4-3 illustrates the organics diversion forecast for the City of Houston.

Figure 4-3
City of Houston Organic Diversion Forecast



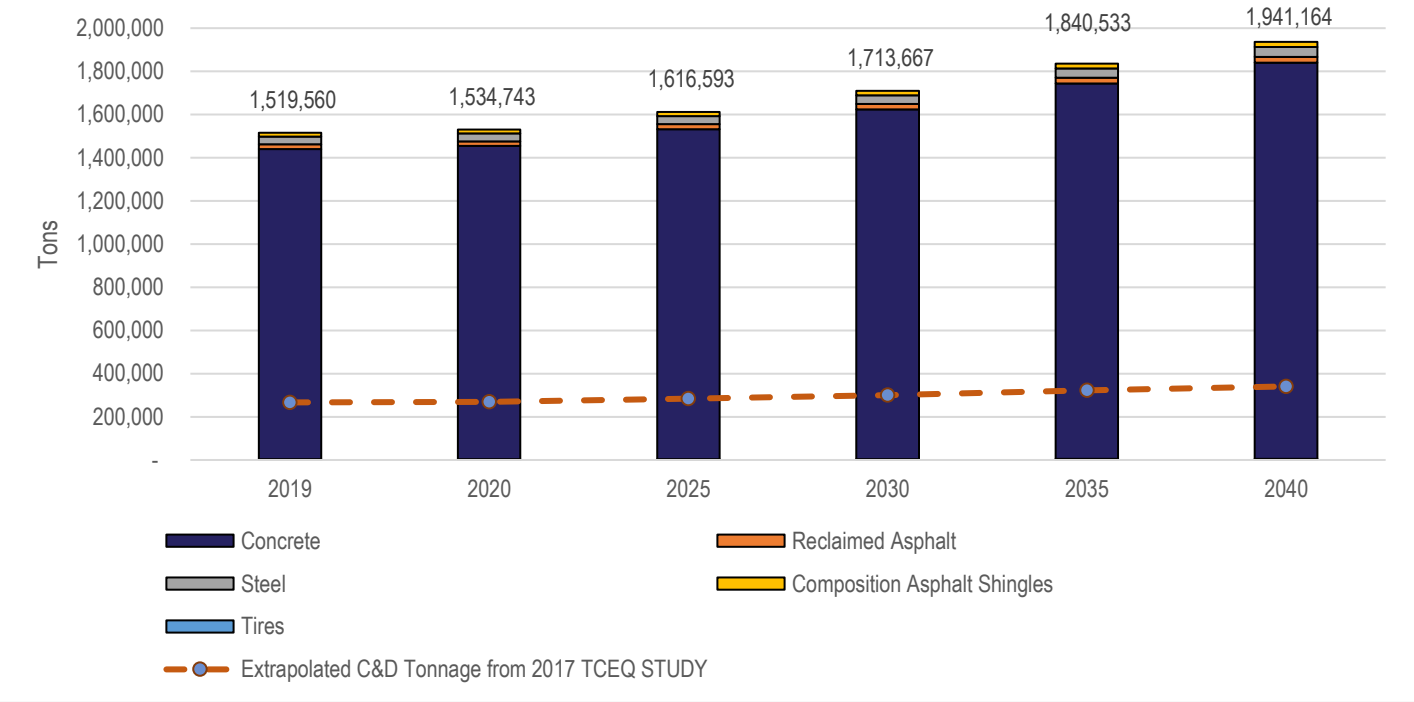
Construction & Demolition Materials

There are several demolition and C&D recycling companies that operate within the City of Houston. Based on conversations with some of these companies, it is estimated that approximately 1.5 million tons of C&D material is diverted on an annual basis from within the City of Houston. C&D material includes concrete (i.e. aggregate), reclaimed asphalt, steel, composition asphalt shingles, and tires.[4] Table 4-12 and Figure 4-4 summarize the C&D diversion forecast, which is projected to increase with population growth.

Table 4-12
City of Houston Construction & Demolition Materials Diversion (Tons)

	2019	2020	2025	2030	2035	2040
C&D Materials	1,519,560	1,534,743	1,616,593	1,713,667	1,840,533	1,941,164

Figure 4-4
City of Houston C&D Diversion Forecast



Other Recyclables

It is interesting to note that the amount of C&D being diverted within the City of Houston (1,519,560 tons) is significantly greater than the amount estimated per the 2017 TCEQ Study 256,271 tons. This is due to the very active C&D diversion program within the City of Houston and this Region by several C&D contractors within the Houston area, most notably Cherry Companies.

The final component of the waste diversion forecast includes other recyclables which combine for a small percentage (1.7%) of all diverted materials. These materials include electronic waste, household hazardous materials, textiles, tires, and other uncategorized materials.

[4] The following additional material could be diverted if markets for them are established: sheet rock, carpet, treated wood, gypsum, and glass.

Table 4-13 summarizes the forecast for these types of materials, which is based on the 8.17% allocation factor (Houston residents as a percentage of the State of Texas population). These generation rates are assumed to grow at the same annual growth rates as population.

Table 4-13
City of Houston Other Recyclables (Tons)

	2019	2020	2025	2030	2035	2040
Other Recyclables	13,460	13,594	14,319	15,179	16,303	17,194

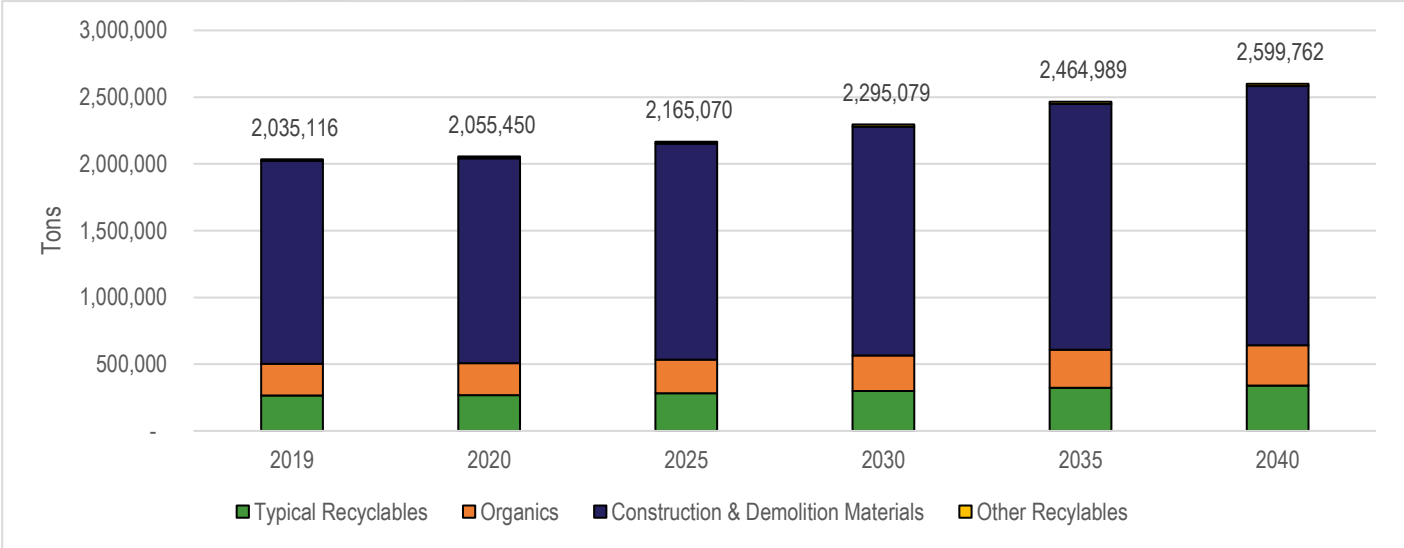
Total Diversion Forecast

Table 4-14 and Figure 4-5 summarize the total diversion forecast, which includes the following materials: typical recyclables, organics, C&D waste, and other recyclables.

Table 4-14
City of Houston Total Diversion Forecast (Tons)

	2019	2020	2025	2030	2035	2040
Typical Recyclables	266,055	268,714	283,045	300,041	322,254	339,873
Organics	236,041	238,399	251,113	266,192	285,899	301,531
Construction & Demolition Waste	1,519,560	1,534,743	1,616,593	1,713,667	1,840,533	1,941,164
Other Recyclables	13,460	13,594	14,319	15,179	16,303	17,194
Total Diversion Tonnage	**2,035,116**	**2,055,450**	**2,165,070**	**2,295,079**	**2,464,989**	**2,599,762**

Figure 4-5
City of Houston Total Diversion Forecast



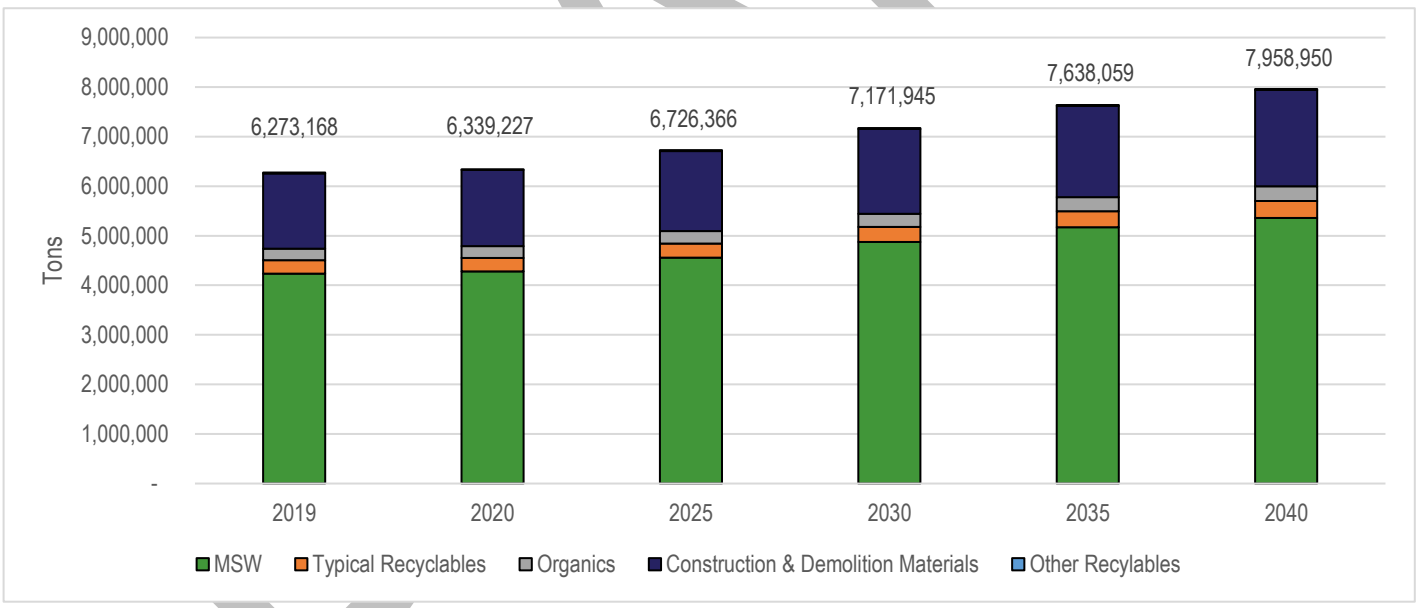
Forecast Summary

The total generation forecast is comprised of both the disposal and diversion forecasts. Table 4-15 and Figure 4-6 summarize the generation forecast. Based on the data as shown in Table 4-15, the City has an estimated diversion rate of approximately 32.4%. However, it should be noted that 75% of the diversion rate is due to C&D. Excluding C&D, the diversion rate is approximately 10.9% (515,556 tons/4,238,054 + 515,556 = 10.9%). Based on this analysis, while a significant portion of the waste stream generated within the City of Houston is diverted, there are additional opportunities to increase the diversion of materials from landfills within the City of Houston in a cost-effective manner.

Table 4-15
City of Houston Total Generation Forecast (Tons)

	2019	2020	2025	2030	2035	2040
Total Disposal	4,238,052	4,283,777	4,561,296	4,876,866	5,173,070	5,359,188
Total Diversion	2,035,116	2,055,450	2,165,070	2,295,079	2,464,989	2,599,762
Total Generation	**6,273,168**	**6,339,227**	**6,726,366**	**7,171,945**	**7,638,059**	**7,958,950**

Figure 4-6
City of Houston Total Generation Forecast by Type of Material



5.0 Facilities Assessment

Key Findings

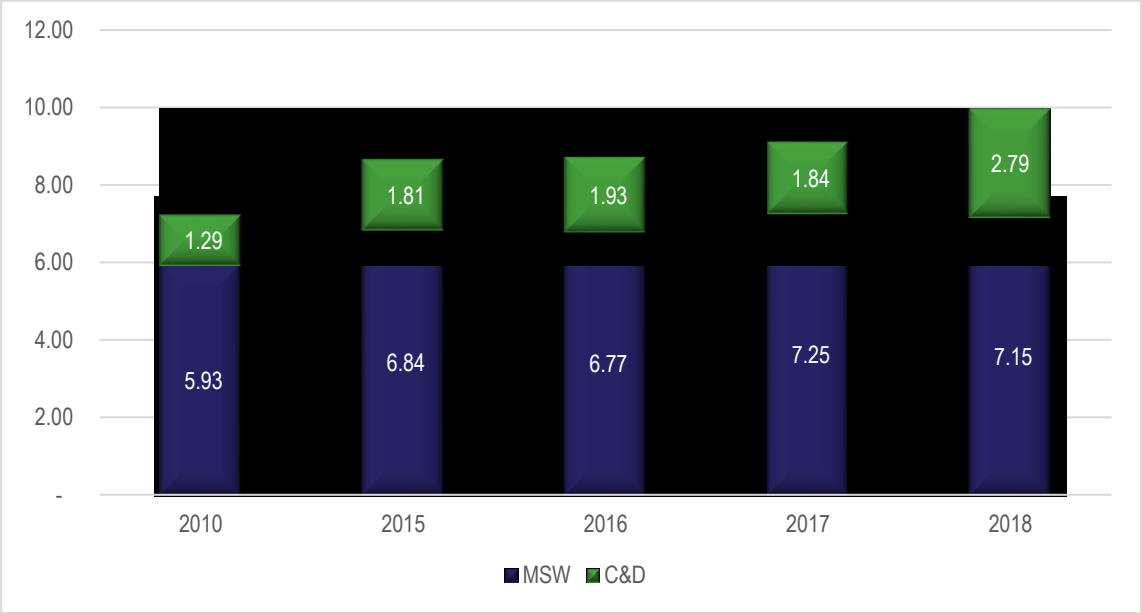
1. Management of municipal solid waste requires a complex infrastructure, including facilities to collect, process, recover, transfer, and dispose of wastes.
2. The City relies on facilities throughout the region to meet its needs. Based on TCEQ reports, all of the MSW landfills in the H-GAC region report they accept waste generated in Harris County. Waste is also imported from other counties to the McCarty Road Landfill located in Houston.
3. The private sector has a critical role in meeting Houston's municipal solid waste management needs. This includes hundreds of recycling businesses as well as material recovery facilities, mulch and composting operations, transfer stations and landfills. This fact has both benefits and risks to the City that were evaluated in the planning process.
4. Currently, the City relies primarily on the McCarty Road, Blue Ridge or Atascocita Landfills for disposal of waste collected by City crews, which is primarily residential waste. These landfills have a combined capacity of 140.2 million tons of waste, or approximately 37 years at current rates of disposal. **The McCarty Road Landfill has 13 to 16 years of remaining capacity and the Atascocita Landfill has 24 years of remaining capacity** (Source: TCEQ MSW Landfill Annual Reports). It generally takes between **10 to 15 years to secure new capacity in Texas** under today's political and regulatory climate. There is a total of 13 operating municipal solid waste landfills in the H-GAC region with a combined remaining capacity of between 30 to 40 years assuming current per-capita disposal rates.
5. A total of 2.8 million tons of C&D waste is disposed at the 15 operating Type IV C&D landfills in the region. Regionally, these facilities have an estimated 20 to 30 years of remaining capacity.
6. **In 2010, 7.2 million tons of waste were landfilled in the H-GAC region; in 2018, 9.9 million tons were landfilled** (Source: TCEQ Annual Municipal Solid Waste Report & Landfill Annual Reports to TCEQ). This increase is largely attributed to increases in population and economic activity. Also, tonnages associated with Hurricane Harvey are reflected in the fiscal year 2018 figures, explaining the increase in C&D disposal quantities from 1.8 million tons to 2.8 million tons**. Regionally, the per-capita disposal rate for MSW increased from a rate of 5.22 pounds per capita per day (pcd) in 2010 to 5.52 pcd in 2018**. In 2040, the estimated regional population is projected to be 9.0 million. Assuming no change in the disposal rate per capita, this represents approximately 229 million tons requiring disposal from 2018 to 2038. Current Type I and Type IV landfill capacity is 328.5 million tons.
7. The City-owned facilities, including recycling drop-off centers, depositories and environmental service centers help facilitate recycling, and proper management of household hazardous waste.
8. There are approximately 500,000 tons of annual capacity at material recovery facilities (MRFs) in the Region. The majority of this capacity is located within the City of Houston. These facilities process comingled recyclable materials for market. Prior to March 2019, the City relied on three MRFs to process comingled recyclables. Since March 2019, the residential co-mingled recyclable materials collected by the City are being taken to the newly constructed FCC MRF located in northeast Houston. The FCC facility has a capacity of 145,000 tons per year.
9. The growth of the mulch and composting industries in the last few years has had an impact on the quantities of materials that would otherwise require disposal. In 2017, over 600,000 tons of organic material were processed regionally and marketed instead of being landfilled.
10. In addition to the City's three transfer stations, there are 10 privately operated transfer stations serving Houston and an additional 8 transfer stations located outside Houston. Twenty-six percent of the waste collected in the region is

The management of MSW in Houston requires a regional, complex, integrated waste management system to meet the MSW needs of Houston's residents and businesses.

Houstonians might be surprised at the amount of recycling taking place in the H-GAC region. Over **800,000 tons of organics** are recovered; over **2.5 million tons of C&D** are processed and recycled; and over **300,000 tons of materials** such as paper, metals and plastics are recovered at Houston material recovery facilities and that does not include private sector recycling such as scrap businesses. Still, over 9.7 million tons of waste are landfilled in the region.

taken to a transfer station for transfer to one of the area's regional landfills. An additional transfer station is planned for northeast Houston at the City's Northeast Service Center.

Figure 5-1
Disposal Quantities in H-GAC Region (million tons/year)



A Complex Regional System

According to TCEQ records, there are 111 TCEQ-authorized municipal solid waste (MSW) management facilities located in Houston (excluding liquid waste facilities). In the H-GAC Region (Region), there are 230 facilities (refer to Table 5-1).

Of the 111 facilities in Houston, 41 are TCEQ-authorized recycling and resource recovery (RR) facilities. These 41 facilities include mixed waste processing facilities and material recovery facilities, electronic recycling, construction & demolition recycling, and shingle recycling.

In addition to these 41 authorized facilities, there are recycling facilities that do not require TCEQ authorization such as the City's Westpark Consumer Recycling Center and a number of private recycling businesses. An H-GAC database identifies over 32 recycling drop-off centers in Harris County, 21 of which are located in Houston. A review of local data also identified between 150 and 200 businesses that provide some form of recycling services.

The Westpark Consumer Recycling Center is one of only several options that Houstonians have to recycle materials.

There are approximately 18 Houston facilities that either mulch wood or produce compost, and 52 regionally. Composting and wood grinding facilities process yard waste, brush and tree waste, biosolids (digested wastewater treatment plant sludge) and a small amount of food residuals.

The use of transfer stations allows short-haul collection vehicles to transfer waste to larger, more efficient trucks. Given Houston's traffic conditions, these facilities are especially important to reduce the cost of hauling waste and reducing

vehicle emissions. The City owns three transfer stations and is planning a new facility in northeast Houston. There are 13 operating MSW transfer stations in the City and 21 operating in the Region. An additional eleven transfer stations are permitted regionally but are either inactive or not constructed. In 2017, a total of 2.5 million tons were sent to transfer stations in the Region before being sent to a landfill.

Materials that are not recovered are disposed at one of the 27 operating landfills located in the Region. Twelve of these are municipal solid waste landfills (Type I) and 15 are construction and demolition waste landfills (Type IV). Regionally, over 9.9 million tons of waste were disposed in 2018.

TCEQ-authorized facilities also manage specific waste materials including household hazardous wastes ("HHW"), medical wastes, grease and grit trap wastes and tires. With the exception of nine permitted landfill gas-to-energy operations in the Region, there are no known energy from waste facilities operating in the Region.

Table 5-1
TCEQ-Authorized Regional Waste Management Facilities

Type of Facility	# Authorized in Houston	# Operating in Houston	Authorized in H-GAC Authorized Region	Operating in H-GAC Region
Recycling[1]	41	40	76	74
Composting	19	18	54	52
Medical Waste Transfer & Processing	3	3	5	5
Grease & Grit Trap Waste Transfer & Processing	8	5	8	5
Transfer Stations[2]	19	13	31	21
MSW Landfills – Type I[3]	2	2	14	12
Construction & Demolition Landfills – Type IV	12	10	17	15
Landfill Gas Recovery	2	2	9	7
Citizen Convenience Centers & Low Volume TS	0	0	11	11

1. Includes C&D recycling, electronics recycling, shingle recycling, mixed waste processing and material recovery facilities. A breakdown of these facilities is presented later in this report. Total operating facilities is uncertain as there are no reporting requirements for these facilities.
2. FCC's Material Recovery Facility and Republic's Resource Renewal Complex are authorized as transfer stations but only manage recyclable materials from single stream residential recyclables collections and commercial sector recyclables. Thirteen (13) of the nineteen (19) permitted Houston transfer stations transferred MSW in 2018.
3. One is permitted but not constructed (Darrell Dickey Landfill). Does not include one MSW landfill that accepts primarily commercial/industrial waste that is an industrial waste landfill (Conroe Industrial Non-hazardous Landfill).

MSW Landfills

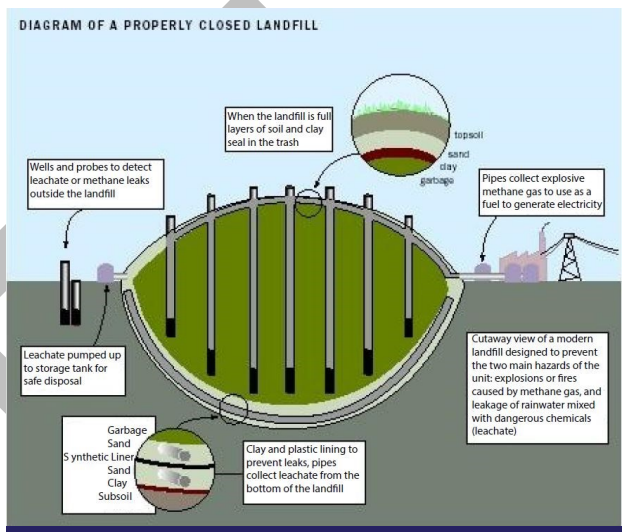
MSW Landfill Requirements

The majority of Houston's waste is disposed in one of the 12 operating municipal solid waste landfills (Type I) or 15 operating construction and demolition (C&D) landfills (Type IV) in the H-GAC region. The Type I or IV designation refers to the regulatory requirements as governed by the Texas Commission on Environmental Quality (TCEQ). A landfill is an

engineered facility for the disposal of waste. MSW landfills are designed to mitigate potential environmental consequences of disposal, including impacts to water quality, air and land resources. This is accomplished through the use of liner and leachate collection systems, operating practices and ultimately closure and post-closure care of the site. The basic components of a landfill are presented below. It should be noted that the requirements for Type I and Type IV landfills are different because of the differences in the types of waste accepted at each.

Composite liner requirements— typically includes a flexible membrane (i.e., geo-membrane) overlaying two feet of compacted clay soil lining the bottom and sides of the landfill. They are used to protect groundwater and the underlying soil from leachate releases.

Figure 5-2 Landfill Design Concept
Source: U.S. Environmental Protection Agency



It takes approximately 10 to 15 years to site, permit and construct a new landfill.

1. **Leachate collection and removal systems -** sit on top of the composite liner and remove leachate from the landfill for treatment and disposal.
2. **Operating practices -** include compacting and covering waste frequently with several inches of soil. These practices help reduce leachate generation and odors, control litter, insects, and rodents, and protect public health. Figure 5-2 shows a cross-section of a municipal solid waste landfill.
3. **Groundwater monitoring requirements -** requires testing groundwater wells to determine whether leachate has escaped from the landfill.
4. **Landfill gas management** – as waste decomposes, it produces methane, a gas similar to natural gas. This gas must be managed, which often includes collection and processing for potential energy recovery.
5. **Closure and post-closure care requirements -** include covering landfills and providing long-term care of closed landfills.
6. **Financial assurance -** provides funding for environmental protection during and after landfill closure (i.e., closure and post-closure care).

Regional MSW Landfill Capacity

The City of Houston does not own or operate either a Type I or a Type IV landfill. The City relies primarily on three landfills for the disposal of residential waste collected by SWMD crews. These facilities include McCarty Road, Atascocita and Blue Ridge. With the exception of the Chambers County Landfill, all of the landfills in the region are owned and operated by private entities. The location of regional landfills is presented in Appendix B.

Table 5-2 presents landfill remaining capacity. The three landfills that the City relies on for residential waste disposal have a combined capacity of approximately 38 years. The McCarty Road Landfill has 13 years remaining capacity at current rates of disposal; the Atascocita Landfill has remaining capacity of 24 years at current rates of disposal; the Blue Ridge Landfill has a reported 88 years of capacity at current rates of disposal. On a regional basis, three other landfills (Altair Disposal Services Landfill, Galveston County Landfill and Chambers County Landfill) have 20 years or less remaining capacity. It should be noted that as one landfill reaches its capacity, the waste from that landfill will be directed to another landfill, thereby increasing its annual disposal quantities, and reducing its remaining site life.

Table 5-2 Type I Landfills – Ownership & Capacity				
Landfill	Owner	Remaining Capacity Tons	Remaining Capacity Cubic Yards	Remaining Capacity Years (2017)
McCarty Road	Republic	23,748,385	21,472,319	13
Atascocita	Waste Management of Texas	29,228,482	38,458,529	21
Blue Ridge	Blue Ridge Landfill TX, LP	87,275,249	142,373,978	86
Houston Primary Landfills		**140,252,116**	**202,304,826**	**37**
Houston Secondary Landfills		**127,448,641**	**157,000,630**	**40**
Total*		**267,700,757**	**359,305,456**	**31**

Source: TCEQ Municipal Solid Waste – A Year in Review 2017. Assumes current rates of disposal. *Does not include Conroe Industrial Non-hazardous Waste Landfill with a capacity of 5.7 million tons and accepted 49,300 tons in 2017

Table 5-3 presents data on historic waste disposal quantities in the H-GAC region. A key assumption used by TCEQ in determining landfill life is that disposal rates remain constant over the life of the facility. However, the continued growth in population and economic activity has resulted in increased annual disposal quantities in the Region. In 2010, the H-GAC region disposed of 5.93 million tons of waste in Type I landfills. By 2017, this quantity increased to 6.97 million tons, a 17.5% increase. Over the same period, the population of the H-GAC region increased from 6.1 million in 2010 to 6.9 million in 2017, a 13% increase (Sources: Texas Demographic Center & Texas Water Development Board). Therefore, on a regional basis, waste disposal per capita increased from 5.22 pounds pcd in 2010 to 5.5 pcd in 2017. The impacts of anticipated growth in the region is discussed later in this report.

Table 5-3 also shows the distribution of market share for these landfills. The three landfills that the City relies on for its disposal accounted for 55% of the waste disposed in the Region. The McCarty Road Landfill owned by Republic Services decreased from 30% of the region's market share in 2010 to 21% in 2017. The Blue Ridge Landfill, also owned by Republic Services, increased from 9% in 2010 to 16% in 2017. And other than the increase in Fort Bend Regional Landfill's market share going from 10% to 15%, there have not been major shifts in waste flow over the period 2010 to 2017.

Table 5-3 Type I Landfills – Annual Throughput (Tons)							
Historical Throughput	2010	2015	2016	2017	2018	2010% Market Share	2018% Market Share
McCarty Road	1,793,086	1,426,088	1,116,310	1,364,814	1,619,174	30%	23%
Atascocita	939,804	1,242,928	1,253,621	1,209,440	1,248,556	16%	17%
Blue Ridge	516,629	1,060,899	1,176,325	1,244,016	1,115,761	9%	16%
Subtotal	**3,249,519**	**3,729,915**	**3,546,256**	**3,818,270**	**3,983,491**	**55%**	**56%**
Subtotal	**2,678,701**	**3,106,195**	**3,228,211**	**3,436,442**	**3,171,461**	**45%**	**44%**
Total	**5,928,220**	**6,836,110**	**6,774,467**	**7,254,712**	**7,154,952**	**100%**	**100%**

Impacts of Growth on MSW Capacity

Table 5-2 shows that the anticipated remaining capacity of the facilities in the region is approximately 37 years. This assumes that annual waste quantities do not increase above the 2017 rate. However, as demonstrated between 2010 to 2017, waste quantities have continued to increase, even at a rate higher than the increases in population. For the planning period, 2018 - 2038, population in the H-GAC region is anticipated to increase from 6.9 million to over 8.8 million. Assuming no increase in waste disposal rates per capita, municipal solid waste quantities will increase from 6.9 million tons per year to 10.9 million tons per year. The amount of waste disposed of cumulatively over the planning period is anticipated to be 190 million tons between 2019 – 2038.

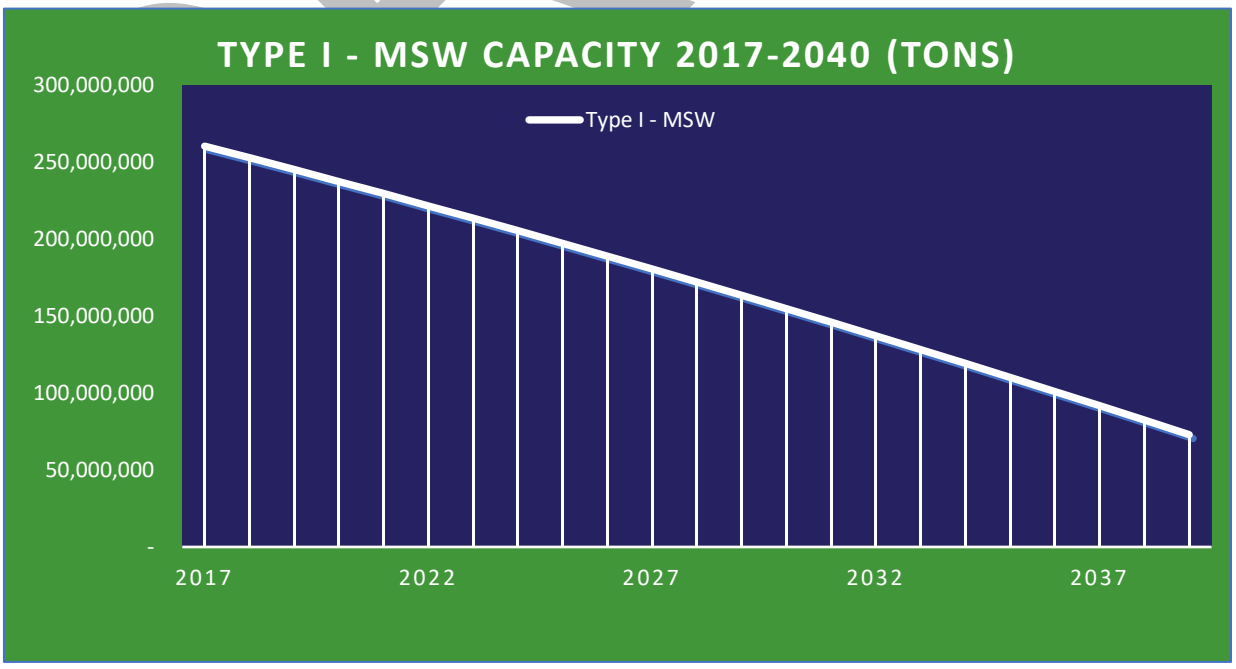
Current regional Type I disposal capacity is 267 million tons. By 2038, 71% of the current disposal capacity will be filled. At the end of the planning period (2040), there is projected to be an estimated 92 million tons of remaining capacity if there are no expansions or new sites permitted (Figure 5-3).

This also does not take into consideration the potential that C&D landfills will have reached capacity and the Type IV waste that would normally go to these landfills may be directed to Type I landfills. It also does not take into consideration other factors including changes in regional economic activity, storm events and the impacts of future source reduction and recycling programs.

If there are no major changes in capacity, and waste disposal quantities continue to increase at projected rates, one landfill will have reached capacity and six landfills, including McCarty Road, will have ten years or less of remaining capacity. Four key factors are uncertain at this time that will affect remaining capacity at any specific landfill.

1. Whether any of the landfills are able to expand their current facility;
2. When a landfill in the region reaches capacity, where the flow of that waste will go and how will it impact a specific landfill's remaining capacity;
3. What factors could impact the waste disposal rate in a way that would reduce annual disposal quantities; and
4. The region's C&D landfills have less capacity than the Type I landfills. It is possible that as C&D options are reduced, some of the waste that currently goes to MSW landfills will ultimately go to Type I Landfills.

Figure 5-3
H-GAC Region - Remaining Capacity



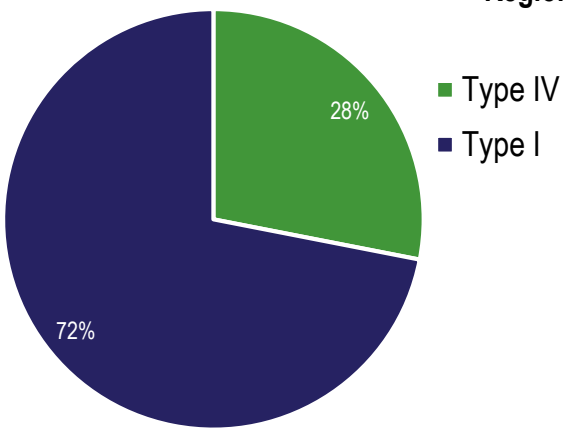
Construction & Demolition Landfills

The H-GAC region has a total of 15 operating Type IV landfills. These landfills are designed to only accept C&D debris and brush. Because they do not accept putrescible waste, the liner and final cover requirements for Type IV landfills are less stringent than the requirements for Type I landfills.

The H-GAC region is unique to Texas in its number of Type IV facilities. Approximately 21% of the total waste stream goes to these facilities compared to the North Central Texas Council of Governments (NCTCOG) region (Dallas/Fort Worth) where only 7% of the waste stream goes to Type IV facilities. In the NCTCOG region, there are only 3 permitted Type IV facilities.

Table 5-4 presents a summary of C&D landfill capacity (60.8 million tons) and 2017 annual disposal quantities (1.85 million tons). (Source: TCEQ Annual MSW Report)

Figure 5-4
Disposal Facilities Used in H-GAC Region



The regional capacity of Type IV landfills is 40 million tons and at current rates of disposal at 1.8 million tons per year, there are 32 years remaining capacity. Of the 40 million tons of regional capacity, 28 million tons are located within Houston City boundaries, or 70%. Houston Type IV landfills disposed 1.4 million tons in 2017, or 77% of the total amount disposed in regional Type IV landfills.

Table 5-4
C&D Landfill Capacity

C&D Landfills	Tons of Capacity	Cubic Yards of Capacity	2017 Tons	Years Remaining Capacity
Total	60,824,019	104,310,227	1,852,255	22

Table 5-5 presents Type IV landfill disposal quantities for 2010, 2015, 2016 and 2017. As with the case for Type I MSW landfills, the amounts of waste disposed in Type IV landfills has continued to increase from 2010 to present. The 2010 C&D per capita disposal rate was 1.15 per capita per day (pcd); this rate increased to 1.46 pcd in 2018, a 27% increase in pcd disposal. Based on landfill reports to TCEQ, C&D disposal quantities for 2018 increased by approximately 700,000 tons in one year. This is largely due to the impacts of Hurricane Harvey, which occurred in late 2017, but for reporting purposes is shown in 2018. (TCEQ reporting periods are August through September.)

Table 5-5
Historic Type IV Disposal Rates

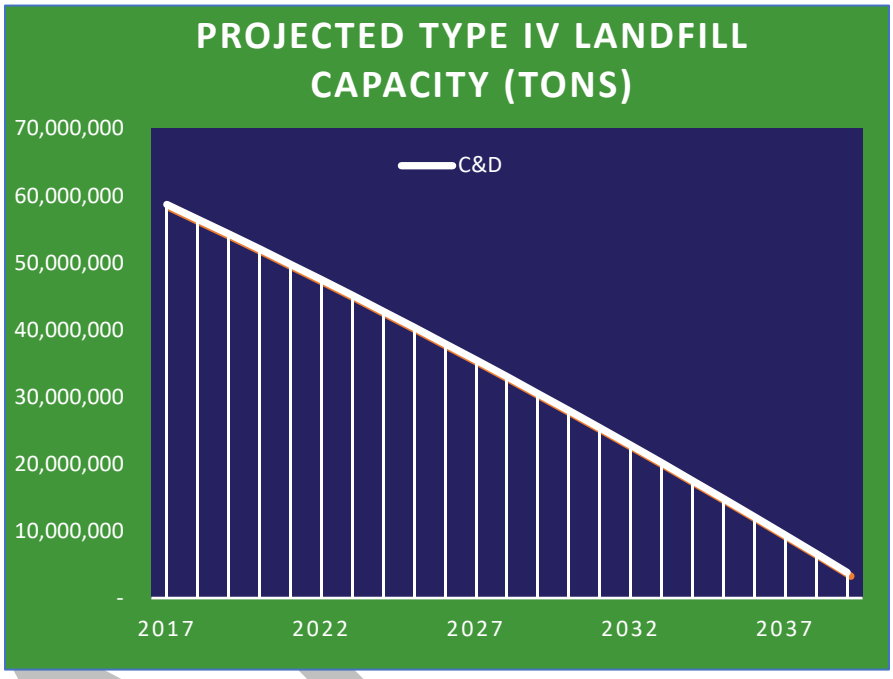
C&D Landfills	2010	2015	2016	2017	2018
Total	1,285,919	1,808,309	1,931,682	1,852,285	2,792,082

Impacts of Growth on C&D Capacity

Figure 5-5 illustrates remaining Type IV capacity to the year 2040. Regional Type IV landfill capacity is anticipated to reach capacity by approximately 2034. Once these sites reach capacity, waste will have to be disposed at remaining Type I landfills if no additional Type IV capacity is permitted. It should be noted that the majority of waste generated from Hurricane Harvey went to Type IV landfills. Future storm events will significantly impact future Type IV disposal capacity.

By 2020, 5 of the 15 Type IV landfills will have exceeded capacity. In 2040, only 4 of the 15 will have remaining capacity, unless there is additional capacity permitted prior to these years.

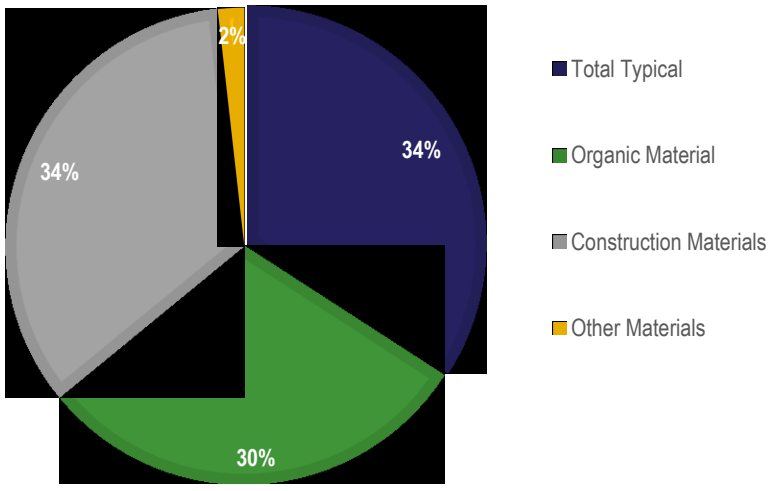
Figure 5-5
Type IV Remaining Capacity (tons)



Recycling Facilities and Environmental Service Centers

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products (Source: EPA). Houston's recycling infrastructure includes material recovery facilities, recycling centers, businesses that pay for recycled materials and processors of materials into new products. According to a TCEQ sponsored report (*Study on the Economic Impact of Recycling- July 2017, TCEQ*), 9.2 million tons of material were recycled in the state of Texas – compared to 31 million tons of waste landfilled state-wide in 2015. This is equivalent to a 23% recycling rate state-wide.

Figure 5-6
Texas Recycles 9.2 Million Tons In 2015

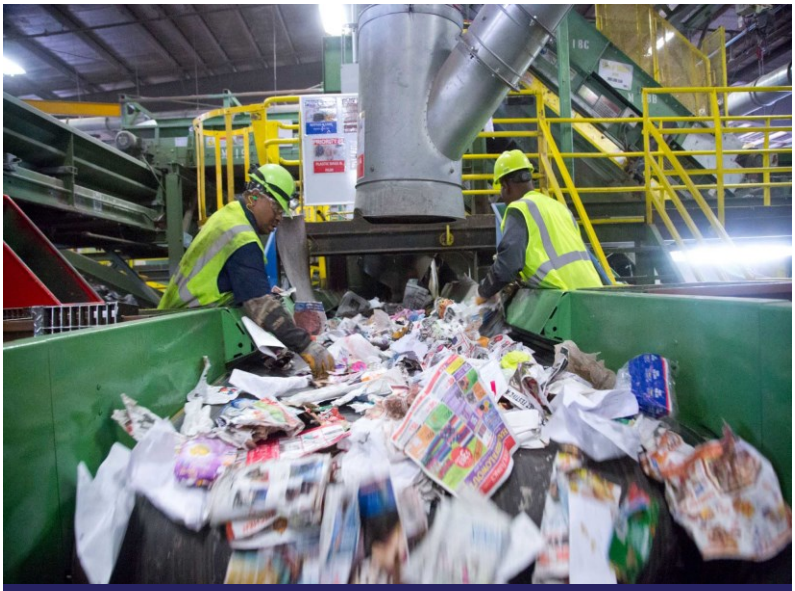


Material Recovery Facilities

The EPA defines a Material Recovery Facility ("MRF") as *"a central operation where comingled and/or source separated recyclables are processed mechanically or manually. Here a separation and/or beneficiation of recyclables prepares them to meet market specifications for sale."*

The City's curbside recycling program collects comingled or mixed recyclable materials that are put at the curb in a single container in a manner known as single-stream collection. These comingled materials are then transported to a Material Recovery Facility (MRF).

Table 5-6 presents a summary of material recovery facilities located in the Region. ***These facilities are designed to process recyclables from both the residential and commercial sectors.*** Companies that collect recyclable materials often deliver them to these facilities. Representatives of the industry have indicated that the flow of materials from the commercial sector have increased in recent years as corporations take actions to reduce their environmental impacts.



MRF designs incorporate both manual and mechanical separation
Source: https://www.houstonchronicle.com/business/article/Waste-Management-continues-to-struggle-with-6085567.php.

Total capacity of these regional MRFs is over 494,000 tons per year, or 1,590 tons per day assuming an 8-hour operating shift. Additional hours of operation can increase daily and annual throughput of these facilities. There was a reported 307,000 tons of material processed in 2017, or 62% of capacity.

Table 5-6
MRF Capacity in H-GAC Region

MRF	Address	Owner	2017 Tons Recovered	Capacity Throughput
Gasmer MRF	4939 Gasmer Drive Houston	WM	78,000	120,000 tpy
Houston Clay Road MRF	9590 Clay Road Houston	WM	105,000	204,000 tpy
Westside (Brittmore) MRF	1200 Brittmore Road Houston	WM	87,000	120,000 tpy
Global Waste Services	7172 E Mt Houston Road Houston	WCA	N/A	N/A
Houston Sort Center	5757 B Oates Road Houston	Republic	37,580	50,000 tpy
Independent Texas Recyclers	6810 Irvington Boulevard Houston	Independent Texas Recyclers	N/A	N/A
FCC	9170 Ley Road Houston	FCC	Opened March 2019	145,000 tpy

Organics Processing Facilities

Organic wastes or residuals are often disposed in landfills. However, organics processing facilities are proliferating in the H-GAC region. In the region, many organic wastes and residuals are recycled through the manufacture of mulch and compost rather than being disposed. Approximately 30% of wastes recycled in Texas in 2015 and voluntarily self-reported to TCEQ for the *Study on the Economic Impact of Recycling* was organic materials. That percentage is likely to be higher in the Houston area because of the accessibility and capacity of organics processing facilities. There is also a greater percentage of organic materials available in the Houston market due to its climate and types of vegetation found in the Houston area versus some other parts of Texas. There are no anaerobic digestion or other energy-from-waste facilities in the H-GAC region except from landfill gas.

There are 52 known mulch and compost manufacturers in the H-GAC Region which are available to process organics generated within the City of Houston and divert materials from landfills available to receive the City's MSW for disposal. Table 5-7 presents a summary of facilities in the H-GAC region based on TCEQ records and interviews with various organics processors in the region.

Table 5-7 presents estimates of the quantities of organics managed at major facilities in the region. Over 235,000 tons were processed at facilities located in Houston and an additional 314,000 tons were processed at facilities located outside the City limits, for a total regional quantity of 549,000 tons. It should be noted that some material produced in Houston is being processed by facilities located outside the City's boundaries.

Table 5-7
Estimated Throughput and Capacity of Major Facilities

	Throughput (Tons/yr)	Capacity (Tons/yr)
In Houston	>235,000	481,000
Outside Houston	>613,500	>815,000

Transfer Stations

Transfer stations are designed to improve collection efficiency by transferring waste from collection vehicles to more efficient long-haul vehicles. This allows the collection vehicles to spend more time collecting waste, versus hauling long distances to the landfill. There is a total of 21 operating transfer stations in the H-GAC region, three of which are owned by the City of Houston. Regionally, approximately 26% of the waste collected from the residential and commercial sectors goes to a transfer station before it is sent to a landfill.

Transfer stations can be designed to recover materials including brush and C&D wastes. In 2017, four of the region's transfer stations reported recovering for diversion 37,370 tons of material sent to the transfer station. Most of the recovered material was either C&D material or brush. Two of the City's transfer stations are located next to either a depository or a recycling center.

The City's three transfer stations are these:

1. Northwest Transfer Station (14424 Sommermeyer Street)
2. Southeast Transfer Station (9225 Lawndale Street)
3. Southwest Transfer Station (5904 Westpark Drive)

The City's transfer stations were permitted in 1999 and are operated under contract by Republic Services (last negotiated in 2009). The Southeast and Southwest Transfer Stations are direct-dump operations where waste is deposited on the tipping floor and front-end loaders push the waste into hoppers that direct the waste into transfer trailers. The Northwest Transfer Station is designed to have a grapple crane load the waste into the transfer vehicles. None of the City's transfer stations is currently designed to segregate waste for recovery.

Table 5-8 presents the waste throughput for the City's transfer stations in 2017. The City's transfer stations had a combined throughput of 695,096 tons (Source: City of Houston). Of the 695,096 tons, City trucks delivered 394,779 tons, or 57% of the waste going to these facilities. The City's contract with Republic Services allows it to use the facility for its collection vehicles and other private sector haulers. Approximately 43% of the waste taken to the City's three transfer stations is from private haulers.

Table 5-8
2017 – City Transfer Stations

	City of Houston	Republic Services	All Other Privates	Total Tonnage
Northwest	86,988	117,418	18,212	222,619
Southeast	194,057	34,927	11,053	240,039
Southwest	113,734	80,306	38,397	232,438
Total	**394,779**	**232,653**	**67,663**	**695,096**
% of Total	**57%**	**33%**	**10%**	**100%**

In 2018, the City issued a request for proposals for the design of a new transfer station to be located in northeast Houston. The planned facility location is 5711 Neches Street, Houston, Texas.

Table 5-9 provides a summary of transfer stations in the H-GAC region. There are 31 permitted transfer stations in the H-GAC region; however, only 20 are accepting waste. A total of 2.3 million tons of waste was directed to these transfer stations in 2017, which is equal to 26% of the total amount of waste (MSW + C/D) that was disposed in the Region for that year. On average, 7,300 tons per day are sent to regional transfer stations.

The City currently relies primarily on their own facilities, but at times have used private transfer stations including the Rufino Transfer Station. Approximately two-thirds of the City's MSW is sent to a transfer station before going to the landfill.

Table 5-9
H-GAC Transfer Stations

Name	2011 (TPY)	2015 (TPY)	2016 (TPY)	2017 (TPY)	Permitted Capacity (TPD)	2017 (TPD)
Houston SW Transfer Station	311,435	292,856	271,317	244,213	2,000	783
Houston NW Transfer Station	162,482	226,364	220,391	217,157	2,000	696
Houston SE Transfer Station	194,793	219,022	229,169	241,632	2,000	774
HSWMD Transfer Station Total	**668,710**	**738,242**	**720,877**	**703,002**	**6,000**	**2,253**
Houston Private Sector TS	**746,997**	**1,612,791**	**1,577,825**	**1,582,303**	**19,625**	**5,071**
HSWMD TS Total + Private Sector TS	**1,415,707**	**2,351,033**	**2,298,702**	**2,285,305**	**25,625**	**7,325**
Outside Houston TS Total	**95,214**	**119,803**	**126,381**	**224,323**	**NA**	**711**
Total Transfer Station	**1,510,921**	**2,470,836**	**2,425,083**	**2,509,628**	**NA**	**8,036**

Note: Totals for Houston transfer stations may vary from Table 5-9 due to differences in reporting periods.

Other Waste Management Facilities

Other facilities assessed as part of the planning process that are presented in the Facilities Report include:

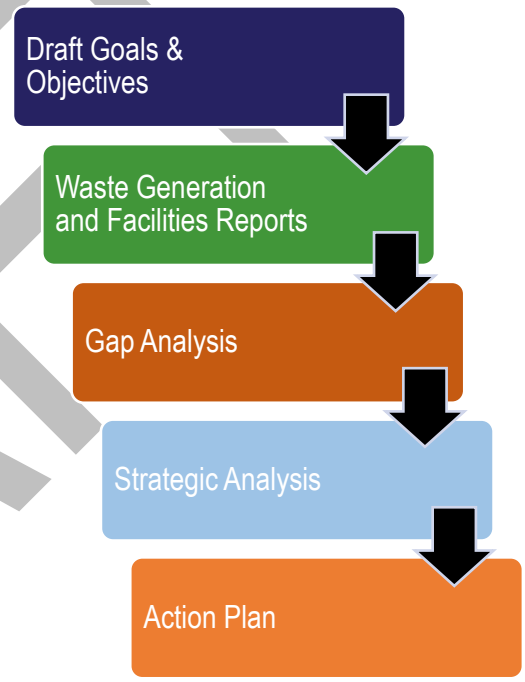
1. Grease and grit trap waste facilities
2. Tire Facilities
3. Medical Waste Facilities
4. Used Oil
5. Battery Recycling
6. Ash Management Sites

6.0 Strategic Analysis

Based on the City's needs, resources and current services, the Project Team identified a number of strategies in the form of either policies or programs that could be implemented to achieve the City's goals and objectives for the solid waste management system (System). This section defines these policies and programs as well as the Mayor's Advisory Task Force's (MATF) priorities. The Strategic Analysis Report evaluates these options using the following criteria.

As part of the Planning Process, the Project Team prepared in-depth Options Analysis Reports. These Reports evaluate each of the options presented to, or suggested by, the MATF.

- Impact on the waste stream and other environmental impacts
- Technical feasibility
- Regulatory and legal issues
- Financial impacts
- Complexity of implementation and administrative requirements
- Social issues and environmental justice



The MATF priorities for strategies related to waste minimization, reuse, recycling and organics management are presented in this section, as well as the MATF's input on collection services and long-term disposal capacity risks. The Project Team also identified strategies options that are consistent with the City's Climate Action Plan and Resiliency Plan.

Process

The first step in the planning process was the establishment of Draft Goals and Objectives for the Plan. These Draft Goals and Objectives provided direction as to the types of services to be provided and policies and programs that should be adopted to achieve the City's vision. The Project Team conducted workshops with both the MATF and SWMD senior management to better understand key local issues and MATF priorities for the City's future program. This section presents a summary of policy and program options and priorities for the following system elements:

- Financial Sustainability
- Waste Minimization, Reuse & Recycling
- Organics Management
- Collection
- Transfer Stations
- Energy & Resource Recovery
- Assuring Disposal Capacity
- Illegal Dumping

Financial Sustainability

A key to the City's ability to implement an integrated solid waste program is adequate funding for staff, equipment and services such as material processing and waste disposal. The City's program is funded through the General Fund, which is different than other cities that rely on enterprise funds that are financed via a solid waste user fee, and sometimes also a monthly environmental fee. **Based on an initial review of the City's budget in comparison to other cities, Houston's solid waste program is underfunded between $20 million and $40 million per year. The following section presents a description of alternative options to fund the City's solid waste program.**

Enterprise Funds and User Fees

Enterprise funds are created by municipal governments throughout the United States to provide a variety of governmental services in a manner that allows them to operate as business units that are financed through user fees versus tax revenues. The vast majority of solid waste utilities located in Texas are operated within an enterprise fund and charge a user fee, as do many of the solid waste utilities located within the United States. Similar to the City of Houston's water and wastewater utility, the solid waste utility would be able to issue revenue bonds if it were in an enterprise fund, which would prevent the City from needing to utilize its general obligation debt capacity to fund solid waste related capital needs. This preserves the general obligation debt capacity to fund "traditional" General Fund activities (police, fire, etc.).

The vast majority of solid waste utilities within Texas, and many throughout the United States, rely upon a dedicated solid waste user fee that is "cost-based" so as to ensure that all operating and capital costs required to operate a solid waste system, including the routine replacement of vehicles as they reach the end of their useful life, are fully funded and there is a sustainable revenue stream for the utility.

Unfortunately, when a solid waste utility is reliant upon the General Fund for tax revenues to fund its operations, if unexpected issues arise that were not budgeted (recessions, storm events, etc.), it is not uncommon to have the solid waste utility's capital budget severely restricted or even eliminated due to other pressures placed on the General Fund. Placement of a solid waste utility within an enterprise fund, with an equitable, cost-based solid waste user fee funding mechanism, will ensure that utility a consistent and reliable revenue source, while ensuring service reliability.

The MATF was unanimous in its agreement that the City needs an Enterprise Fund paid for with Service Fees to pay for solid waste services.

Municipal Solid Waste Funding Options Used by Other Cities in Texas and the U.S.

Below is a brief summary of some of the different types of user fees that have been implemented by cities within Texas, as well as throughout the United States. In reviewing the ten largest cities in the Houston-Galveston Area Council (H-GAC), the Project Team found that all cities except Houston have a solid waste user fee. Seven of the cities charge a separate, dedicated monthly solid waste user fee. In Pasadena, the monthly user fee is included as a component of the monthly water bill. In The Woodlands, the fee is assessed along with property taxes once a year. The user fees charged by these cities are shown in Table 6-1. In Texas all ten of the largest cities in the state have a residential solid waste user fee - except for Houston. While these nine cities have different types of residential solid waste user fees (flat monthly fee, variable rate for different size cans, base charges, environmental fees, etc.), they all have the one common factor of a user fee – ensuring a reliable revenue stream so as to provide sufficient funding to pay for the operating and capital costs (trucks, transfer station capital repairs, etc.) associated with providing the citizens of their respective cities with the necessary solid waste and recycling services in a financially sustainable manner. The user fees charged by these cities are shown below in Table 6-2.

Table 6-1 Ten Largest Cities in the H-GAC Region			
Rank	City[1]	Population	Monthly Solid Waste User Fee[2]
1	Houston	2,325,502	$ -
2	Pasadena[4]	151,718	24.50
3	The Woodlands[5]	108,070	14.15
4	Pearland	102,513	20.11
5	League City	95,735	18.26
6	Sugar Land	91,192	19.38
7	Missouri City	74,092	13.26
8	Baytown	73,720	27.71
9	Conroe	66,181	16.19
10	Galveston	49,471	20.48

1. The Woodlands is classified as unincorporated territory but was included for the purposes of this comparison.
2. Cities are ranked by population size according to U.S. Census Bureau
3. A 96-gallon cart is chosen if/when other options are available to keep service level and cost comparisons equal
4. The charge for solid waste service in Pasadena is included with the water bill.
5. Residents of The Woodlands pay $169.80 for solid waste collection once a year, collected with property taxes. $169.80 / 12 = $14.15.

Table 6-2 Ten Largest Cities in Texas Monthly Residential Solid Waste User Fees				
Rank	City[1]	Monthly Solid Waste User Fee[2]	Monthly Environmental Fee	Enterprise Fund
1	Houston	$ -	$ -	No
2	San Antonio	26.76	3.24	Yes
3	Dallas	31.00	-	Yes
4	Austin	43.50	8.95	Yes
5	Fort Worth	22.75	.50	Yes
6	El Paso	19.00	5.00	Yes
7	Arlington	16.01	-	No
8	Corpus Christi	16.91	-	No[3]
9	Plano	16.10	-	Yes
10	Laredo	18.00	-	Yes

1. Cities are ranked by population size
2. A 96-gallon cart is chosen if/when other options are available to keep service level and cost comparisons equal
3. Located in the "Utility System Fund"

In reviewing the twenty-five largest cities in the United States, the Project Team found that 16 have a solid waste user fee or dedicated "solid waste tax assessment," with two more considering the implementation of a user fee (New York, Denver). That means 72% of the cities have a dedicated funding mechanism or are considering implementing such a mechanism. It should be noted that several cities that do not have user fees identified a variety of issues regarding illegal dumping, litter, etc. The user fees charged by the 25 largest cities in the United States are shown in Table 6-3. In addition, some cities that do not have solid waste

user fees have access to other types of revenue streams. For instance, New York City has access to several other tax revenue streams, such as a personal income tax, as well as a business income tax.

Table 6-3
Twenty-five Largest Cities in the US

Rank	City[1]	Population	Monthly Solid Waste User Fee	Monthly Environmental Fee	Total Monthly Fee
1	New York City[3]	8,398,748	$ -	$ -	$ -
2	Los Angeles	3,990,456	36.32	-	36.32
3	Chicago	2,705,994	9.50	-	9.50[5]
4	Houston	2,325,502	-	-	-
5	Phoenix	1,660,272	30.55	-	30.55
6	Philadelphia[4]	1,584,138	-	-	-
7	San Antonio	1,532,233	26.76	3.24	30.00
8	San Diego	1,425,976	-	-	-
9	Dallas	1,345,047	31.00	-	31.00
10	San Jose	1,030,119	107.67	-	107.67
11	Austin	964,254	43.50	8.95	52.45
12	Jacksonville	903,889	12.65	-	12.65
13	Fort Worth	895,008	22.75	0.50	23.25
14	Columbus[4]	892,533	-	-	-
15	San Francisco	883,305	78.17	-	78.17
16	Charlotte	872,498	8.93	-	8.93[6]
17	Indianapolis	867,125	12.93	-	12.93[7]
18	Seattle	744,955	115.90	-	115.90
19	Denver[3]	716,492	-	-	-
20	Washington DC	702,455	-	-	-
21	Boston	694,583	-	-	-
22	El Paso	682,669	19.00	5.00	24.00
23	Detroit	672,662	20.00[8]	-	20.00
24	Nashville	669,053	-	-	-
25	Portland	653,115	43.60	-	43.60

1. Per U.S. Census Bureau – 2018 Population Estimate
2. A 96-gallon cart is chosen if/when other options are available to keep service level and cost comparisons equal
3. Discussions being held regarding development of a user fee
4. Cities having litter / illegal dumping issues
5. This fee pays for a "portion" of the residential solid waste services
6. Residents are assessed a specific fee on their property taxes to "offset" the cost of waste collection, disposal, and recycling services
7. Indianapolis Solid Waste Special Service District charges a tax rate of $0.0862 on each $100 net assessed value. Median house price of $180,000 x 0.0862 per $100 = $155.16 / 12 months = $12.93 per month
8. Residents of Detroit pay $240 for solid waste collection once a year. $240 / 12 = $20.

Municipal Solid Waste User Fee Estimate

In order to develop an estimate of what Houston residents might expect to pay with regard to a solid waste user fee (if one were implemented), it is essential to first have a rough estimate as to the operating and capital requirements associated with operating a solid waste utility the size of Houston's. Therefore, the Project Team developed high level

estimates for what the City would need to spend on an annual basis for rolling stock (trucks, trailers, etc.) (Table 6-4), other capital needs (Table 6-5) as well as other operating costs (Table 6-6) if the solid waste utility were to be operated in an enterprise fund versus the General Fund. Each of these amounts are detailed in the tables below, with the total cost summarized and an estimated solid waste user fee shown in Table 6-6.

Therefore, the Project Team developed a preliminary estimate of the potential capital needs regarding rolling stock. Table 6-4 shows that the City needs to purchase on an annual basis approximately 41 garbage trucks and 7 transfer trailers. The analysis supporting the need to purchase on average 41 trucks and 7 trailers per year assumes an annual replacement of front-line automated sideloader (ASL) vehicles based on a seven-year useful life, and a ten-year useful life for all other vehicle types, which is fairly standard within the industry.

Table 6-4
Capital Needs - Vehicles

Vehicle Type	Number of Trucks	Frontline %	Frontline Trucks[4]	Useful Life (Years)[5]	Annual Number of Replacements[6]	Replacement Cost[7]	Annual Capital Need
ASL Garbage	111 [1]	100%	111	7	16	$ 280,863	$ 4,493,808
ASL Recycling	50 [2]	100%	50	7	8	280,863	2,246,904
Knuckle Boom	41 [3]	80%	33	10	4	183,374	733,496
Roll-off	16 [3]	80%	13	10	2	140,778	281,556
Rear Load	40 [3]	80%	32	10	4	181,661	726,644
Tractor Truck	77 [3]	80%	62	10	7	88,486	619,402
Trailer	77 [3]	80%	62	10	7	72,500	507,500
Capital Purchase							**$ 9,609,310**

1. ASL Garbage requirement was determined by taking the 2020 Budget number for households served (396,730) and dividing those households by the City's goal of 900 households/garbage route and 4 service days, with weekly collection. The calculation is as follows: 396,730/900/4 = 111 (rounded up).
2. ASL Recycling requirement was determined by taking the 2020 Budget number for households served (396,730) and dividing those households by the City's goal of 1,000 households/recycling route and 4 service days, with every other week collection. The calculation is as follows: 396,730/1000/4 x 0.5 = 50 (rounded up).
3. Per email from City staff 10/14/2019. This number includes reserves.
4. Per City staff, 20% reserve rate. Calculated as number of vehicles times frontline %. E.g. knuckle booms, 41 x 80% = 33 (rounded up).
5. Industry standard useful lives.
6. This number is calculated by dividing the frontline vehicles by the useful life and rounding up. E.g. ASL Garbage, 111/7 = 16.
7. Per spreadsheet "SWM Fleet As of 10-8-19" from Fleet Services on 10/8/2019.

In addition to the capital needs associated with rolling stock, there are other capital needs that need to be incorporated into a potential solid waste user fee. These costs have been listed below in Table 6-5; and in order to "levelize" these costs over an extended period of time, the Project Team has assumed a 20-year bond is issued at a 5% interest rate to fund these capital needs. It is important to note that these are not all of the capital needs that would be required by the City's Solid Waste Management Department. Table 6-5 merely shows those capital costs that have been identified at this time. To thoroughly forecast all of the required capital costs, it is critical that the City develop a comprehensive 10-year Capital Improvement Plan (CIP) for the solid waste utility.

Table 6-5 Capital Needs - Other	
Facility	**Amount**
New Depositories[1]	
5 x $ 1,640,000	$8,200,000
Transfer Station Repairs[2]	
Northwest Transfer Station	$4,801,139
Southwest Transfer Station	650,118
Southeast Transfer Station	3,846,242
Transfer Station Repairs Subtotal	$9,297,500
New Transfer Station – Northeast[3]	$8,000,000 - $10,000,000
Total Capital Needs[4]	**$25,497,500 – 27,497,500**
20 Year Bond Issue at 5%	**$2,126,228**

1. Per City Staff – per City General Services Department – 2018 (not including land).
2. Solid Waste Disposal Asset Valuation – City of Houston Solid Waste Management Department – July 16, 2012 SAIC. Inflated at CPI for non-residential construction, 1.86% per year for 2012-2019.
3. High level estimate. $10 million assumed for debt issue.
4. This is not a comprehensive list of all capital needs, but merely a preliminary assessment.

If the City elects to place the solid waste utility within an enterprise fund, there are several costs that should be budgeted regarding the solid waste utility receiving support services from the General Fund as well as for the billing for solid waste services, which would most likely be provided by the City's utility billing function (i.e. water and wastewater utility). The costs in Table 6-6 are merely estimates and would need to be finalized as part of a comprehensive cost of service study if the City were to elect to implement a residential solid waste user fee.

Table 6-6 Other Costs			
Cost	**Amount**		
General Fund – Support Services[1]			$1,000,000
Customer Billing	Customer Count	Billing Fee[2]	Annual Expense
Residential	462,736 [3]	$ 0.75	$ 4,164,624
Multi-Family	478,538 [3]	0.75	4,306,842
Commercial	38,975 [4]	0.75	350,775
Customer Billing Subtotal			$ 8,822,241
Grand Total			**$ 9,822,241**

1. Estimated costs for legal, financial, procurement, and human resources. This cost varies widely by city. NewGen believes this to be a conservative estimate.
2. Estimated cost, typically paid to the municipality's water and wastewater utility, or electric utility (if municipally owned and operated). This fee typically ranges from $0.50 to $1.00 per month per account. NewGen assumed $0.75 per account.
3. Per Waste Generation Forecast
4. This number was calculated on a pro-rata basis using Fort Worth's number of commercial accounts and population compared to Houston's.

Environmental Fees

Based on the Solid Waste Management Department's FY 2020 budget, and the assumptions shown in Tables 6-4, 6-5 and 6-6, the Project Team developed a high-level estimate of what a user fee might potentially be for the City of Houston if it were to move towards the creation of a monthly residential solid waste user fee. The analysis shown in Table 6-7 is an estimate using the FY 2020 Solid Waste Management Department budget of $84,956,973 and the Recycling Revenue Fund budget of $4,934,277 as a starting point. Based on this analysis it is estimated, as shown in Table 6-7 the user fee would be approximately $22.40 to $23.05 per month per single-family residential account.

Table 6-7
Estimated Monthly Residential User Fee

	FY 2020	Inflation Adjustment	FY 2021
FY 2020 SWMD Budget	$ 84,956,973	3%	$ 87,505,682
FY 2020 Recycling Revenue Fund Budget	$ 4,934,277	3%	$ 5,085,305
Rolling Stock Capital Requirement	$ 9,609,310[1]	3%	$ 9,897,589
Other Capital Requirement (Debt)	$ 2,126,228[2]		$ 2,126,228
Other Costs	$ 9,822,241[3]	3%	$ 10,116,908
Total Costs	$ 111,449,028		$ 114,728,713
Households	396,730	1.28% [4]	401,808
Cost/HH/Month	$ 23.41		$ 23.79

1. Per Table 6-3, Capital Needs - Vehicles
2. Per Table 6-4, Capital Needs – Other
3. Per Table 6-5, Other Costs
4. Household annual growth rate per Waste Generation Forecast

The Project Team investigated establishing an environmental fee for the City. The Project Team looked at Austin, Fort Worth, and San Antonio for comparison purposes while researching environmental fees in the State of Texas. Through communication with staff members for each city and research of online information, the Project Team developed an understanding of the use and application of such fees. In general, environmental fees are used to defray costs incurred by solid waste management departments for activities that cannot be assigned to individual customers, such as illegal dumping clean-up. The fee is generally charged to all residents, even if they are not customers of the city's solid waste management department. The fee is also charged to commercial and industrial accounts. Table 6-8 shows a summary of the fees for the comparison cities.

Table 6-8 Environmental Fees			
Customer Type	**Austin**	**Fort Worth**	**San Antonio**
Residential	**$8.95 total** ▪ $4.70 to Solid Waste Department ▪ $4.25 to Code Enforcement	Apartment Complexes: $0.50/unit Residential: $0.50	**$3.24 total** ▪ $2.244 to Solid Waste ▪ $1.00 to Parks
Commercial	$16.50	$10	**$3.24 total** ▪ $2.244 to Solid Waste ▪ $1.00 to Parks
Industrial	$16.50	$35	**$3.24 total** ▪ $2.24 to Solid Waste ▪ $1.00 to Parks

Austin: Austin calls their fee the "Clean Community Fee." The fee is associated (i.e. linked to the individual or business) with an electric meter. However, there are sections of Austin where Austin Energy is not the electric provider, but Austin Water and Austin Resource Recovery (ARR) are service providers. In this scenario ARR would add the Clean Community Fee to the water account if a physical structure is present. For multi-unit structures, both residential and commercial, the City's premise management team determines the number of units by reviewing site plans. The Clean Community Fee is applied to each unit in the structure. For example, in an apartment complex with a leasing office, each apartment unit would be billed the residential fee, and the leasing office would be billed the commercial fee.

The solid waste portion of the fee funds services such as street sweeping, litter abatement, Recycle & Reuse Drop-Off Center, business outreach, Austin Reuse Centers, zero waste program development, Clean Austin, dead animal collection, and boulevard sweeping.

Fort Worth: Fort Worth calls their fee the "Environmental Protection Fee." Revenues from the fee are handled by the City's Code Enforcement Department. The fee is associated with water meters. For apartment complexes with a master meter, the residential fee is billed to each apartment unit and the commercial fee is billed to the leasing office. For commercial properties with multiple businesses, such as strip malls, the commercial fee is assigned to each business unit. The Code Department has on file the number of individual units associated with a property. The number is updated for each property every two years. Fort Worth also charges a separate industrial fee.

Revenues generated by the fee primarily cover activities associated with hazardous waste. Revenues may also cover costs for disposal services, environmental programs or environmental services. These dedicated funds help the City pay for federal and state environmental mandates such as cleaning up abandoned property, asbestos abatement, underground storage tank compliance, storm water management, spill response clean-up, and operation of a household hazardous waste collection facility.

The Environmental Protection Fee was instituted in 1996. The fee amount has not changed since then. According to City staff, 75% of residents indicated in a survey that they would be willing to raise the fee to $2/month.

San Antonio: San Antonio calls their fee the "Environmental Fee." The fee is associated with electric meters. For multi-unit structures, the fee is on the submeters, so each individual apartment or business unit is billed the fee. The fee is also on electric meters associated with things like lighted billboards, pump stations, etc.

This fee is intended to defray expenses incurred to clean up illegally dumped waste, collecting and disposing of dead animals, performing regulatory maintenance on closed landfills, providing environmental services to the City's park system, and equitably sharing costs for neighborhood clean-ups benefiting residents and businesses that do not pay a monthly solid waste processing fee.

Based on Houston's current population, and assuming a $1 fee for residential customers and a $5 fee for commercial/industrial accounts, the SWMD could expect to generate approximately $13,633,788 in revenue from an environmental fee. The calculation is shown in Table 6-9 below. The actual fee amounts would be determined by what programs would be funded through the fee.

Table 6-9
Houston Proposed Monthly Environmental Fee Revenue

Customer Type	Number of Customers	Fee Amount	Annual Revenue
Residential	462,736 [1]	$1	$ 5,552,832 [3]
Multi-Family	478,538 [1]	$1	5,742,456
Commercial/Industrial	38,975 [2]	$5	2,338,500
Total			$ 13,633,788

1. Per Waste Generation Report
2. This number was calculated on a pro-rata basis using Fort Worth's number of commercial accounts and population compared to Houston's. Fort Worth's population is 895,008, Houston's population is 2,325,502. Fort Worth's number of business accounts is about 15,000. 2,325,502 / 895,008 x 15,000 = 38,975.
3. Calculation: 462,736 customers * $1 * 12 months = $5,552,832 annual revenue.

Other Financial Recommendations

Develop a ten-year capital improvement plan. The City must maintain several facilities including transfer stations, environmental service centers, depositories and recycling facilities as well as a large fleet of vehicles. The City should prepare a comprehensive capital improvement plan that forecasts long-term needs and updates this on a regular basis.

Continue to secure grants for program implementation. The City has been successful in securing grants from agencies such as H-GAC and other public and private entities. In order to expand the scope of the City's waste minimization and recycling efforts, it should expand its outreach in securing grants. As an increasing number of private entities take greater interest in reducing their environmental footprint, the City should reach out to the private firms and associations for such grants. It is recommended that a task force focusing on the private sector be formed to assist in implementing the Plan.

Begin discussions concerning a solid waste user fee. The Project Team would recommend that the City's executive management and solid waste management staff begin discussions regarding the benefits of a solid waste user fee and how it might benefit the General Fund. This would include developing a plan for how to address this topic with the various constituents that comprise the City of Houston.

Develop a comprehensive solid waste cost of service, rate design and environmental fee study. Concurrent with the first three recommendations, the Project Team would recommend a comprehensive cost of service study be undertaken (including the development of a ten-year capital improvement plan). This will allow the City to accurately

forecast the City's capital and operating costs for current and new solid waste and recycling programs and the associated user fees and environmental fees required to fund these programs in a long-term sustainable manner.

Landfill Disposal

Landfill Policy Issues

- Regional MSW landfills (Type I landfills) have approximately 30-40 years of remaining capacity. The three landfills that the City primarily relies upon for disposal are the McCarty Road Landfill, the Atascocita Landfill and the Blue Ridge Landfill. Respectively, these landfills have 13, 25 and 80 years of remaining capacity at current rates of disposal.
- The City's current landfill contracts were renegotiated in 2020. These agreements establish tipping fees and operational requirements for the City's transfer stations and rates for landfills.
- There is approximately 20-30 years of remaining disposal capacity at C&D (Type IV) landfills.
- Reliance on the private sector for waste disposal reduces certain financial risks to the City. These include potential environmental liabilities, costs of construction and operation, and long-term financial responsibility for the sites.
- It takes 10-15 years to site, permit, design and construct a new landfill.
- There are TCEQ regulations related to where landfills can be located and three counties in the H-GAC region have site location ordinances.
- Other site selection criteria include proximity to sensitive land uses such as schools and hospitals and access to roadways, among others.
- Environmental justice issues must be considered when selecting a site for a new landfill.

The City relies 100% on the private sector for its disposal needs.

Five key factors that will affect remaining MSW landfill capacity at any specific landfill include the following:

- Is there the potential that the landfill can expand its current capacity by either going higher or adding acreage?
- A new landfill in the region is permitted and constructed.
- After a regional landfill reaches capacity, which landfill will accept the waste previously disposed at the closed landfill?
- Potential significant reductions in waste through waste reduction or recycling efforts exist.
- The region's Type IV landfills have less capacity than the Type I landfills. It is possible that as Type IV options are reduced, some of the waste that currently goes to Type IV landfills will ultimately go to Type I Landfills.

MATF Survey Question: *What do you believe are the biggest disposal issues facing Houston?*

The City is required by law to assure that there is at a minimum once-per-week collection of municipal solid waste. Other services provided by the City are intended to improve the environment (recycling and recovery programs) and increase the availability of disposal options (depositories). Table 6-10 presents the MATF's scoring of the significance of disposal.

Table 6-10
Major Disposal Issues Identified by the MATF

Challenges	Very Significant 3 points	Significant 2 points	Not a Concern 1 point	Score
MSW Landfill capacity being 30-40 years	4	4		20
C&D Landfill capacity being 20-30 years	5	3		21
City has no control over new capacity	3	2	1	14
Anticipated cost increases of disposal	5	2		19
Selecting sites for new landfills	9	1		29
Environmental justice related to new facilities	4	2	1	17
Environmental impacts of landfills	3	4	1	18
Distances waste will have to be hauled when close-in landfills reach capacity	8	2		28
Points	**3**	**2**	**1**	

The MATF ranked disposal issues from most significant to least significant, as follows.

1. Selecting sites for new landfills
2. Distances waste will have to be hauled when close-in landfills reach capacity
3. C&D Landfill capacity being 20-30 years.
4. MSW landfill capacity being 30-40 years.
5. Anticipated cost increases of disposal
6. Environmental impacts of landfills

Figure 6-1 illustrates landfill capacity in 2040 if there are no significant changes in current facilities or new facilities sited. All of the landfills in the H-GAC region have indicated that they accept waste from Harris County. By the year 2040, five landfills, including McCarty Road and Atascocita will have reached capacity.

Figure 6-1
Remaining Tons of Capacity in Type I Landfills in 2040
(million tons)

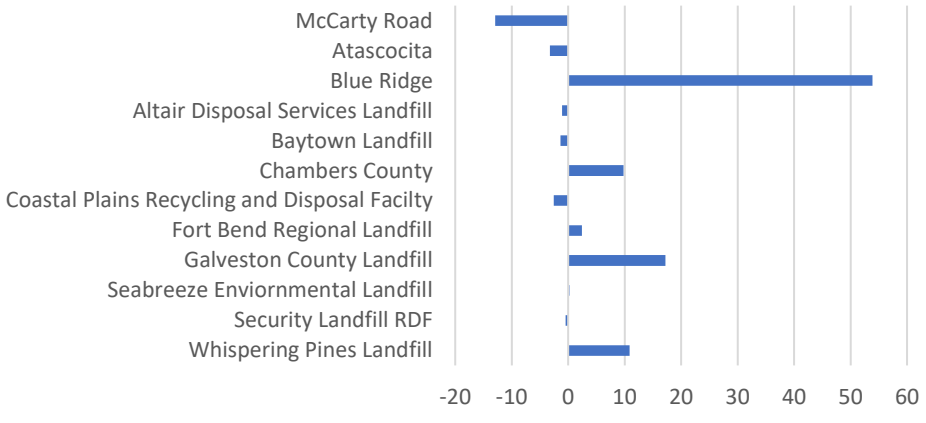


Figure 6-1 illustrates remaining MSW landfill capacity in 2040. Without major changes, capacity falls from approximately 267 million tons in 2018 to 72 million tons in 2040. Seven of the 12 landfills will have reached capacity before 2040 unless capacity additions or new landfills are identified.

The City's contract for both transfer stations and landfill disposal expired in 2019. The City is in the process of renegotiating these agreements. This action item is to sign mid-term agreements for the disposal of waste that is not part of the transfer station agreement. The City's contract for disposal provides the City the option to direct haul waste from the point of collection to the landfill site without using one of the transfer stations. These contracts are used in instances where the landfill is closer to the point of generation than the transfer station, or in times when the transfer station may not be operational. In 2019, approximately 25% of the City's waste was directly hauled to a landfill. Landfills that the City has relied on for direct haul include the Atascocita Landfill and the Blue Ridge Landfill and Waste Management Type IV landfills.

Continuously monitor landfill capacity in the region. For residential waste, the City relies on landfills through agreements with private operators, whether through the transfer station agreement or the landfill agreements. These agreements provide for disposal services for 10 years. A review of TCEQ annual reports indicates that all MSW landfills in the region reported that they accepted waste from Harris County. A number of factors will affect this regional capacity including continued regional population increases, economic activity, success of waste minimization and recycling programs, storm events and other factors. Also, as C&D landfill capacity decreases with the closure of Type IV landfills over the next, 20 years, this C&D waste will have to be disposed of at MSW landfills. However, there is also the potential that landfill owners will seek to expand current facilities, adding to regional capacity.

There are three landfills in the H-GAC region that are currently pursuing permit amendments to expand their landfills.
Seabreeze Landfill Expansion: In January 2019, the Type I Seabreeze Landfill owners filed a permit amendment to modify their facility. The amendment will add approximately 14.5 million cubic yards of capacity.

Greenhouse Road Landfill Expansion: Currently, the Greenhouse Road Type IV landfill is seeking a permit expansion from TCEQ. The expansion is projected to add approximately 23 years to the facility's life.

Tall Pines Landfill Expansion: The Tall Pines Landfill Expansion permit amendment was originally filed in 2016. The amendment would increase capacity from 11.8 million cubic yards to 26.9 million cubic yards.

City should site, permit and contract a City-owned landfill to meet the City's long-term disposal needs. The City relies entirely on private-sector landfills to meet its disposal needs. This places long-term risks of not having available disposal capacity for MSW not only generated by the City's residential sector, but also the City's businesses and institutions.

A landfill site for the City should be between 600 and1000 acres. This size of the parcel will allow for significant buffer zones, long-term disposal capacity and the ability to site ancillary waste management facilities (maintenance facilities and material recovery operations) at the same location. There are federal regulations pertaining to where landfills can be located and what areas are restricted from landfills. Restricted areas are those close to airports, floodplains, wetlands and certain geologic conditions. Landfill sites should also take into consideration proximity to schools, hospitals, cemeteries, historic sites and other sensitive land uses. Environmental Justice issues must also be assessed as part of the site selection process.

There are three possible scenarios for Houston's future MSW disposal program.

1. Continued reliance on the private sector for disposal of waste;
2. City ownership of a landfill with public operations; and
3. City ownership of a landfill with private operations, similar to how the City manages its transfer stations.

Examples of landfill ownership and operation are presented in Table 6-11

Table 6-11 Landfill Ownership/Operation for Major Texas Cities			
	Public / Public	Public / Private	Private / Private
Austin			●
Arlington		●	
Corpus Christi		●	
Dallas	●		
El Paso	●		
Fort Worth		●	
Garland	●		
San Antonio			●
Houston			●

Public vs. Private Ownership

Currently, the City relies completely on the private sector for disposal of waste at one of several landfills in the region. There are advantages and disadvantages associated with public versus private ownership of landfills. Table 6-12 analyzes public ownership.

Table 6-12 Public Ownership Advantages & Disadvantages	
Advantages	**Disadvantages**
▪ Control over capacity ▪ Greater cost control in a less competitive overall landfill market as landfills close ▪ Revenue generation potential ▪ Ability to place additional waste management facilities at the site	▪ Environmental Risks ▪ Cost overruns ▪ Site selection process is highly political ▪ Capital cost requirements

Evaluate the potential for using existing landfill sites for material recovery options, including organics recovery and C&D recycling. At some landfills in the region, there is both C&D recycling and organics recovery. The SWMD should work with regional landfill owners to determine whether there are additional opportunities for using these sites for recovery of materials. Included in this recommendation is for the City to continue to explore options for using closed landfill sites for productive uses similar to the Sunnyside Landfill Solar Project (Figure 6-2).

Figure 6-2
Sunnyside Landfill Solar Project

Sunnyside Landfill Project: Few advances in landfill technologies are anticipated in the near to mid-term for the design, operation and closure of landfills. Some landfills in Texas, including closed landfills are installing photovoltaic solar systems as a cover option. This is a unique way of using land that is otherwise unsuitable for many other needs. The City of Houston has recently approved a project that involves placing solar panels over the closed Sunnyside Landfill. This project will ultimately generate 70 MW of electricity. The City can, through various policies, encourage other landfills or closed sites to develop these types of projects which would help achieve the City's Greenhouse Gas Emission reduction targets.

Collection Services

Providing efficient and reliable MSW, recyclables and brush and bulky waste collection is the core service that is provided by the SWMD. At a minimum, state law requires that the City provide once per week collection of MSW or require such frequency of collection by ordinance. In addition to these services the SWMD provides a number of other services that are described in Section 2.0 of this Plan

- The collection system needs to be **right-sized** to improve service efficiency and reliability. More routes need to be added to address Houston's unique characteristics. This will require more trucks and staff positions.
- The City's aging fleet is affecting program reliability and efficiency. Older trucks (beyond 7 years) create service reliability problems and increases the annual maintenance budget significantly.

- Staffing is an issue – in 2018, actual overtime costs for the SWMD staff were equivalent to 37.5 FTEs. A review of other cities shows that Houston staff serve almost twice as many households per staff member compared to other cities. The understaffing leads to significant overtime and high stress conditions.
- The City's staff put in significant overtime hours to deal with Hurricane Harvey. With climate change, more frequent and severe storms can be expected.
- The Houston region has experienced several storm events in the recent past which have placed a significant burden on the City's collection staff. In the past 20 years, over 11 major storm events and hurricanes have been recorded.
- The commercial sector is reliant on the private haulers for waste and recyclable material collection.
- Apartments are responsible for their collection. A growing percentage of Houstonians will rely on building owners for waste collection and recycling services.
- The City's large area and land use patterns makes it difficult to efficiently collect waste from certain parts of the City. Some of the outlying areas might be better served through contracts with the private sector.

As part of the MATF Priorities workshop, MATF members were asked to evaluate the services that SWMD provides. The average scores are presented in Table 6-13, below. A 5 is the most favorable possible response. The results of the survey show generally positive marks for MSW, recyclable and yard and tree waste collection services. The MATF rated services associated with junk waste collection, Environmental Service Centers, public information programs, and illegal dumping in the lower half of the rating scale. Comments related to facility access both in terms of proximity and hours of operation were cited as factors for low scores. Illegal dump clean-up was rated as having the lowest performance of all SWMD services.

MATF Survey Question: *How would you rank the services provided by SWMD?*

Table 6-13
SWMD Performance Scores by the MATF

SWMD Activity	5- Highest Performance 1-Lowest Performance
MSW Collection	4.3
Recycling Collection	3.0
Yard Waste Collection	3.1
Junk Waste Collection	2.6
Tree Waste Collection	3.0
Environmental Service Centers	2.4
Illegal Dumping Clean-up	1.6
Depositories, Recycling Centers	2.3
Public Information	2.3

Provide efficient collection of MSW, recyclables, organics and brush/bulky waste. To improve collection efficiency, four things must happen: 1) Routing must be right-sized, 2) fleet of trucks that are used has to be upgraded, 3) staffing levels for collection must be commensurate with the right-sizing of routes and 4) fleet maintenance must be improved.

Program Right-Sizing: It is critical that the program be **right-sized** and operating with a modern fleet that can perform reliably. To accomplish this, the number of trucks and staff must be increased from its current levels and older trucks must be phased out on an accelerated basis. The phase-out should occur over several years so as not to create the need to replace a large number in any one year. Figure 6-3 shows the estimated number of trucks that will be required in future years for MSW collection and recyclable material collection.

In addition to right-sizing the fleet, the City must also replace older trucks on an accelerated basis in order to reduce maintenance costs. A review of maintenance records shows that the City is paying approximately $1.0 million more in maintenance to keep older (more than 7 years) trucks in the fleet.

Figure 6-3 Projected Residential MSW & Recyclable Collection Vehicle Needs*
***assumes 70% vehicle availabiltiy**

Implement data management program for collection fleet and provide management support to evaluate data for more efficient routing and accountability. The City currently has a contract for data management related to fleet activities. There have been implementation issues associated with this contract. The City should resolve these issues and put in place an active and dynamic data collection system that provides real-time data related to collection efficiency, recycling participation, traffic impacts, and other data.

Implement "Slow Down to Get Around." In 2019, the Texas Legislature adopted HB 61 which was designed to enhance the safety of solid waste collection crews. This law requires drivers on Texas streets to treat solid waste collection crews in the same manner that they currently must treat emergency personnel and construction workers.

Transfer Station Policy Issues

Continuously evaluate alternative fuels and vehicle technologies including CNG and electric vehicles. The City relies primarily on diesel fuel for its collection fleet (including residential collection, brush and bulky waste and illegal dump clean-up). There are communities in Texas and other cities that rely on compressed natural gas (CNG) to power their collection fleets. To implement a CNG or Electric Vehicle (EV) program, the City would have to: 1) invest in the fueling infrastructure; 2) invest in new trucks replacing older diesel trucks; 3) train Fleet Management how to maintain CNG or EV collection and support vehicles; 4) train collection staff to operate vehicles; and 5) monitor progress and look for additional opportunities. A 2016 MIT article estimates the cost of an EV garbage truck at approximately $150,000 more expensive than a comparable diesel vehicle. With advances in technology and battery storage, these costs are anticipated to decrease over time.

Bay Area EV Garbage Truck

Contract for the collection in areas outside the City's core beltway. One of the key factors affecting the efficiency of the SWMD collection fleet is the vast area where the City is responsible for providing collection service. To reduce the mileage on collection vehicles, some of the routes located in these areas should be consider for privatization. The contract would require that any hauler providing service to these areas match exactly the level of service that is provided by City crews.

Evaluate the potential for managed competition to reduce solid waste management costs for the City. Managed competition is defined as a process for determining whether certain City services can be out-sourced to the private sector. The managed competition process generally identifies specific areas, such as solid waste management, where the private sector is given the opportunity to compete against the City for identical services. This can include all or a portion of the services provided by the City. One of the challenges associated with managed competition is that the SWMD currently provides several services that are outside the normal collection of MSW and recyclables. Some of these services include: storm debris management, special event clean-ups, clean-up of homeless camp sites, dead animal collection and others. To reflect a valid cost comparison between the City and private-sector bidders, these costs must be segregated from the City's competitive bid.

A provision of the 2020 City of Houston Budget is for the City to fund a study to evaluate managed competition for both Solid Waste and Fleet Operations. The study began in December 2019 and the first phase is anticipated to be completed in 2020.

Transfer Stations

- A new contract for operation of the City's transfer stations was renegotiated in 2020 This contract will set the terms of payment, length of contract term, and other additional services including the addition of recyclable materials transfer capabilities.
- As the City grows and disposal costs increase in coming years, it is anticipated that the cost of disposing of MSW at the transfer stations will increase.
- The City will continue to balance the use of transfer stations versus direct haul of MSW to landfills – factors will include the costs of disposal at these facilities, haul cost savings, queue times at the transfer stations and landfills and additional wear and tear on trucks associated with using the landfill versus the transfer stations.

- Houston's traffic congestion, along with the City's growing area, will require the construction of new transfer stations in the future.
- Transfer stations will have to be more than just MSW disposal sites. Because the City will be increasing efforts to reduce MSW generation through increased recycling and organics management, transfer stations will be logical locations for the efficient hauling of recyclables and/or organics to processing facilities and markets.
- The Southwest Transfer Station has access issues that cause traffic and safety issues. The City should evaluate measures that can improve access into this facility.
- When evaluating sites for new transfer stations, both public and private entities must take into consideration environmental justice issues.
- The City is the owner of the three transfer stations it relies upon for a majority of the MSW collected. As the owner, the City is responsible for making capital improvements; the operator is responsible for maintaining the site and replacing equipment. In 2012 the City evaluated the three transfer stations. A total of $8 million in site improvements was recommended. Because the facilities are 20 years old, the need to make on-going capital improvements will be necessary.
- There is a total of 13 transfer stations in the City of Houston with 19,625 tons per day throughput capacity in total; regionally there are 21 transfer stations. In 2017, a total of 2.3 million tons were processed in Houston transfer stations and 2.5 tons processed regionally.

Transfer Station Policy & Program Options

Negotiate a contract for the operation of the City's three transfer stations. The City owns three transfer stations. These transfer stations are essential to providing efficient collection of MSW by City crews. Services provided as part of the transfer station contracts include operation of the scale facility, operation and maintenance of the facility and hauling MSW from the transfer station to a permitted landfill. As owner, the City is responsible for any major structural repairs to the facilities.

Make necessary capital investments in the existing transfer stations. The City's three transfer stations were constructed approximately 20 years ago. While the City contracts for the operation of these facilities, the City is responsible for making any capital investments required to keep the facilities operational. One of the major transfer stations improvements that are recommended as part of this plan is to improve access to the Southwest Transfer Station. The entrance to this facility is from Westpark Drive. At times during peak hours of operation, trucks can back-up onto Westpark Drive causing traffic and safety concerns.

The City is in the process of designing a Northeast Transfer Station. Once designed the facility should be constructed and contracted out for operations. The City has determined that it is appropriate to plan, design and construct a fourth transfer station to be located at the Northeast Service Center at 5711 Neches Street. The design of this new transfer station should incorporate opportunities to process certain waste streams such as organics and other recyclables for future recovery at organics processors and the FCC facility.

Develop recyclable material transfer capabilities throughout the City, primarily at existing transfer station locations. Since March 2019, all materials recovered as part of the City's single stream recycling program have been directed to the FCC MRF. This requires that recyclable materials be transported from all sectors of the City to this one facility. Adding capability to transfer this material the way MSW is transported using transfer stations would decrease operating costs and improve program redundancy and efficiency. In the southwest quadrant, the City can use the Brittmore transfer station once its lease to Waste Management has expired.

Identify site locations and permit / construct two additional transfer stations. As the City continues to grow and traffic conditions remain an issue, there will be a need for additional transfer stations in the mid-to-long-term. The site selection of these additional transfer stations will have to take into consideration where the population is growing and the

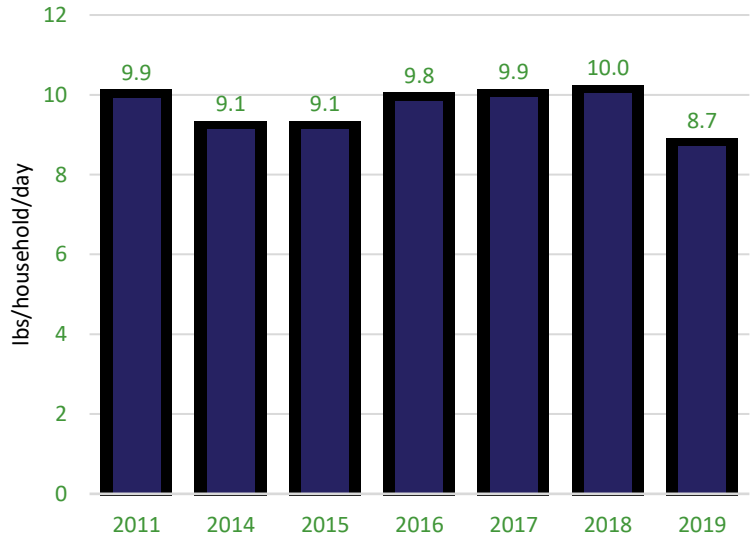
location of landfills anticipated to be used in future years. If the City proceeds to develop its own landfill, it would be good planning to conduct siting for both the landfill and the transfer stations at the same time.

One of the options for securing long-term disposal capacity is through a rail-haul facility. The Region's landfills have approximately 30-40 years of remaining capacity. These are all privately owned and operated landfills. One potential way of securing long-term disposal capacity for the City's waste stream is to haul MSW by rail to a remote landfill. Rail haul is used by major cities including Seattle, Chicago and New York. This is a capital-intensive process and one that requires contracts with rail companies and remote disposal sites, or with a private company to manage all aspects of rail haul. Some of the City's current transfer stations are located along rail lines which may make this option feasible.

Source Reduction, Reuse, Recycling

Houstonians' purchasing decisions, landscaping practices, and understanding of what is recyclable directly affect the cost of collecting, processing, and disposing waste. Figure 6-4 presents historic trends for residential waste disposal rates. This is the amount of waste that is collected by the City and taken to either a transfer station or landfill and includes both household trash and bulky waste. The average for the period 2014-2018 was 9.6 pounds per household per day (p/h/d). In FY 2019, the estimated disposal rate is 8.7 p/h/d versus 10.0 p/h/d in 2018. This 1.3 pound difference translates to 93,000 tons, or $2.0 million in disposal fees. A comparison to other cities shows that a 3.8 p/h/d rate is possible, but requires significant investments in public information, mandatory programs, bans on disposal of certain materials and other policies and programs.

Figure 6-4
Residential Waste Generation Rate



A one pound reduction in the City's overall per capita generation rate is equal to 766,000 tons per year; regionally, the same reduction is 1.8 million tons per year.

Waste minimization is the most cost-effective means of addressing the City's waste management needs. Waste not generated does not have to be collected, transported, or disposed.

Table 6-14 presents a comparison of other Texas cities' waste disposal rates for residential waste. Disposal rates are net of waste minimization, recycling, and organics recovery. It should be noted that the City of San Antonio provides bulky

waste collection only twice per year and allows residents to use one of four bulky waste collection centers. Fort Worth and Dallas provide once per month collection of bulky waste.

Table 6-14 Comparative Waste Disposal Rates					
City	**Houston**	**San Antonio**	**Dallas**	**Fort Worth**	**Austin**
Daily residential waste collected per household/week (Pounds)	**6.2**	**5.9**	**5.6**	**6.0**	**3.5**
Daily Bulky Waste/HH (Pounds)	**2.7**	**0.5**	**3.0**	**0.6**	**0.3**
Total	**8.9***	**6.4**	**8.6**	**6.6**	**3.8**
***The difference between the 8.7 in Figure 6-4 and 8.9 in this Table is due to variances in reporting periods.**					

Table 6-15 presents recycling rates for the residential sector for other cities. Houston's program during this survey was impacted by Hurricane Harvey when the program was cancelled for several months. For 2019, the estimated recycling rate per household is anticipated to be 290 pounds per capita-day (p/cd).

Table 6-15 Recycling Performance in Other Cities					
City	**Houston***	**San Antonio**	**Dallas**	**Fort Worth**	**Austin**
Annual Recyclables / HH (Pounds)	183	328	478	365	474
Mandatory Multi-family Recycling	No	Yes	Starts 2020	No	Yes
*In 2019, this is estimated to be 281.77					

Source: City Budget information

Table 6-16 shows the overall disposal rates presented on a regional basis. These data include waste from both the residential and commercial sectors. Table 6-16 results show the following:

- With the exception of 2018 (Hurricane Harvey), H-GAC is close to the state-wide per capita generation rate.
- The Austin and San Antonio regions generation rates are 85% of H-GAC.
- Hurricane Harvey's impact is seen in the increase from 7.0 to 8.2 p/cd.

Table 6-16 Comparative Per-Capita Disposal Rates (2016-2018) (pounds)					
Region	Houston – Galveston H-GAC	San Antonio AACOG	Dallas – Fort Worth NCTCOG	Austin CAPCOG	State Average
Per-capita Disposal Rates (2016)	7.08	6.20	7.89	5.98	6.83
Per-capita Disposal Rates (2017)	7.06	6.13	7.79	6.02	6.84
Per-capita Disposal Rates (2018)	8.24	5.65	7.59	5.95	7.22
Source: TCEQ MSW Annual Report 2018 Includes data from both MSW and C&D landfills					

There are several variables that affect the waste generation and recycling rates, including the composition of the regional economy, storm events, types of local solid waste programs, and the amounts of waste that might be either imported or exported out of the region. **Even with these variables, however, it is clear from these tables that there are significant opportunities for the City and the region to extend landfill life through more aggressive waste minimization and recycling efforts.**

Key Waste Minimization, Reuse & Recycling Policy Issues

The City collects recyclable materials once every two weeks. The City uses the same type of truck (side loaders and sometimes rear loaders) it uses for solid waste collection to collect recyclable materials. Key issues related to collection include the following:

- Houston's recycling diversion rate is low compared to other cities. An expanded public information campaign is needed to increase both the quantity and quality of materials. One of the reasons for this is that the other cities provide once-per-week collection of recyclable materials versus Houston where materials are collected every other week. While there are no empirical data available regarding recovery rates for once-per-week versus once every two weeks collection, analyzing the effect of collection frequency on recycling diversion rate is something the City may want to consider in the future. Increasing collection frequency will significantly increase collection costs.
- There are high levels of contamination in the materials that are collected as part of the residential recycling program (approximately 30-40%). This increases the cost of collection and processing.
- As participation rates in the recycling program increase, more trucks and staff must be directed to the recycling program. This may result in reductions in available garbage collection vehicles and staff.
- Through the agreement with FCC to process recycled materials, all recycled materials from each quadrant of the City must be delivered to this northeast Houston FCC materials recovery facility.
- In order to supplement City collection vehicles and crews, the City contracted for a private firm to provide recycling collection services in the northwest quadrant of the City. This is anticipated to be a short-term contract, with the City providing services as soon as fleet and staffing needs are addressed.
- Residents of multi-family households have limited access to recycling opportunities. Unlike Dallas, Austin and San Antonio, owners of multi-family complexes are not required to provide recycling services to their residents. This is an increasingly important issue as Houston's population shifts to a greater percentage living in multi-family households.

- The value of recyclable markets has declined significantly over the past two years, in large part due to the loss of the China market for recycled materials. Market development was identified as a high priority action by the MATF. Lower values for recyclable materials may have an impact on private sector recycling.
- Sixty-eight percent of the City's waste is generated by the commercial and industrial sectors. These sectors are also responsible for a large percent of what is currently recycled in Houston. To increase recycling significantly, this sector will need to achieve higher rates of recovery.

Waste Minimization, Reuse & Recycling Options

Expand education/promotion of source reduction, reuse and recycling for residents, including working with non-profits and private sector to leverage existing efforts. Because the primary role of local government is to focus on the down-stream (i.e. recovery) segment of a product's lifecycle, the City is limited on how directly involved it can be on up-stream (i.e. manufacturing) and mid-stream (i.e. reuse/repurpose) segments of a product's lifecycle. Generally, cities' involvement focuses on expanding the promotion of waste prevention, reuse opportunities, and recycling right (reducing contamination). The City is involved in reuse through the Reuse Warehouse and chemical swap shop but is more directly involved in the recycling of materials through the existing recycling program. As part of the public information program, the City has, and should continue to work collaboratively with organizations such as State of Texas Alliance for Recycling, Keep Houston Beautiful and other environmental organizations.

Include more information regarding environmental impacts in City education materials, (i.e. upstream decisions for consumers). The City could include impacts in its education materials to convey the benefits of source reduction, reuse, and recycling. The City could include a "guideline for consumption" to explain the benefits of reusable water bottles, packing lunches in reusable containers, etc.

Lead by example through expanding the City purchasing / procurement guidelines to expand on source reduction, reuse, recycling requirements for City service and product providers. The City could create a sustainability purchasing team, perhaps through the Office of Sustainability in coordination with the Strategic Procurement Division, to develop an Environmentally Preferable Purchasing Guide (EPPG) to promote and encourage environmental stewardship across all City agencies.

Market Development – Senate Bill 649

Senate Bill 649 relating to the promotion of the use of recyclable materials as feedstock for processing and manufacturing was filed during the 86th Legislative Session and took effect on September 1, 2019. This bill mandates researching methods to encourage the use of recyclables as inputs for the creation of new products, which is part of a larger plan to invest in, expand, and promote the state's recycling economy. The State of Texas Alliance for Recycling (STAR) was a driving force behind the legislation, with its Business Council members conducting active advocacy. This legislation requires TCEQ to examine the current recycling economy and take specific actions to develop markets.

Lead by example through expanding the City guidelines on source reduction, reuse, recycling efforts for all City agencies and offices. The City could expand existing guidelines for every City agency to participate in source reduction, reuse, and recycling efforts through an Administrative Procedure (AP) or policy provided to each office and agency, disseminated by the Mayor's Office in coordination with the Office of Sustainability.

Develop Alternative Markets. The City could work with processors, Texas Commission on Environmental Quality (TCEQ), and the Mayor's Office of Economic Development to determine whether reclaimers and/or end users could be attracted to the region to accept more types of recyclables in the City's program, and expand on current local markets where possible. Working with the Office of Economic Development, the City could determine whether tax abatement or

other incentives could be provided to encourage more public/private partnerships similar to the City's current processing agreement with FCC.

Add more drop off locations for recyclables, chemicals, and electronics. In order to make recycling and reuse more convenient for the residents of Houston, the City could increase the number of drop off locations currently available. Currently, there are 6 drop-off locations, five additional facilities would be required to place one in each City Council district.

City of Dallas typically holds 10 Batteries, Oil, Paint and Antifreeze recycling (BOPA) events per year, and City of San Antonio, in addition to their HHW collection facility, typically has 3 mobile collection events per year.

Add more collection events for household hazardous wastes. Currently, Houston offers HHW collection at the Westpark Consumer Recycling Center and each of the Environmental Service Centers. The City could increase the frequency of these events to three times per year. As part of advertising for these events, the City could stress the significance of lithium battery contamination in the garbage and recycling streams and the importance of properly handling lithium batteries.

Expand types of materials collected and reused in City-operated reuse of materials beyond current building materials, electronics, and chemicals. In conjunction with adding more collection events for HHW efforts described above, if certain items seem better suited to add to the City's reuse centers, add the items. Reuse centers would need to have space to accommodate additional materials and potential recipients of the added materials should be identified prior to adding materials.

Add additional materials to recycling programs (e.g. textiles)
The City could continue to work with FCC to determine what and when materials could be added to the curbside recycling program. The City could also work with American Textile Recycling Service (ATRS), Green City Recycler, or other private companies and non-profits to determine the viability of expanding items that can be dropped off at Environmental Service Centers or Neighborhood Depositories for reuse or recycling, such as textiles.

Adopt a mandatory residential recycling ordinance, with strict code enforcement to issue citations for placing recyclables in garbage containers. Providing mandatory recycling services via ordinance requiring residents to participate in curbside recycling would increase recycling participation and disposal diversion in the City. The establishment of a mandatory recycling ordinance would require the drafting of the ordinance language (likely revising Chapter 39 of the City's Code of Ordinances), and the passing of the ordinance revisions by the City Council. The ordinance would require participation and could include banning materials from garbage containers.

Use Code Enforcement at the curb to issue citations for contamination in recycling containers and instruct collection vehicle operators to leave the recycling container unemptied if tagged for contamination. Code Enforcement Officers could check recycling carts for contamination, and tag contaminated carts. Collection personnel would be instructed to not collect from tagged carts. Ordinance revisions would be necessary to codify the procedure (i.e. modify Chapter 39). Education and outreach ahead of enforcement should be conducted to notify residents of the change in procedure.

San Antonio Enforcement

- San Antonio has 34 dedicated Solid Waste Route Inspectors (total population of 1.5 million)
- From SA FY 2018 Annual Report: Achieved 36% Recycling performance rate (performance rate is determined by not only including all of the materials recycled, but also adding the correct material).
- Improved contamination rate from 26% to 20.6%. Green organics contamination went from 43% rejection rate to 22%. In 2008 an average of 1.4 tons per residence sent to landfill, now down to 1 ton.
- Revenue from fines used to offset cost of redirecting waste. FY 2016: Purchase of 5 pickup trucks for new inspectors- $105,000
- Lower contamination rates lead to more efficient recycling routes because contaminated loads don't have to be taken to landfill.
- The Solid Waste Management Department has an inspection team checking the blue bins. The team will document unacceptable items and place a hang tag on the cart, indicating that it won't be picked up until the trash is removed. After a warning, if the inspection team finds more trash, it could result in a $25 fine.
- From the 2018 Solid Waste Annual Report: 46,924 warnings were issued, 1,730 fines issued. 1,730 x $25 = $43,250.
- Improved resident knowledge of acceptable recycling materials; inspectors act as ambassadors to the community.

Implement a Pay-as-You-Throw curbside collection system where setting out more garbage costs more, setting out less garbage costs less. In pay-as-you-throw (PAYT) programs, also known as unit pricing or variable-rate pricing, residents are charged for the collection of garbage based on the amount they throw away, which more closely aligns with how other utilities are charged. There are different approaches to PAYT, including variable rate carts based on size of the cart, stickers or tags residents must purchase to place on garbage bags, or specially marked or colored bags residents must purchase in which to set out garbage. A critical factor in designing PAYT is the need to purchase additional carts ahead of normal replacement schedules. PAYT systems generally only work when there is a fee charged for services provided.

Implement a voluntary technical assistance program to assist multi-family complexes in setting up on-site recycling programs. For multifamily complexes that wish to implement or improve upon recycling accessibility, the City could initiate a technical assistance program, based upon request. Targeting multifamily complexes within the technical assistance program would require that audits be performed by City staff to identify space constraints and other impediments to recycling and provide solutions to the property manager to overcome the impediments.

Adopt a mandatory recycling ordinance for multi-family complexes, with phased in compliance (education, then strict compliance). Mandating recycling services via ordinance requiring multifamily complexes to participate in recycling would increase recycling participation and disposal diversion in the City. The establishment of a Mandatory Recycling Ordinance (MRO) for the City would require the drafting of the ordinance, and the passing of the ordinance by the City Council. Cities in Texas who have already passed MRO's include San Antonio, Austin, Dallas, and San Marcos.

San Antonio Monthly Rate Structure
(Does not include Environmental Service Fee)

The City could include a requirement for a permit for haulers specifically for collecting recyclables from multi-family complexes (see Dallas details shown below), which would provide an opportunity for the City to track which complexes are complying with the ordinance, as well as tons collected from multifamily complexes.

Dallas Multi-Family Recycling Ordinance

- Half of Dallas residents live in multifamily housing.
- The City of Dallas Multifamily Recycling Ordinance requires multi-tenant property owners/managers offer **access to either valet, dual stream, or single stream recycling service** for their tenants. The ordinance applies to properties with 8 or more units.
- Ordinance will go into effect on **January 1, 2020**.
- In addition to offering access to recycling service, property owners and managers must **use a permitted recycling collector for recycling collection service.** (Permitted Recycling Collectors submit annual reports).

Implement a voluntary technical assistance program to assist businesses in setting up on-site recycling programs. Similar to the technical assistance program for multifamily complexes described above, the City could implement a technical assistance program targeting business entities to help businesses identify and reduce unnecessary physical waste. Specifically, the program could evaluate collection and disposal of trash, recycling, organics, and disposal of regulated wastes (including chemicals and electronics).

Adopt a mandatory recycling ordinance for businesses, with phased in compliance (education, then strict enforcement). Mandating recycling services via ordinance requiring businesses to participate in recycling would increase recycling participation and disposal diversion in the City. The establishment of a Mandatory Recycling Ordinance (MRO) for the City would require the drafting of the ordinance, and the passing of the ordinance by the City Council.

Private Sector Partnerships

The commercial sector is taking the lead on several fronts related to changing products and encouraging recycling. Corporate resources should be included as a key resource in implementing Houston's Plan. For example, **Walmart** has recently announced "zero waste" initiatives and Coca-Cola has committed to collecting and recycling its packaging, as well as increasing bottles to 50% recycled plastic by 2020. Unilever also states that their goal is "to move towards a more circular economy, designing products so that more packaging either remains in loops or has the best possible opportunity to be recycled".

Furthermore, **Amazon** has invested $10 million in the Closed Loop Fund, intended to fund large retail and consumer goods companies in building infrastructure that will increase product and packaging recycling, with the intention of ensuring that material is returned to the manufacturing supply chain. It is also Amazon's intention to increase the availability of curbside recycling for 3 million homes in the United States, wherein 1 million tons of recyclable material will be diverted from landfills.

Building upon the circular economy initiatives described in Section XX, in May 2018, the **American Chemistry Council's (ACC) Plastics Division** announced committing to the following goals for capturing, recycling, and recovering plastics:

- 100% of plastics packaging is re-used, recycled, or recovered by 2040.
- 100% of plastics packaging is recyclable or recoverable by 2030.
- 100% of the U.S. manufacturing sites operated by ACC's Plastics Division members will participate in Operation Clean Sweep-Blue by 2020, with all of their manufacturing sites across North America involved by 2022.

In order to do this, ACC recommends moving to a more circular economy which "prioritizes the extension of product life cycles, extracting maximum value from resources in use, and then recovering materials at the end of their service life."1 U.S. plastic resin producers partnering with the ACC plan to focus their attention on the following key areas in order to achieve the goals outlined above:

- Designing new products for greater efficiency, recycling, and reuse;
- Developing new technologies and systems for collecting, sorting, recycling, and recovering materials;
- Making it easier for more consumers to participate in recycling and recovery programs;
- Expanding the types of plastics collected and repurposed;
- Aligning products with key end markets;
- Expanding awareness that used plastics are valuable resources and available for next use.

Establish more informative data management systems to better track trends and provide more transparent and useful data. The City currently maintains data relating to solid waste management across multiple systems and reporting mechanisms, making it difficult to identify system-wide trends, threats and opportunities.

Implement reporting requirements to better track private sector recycling. City Code of Ordinance Chapter 38 states "solid waste operators" must have a "franchise," but the current language is not clear if "solid waste operators" includes recyclables haulers. Chapter 38 could be revised to clarify (or add) recyclables haulers to be included in the requirement for a franchise and require annual renewals of the franchise. The language could also be revised to require that franchise holders provide the City with certain information on a quarterly basis that would at least include tons of recyclables collected and delivered to a processor within the City. The reporting could include number of customers, by type of customers (multi-family or commercial), tons collected, tons processed and marketed, and contamination rates.

Organics

Approximately 35% of the total waste stream is organic material, including food waste, yard trimmings and wood. An additional 25% is paper and paper products which can also be composted. The City's current collection program is designed to first reduce the amounts of yard waste and food waste generated. The City provides separate collection of tree waste every two months (39,157 tons in 2017 and 21,215 tons in 2018). The City provides collection of yard waste in specifically approved biodegradable bags once per week (15,412 tons in 2017 and 9,317 tons in 2018).

Organics Policy Issues

- Biosolids have been identified as a difficult waste to manage at landfills, even though they do not take up a large amount of landfill space. This material can be composted; however, there are few compost facilities in the region that are permitted to accept this material.
- Adding biosolids and food residuals at composting facilities may increase the total capacity of processing facilities; however, few processors are currently authorized or willing to accept it.
- There are opportunities to recover more food waste to be used to feed the hungry. It requires significant coordination and there are agencies that have, as their mission, to make these efforts more productive.
- Houston has a number of food related industries that generate wastes that can be composted versus disposed in landfills.
- Opportunities exist for collection of food residuals from commercial sector; this may require new facilities or existing facilities' permits to be upgraded.
- Post-consumer food residuals are often highly contaminated, especially when collected from the residential sector.

Organics Policy & Program Options

Continue to provide both yard waste and tree waste collection services to residents. The City currently provides once per week collection of yard waste in biodegradable plastic bags. Tree waste is collected every other month. This program is responsible for the collection of approximately half of the material the City currently diverts from area landfills. One of the challenges with this program is the amount of contamination that appears in the tree waste program specifically. Residents often place bulky waste in the tree waste piles. To address this, the City needs to address this issue in their overall public education and enforcement programs.

Encourage greater recovery of acceptable food wastes for feeding low-income residents. EPA's priorities for managing food wastes identify donations of acceptable food waste second to source reduction as a priority. There are a variety of programs throughout Houston which are designed to reduce food waste by directing acceptable food waste for feeding the hungry. The City should be more proactive in doing more to connect generators of food waste with programs such as the Houston Food Bank and others to put this waste to positive use.

Adopt a mandatory recycling ordinance for organics collection with phased in compliance (education followed by enforcement.) The early focus of this strategy is to enforce compliance with current ordinances related to keeping yard waste out of solid waste collection bins and following rules related to tree waste set-out. If the City were to eventually move to residential food waste collection, proper set-out of this material will have to be included in the program.

Encourage diversion from the landfill of biosolids generated at City wastewater treatment plants to processing facilities. Work with organics processors to identify additional available processing capacity for biosolids among the facilities that are currently authorized to accept it. Identify feasibility of expanding capacity at those facilities if appropriate.

Provide greater support and expand availability of Master Composter program to build support of organics diversion and for public education. The City currently trains Master Composters through a program maintained by the State of Texas Alliance for Recycling (STAR). The City of Houston should expand its program to train Master Composters by making training sessions more accessible to the public and holding training sessions more often.

Community Level Composting: A promising trend developing in Houston and elsewhere is composting at the community level. Such programs are typically subscription based and may serve residences – both single-family and multi-family – and small businesses. These programs are typically quite small, particularly at start-up, but they are known for collecting organics with very little, if any contamination. They may process their own compost or deliver to third-party composters. They may be linked to small, community gardens who compost at the back-yard scale at the garden where compost is used. These "boutique" collection and processing operations currently fulfill an important niche in the management of organics because they are able to respond to the public demand for food residual diversion when City-wide diversion programs are not available or not feasible.

Encourage use of locally produced compost, mulch and soil blends outside City Projects. One way to encourage use of locally produced organic products outside of City projects is to include preferences for use of such products in a "Green Building Code" as addressed regarding recycling and resource recovery. This program could be phased with the phasing in of a "Green Building Code."

Lead by example by encouraging use of locally produced compost, mulch and soil blends at City projects and facilities. Institute and enforce a procurement policy favoring locally produced compost, mulch and soil blends at new and existing City projects and facilities. Coordinate with development of Environmentally Preferable Purchasing Guide for other recyclables.

Increase drop-off locations for acceptance of organics including yard waste, brush and tree waste. This action relates to the proposed actions in the recycling and illegal dumping programs to increase greater accessibility of depositories for materials to be properly disposed. There are currently 6 of these facilities – another 5 would place one in each council district.

Initiate Residential Food Waste Collection. Food waste could be collected from single-family residences along with green waste. Green waste is currently collected in compostable plastic bags. Comingled food waste and green waste are typically collected in carts. Introducing an additional cart in the residential collection system would be expensive. In addition, contamination is typically very high in post-consumer food waste, which increases cost and decreases the ability to process it. Most of the organics processors in the region will not accept post-consumer food waste.

Continue to monitor new technologies and processes for managing organic waste streams. There are technologies that are currently available for processing organics in a more complex manner than traditional windrow composting. These technologies have the potential to reduce more waste and different types of material more efficiently and more environmentally acceptable. However, the cost of such options is significantly more expensive than current regional practices.

On the Horizon – Edmonton Anaerobic Digestion Facility
This facility, located at the Edmonton Waste Management Centre (Calgary Canada), will expand the City's organics waste processing capacity and contribute to the goal of diverting 90% of waste from landfill.

The ADF will enable the City to:

Process up to 48,000 tons of organic waste per year and divert it from landfill;

Create renewable energy in the form of electricity and heat;

Produce high quality compost for use in agriculture and horticulture;

Reduce greenhouse gas emissions; and

Remove odors created during the process by using bio-filters.

The construction of the new ADF is now complete. The facility is currently in the commissioning phase, processing organic feed stock from municipal solid waste and generating biogas. It will be fully operational later in 2019. Source: https://www.edmonton.ca/projects_plans/waste_drainage/anaerobic-digestion-facility.aspx

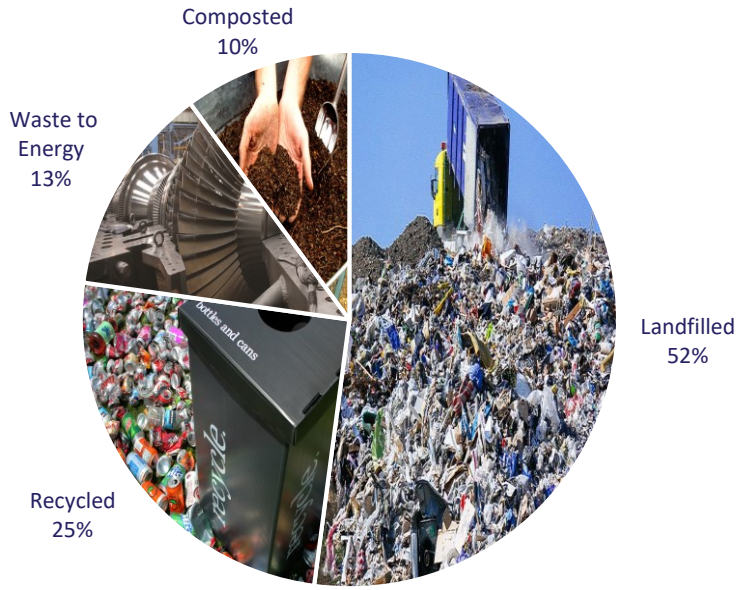
Figure 6-5 Edmonton Resource Recovery Facility

Energy and Resource Recovery

Energy & Resource Recovery Policy Issues
Energy recovery from waste has been demonstrated in the U.S. and other countries around the world. According to the U.S. Energy Information Agency, 12.8% of the MSW in the U.S. is burned for energy recovery. Demonstrated technologies include both mass burn and refuse derived fuels, which combust waste for energy recovery in the form of either steam or electricity. There are no operating waste-to-energy facilities operating in Texas.

With these technologies there are significant financial investments required. For example, a 2,000 ton-per-day facility could cost approximately **$200 - $250 million to construct**. Operating costs (including debt service) are in the range of $75 to $100 per ton, compared to current landfill tipping fees in Texas which are between $25 and $30 per ton. There are also air quality issues and other environmental issues that must be addressed prior to implementation of energy recovery technologies.

Figure 6-6
Waste Management in the US

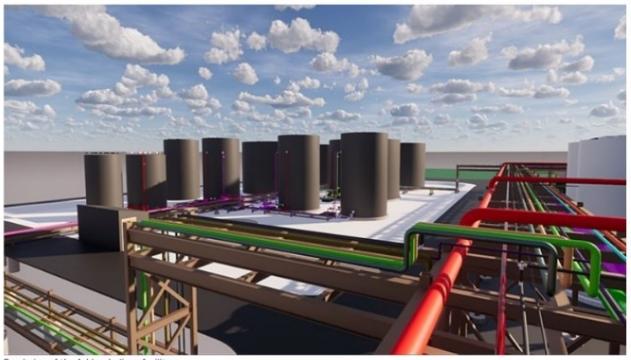


Source: U.S. Energy Information Agency

Technologies such as pyrolysis and gasification can recover energy in a more environmentally acceptable manner. The major risk associated with these technologies is that most of these technologies are relatively new and there are operational concerns. A major concern with adoption of these technologies is the need to have a fairly homogenous waste stream sent to the facility. Energy recovery technologies must compete with other energy alternatives including relatively low-cost natural gas. Table 6-17 presents a summary of characteristics of pyrolysis, gasification and anaerobic digestion.

Table 6-17 Characteristics of Pyrolysis, Gasification & Anaerobic Digestion			
Conversion Technology	**Pyrolysis**	**Gasification**	**Anaerobic Digestion**
Feedstock	**Plastics**	**MSW**	**Organic wastes**
Primary End Product(s)	**Synthetic Oil, Petroleum Oil**	**Syngas, Electricity, Ethanol**	**Biogas and Electricity**
Conversion Efficiency	**62 – 85%**	**69 – 82%**	**60 – 75%**
Facility Size (capacity)	**10 – 30 tons per day**	**75 – 330 tons per day**	**30 – 100 tons per day**
Product Energy Value	**15,000 – 19,000 Btu/lb**	**11,500 – 18,800 Btu/lb**	**6000 – 7000 Btu/lb**
Source: U.S. Environmental Protection Agency			

There are a number of private entities across the U.S. that are investing in alternative technologies. The American Chemistry Council references a report completed by Closed Loop Partners (CLP), an organization that invests in the development of a circular economy. The report concludes the following, "Our analysis indicates that these technologies could meet an addressable market with potential revenue opportunities of $120 billion in the United States and Canada alone. CLP identified 60 technology providers with significant potential for growth, along with 250 investors and strategic partners engaged with them."



Rendering of the Ashley, Indiana facility.
Courtesy of Brightmark Energy

Figure 6-7
Brightmark Plastics Pyrolysis Facility is located in Ashley, Indiana The advanced plastics renewal facility, now under construction, will divert 100,000 tons of plastic waste each year from landfills and incinerators and convert it into 18 million gallons of ultra-low sulfur diesel fuel and naphtha blend stocks and 5 million gallons of wax. Phase one of the plant's construction will represent a $138.3M capital investment in Steuben County, Indiana. Source: Brightmark Energy (2019).

Currently, Brightmark is seeking proposals from cities to locate a facility in their jurisdiction.

Energy and Resource Recovery Program Options

Promote landfill gas recovery for energy recovery. The City should use its contractual leverage whenever possible to have landfills recover landfill gas for energy recovery. This technology is being used in the H-GAC region and involves capturing the gas generated from the decomposition of organic material in the waste and either using it to generate electricity on site or converting it to pipeline quality gas. Section 6 includes a listing of landfills that are currently recovering energy from landfills. These include the three primarily MSW landfills used by the City of Houston (McCarty, Blue Ridge and Atascocita).

Periodically evaluate resource recovery and energy-from-waste technologies to determine if it is appropriate for Houston to invest in such technologies for waste management. There are technologies currently available for converting waste to energy; however, these technologies are costly and pose certain environmental risks. New technologies such as pyrolysis, gasification and anaerobic digestion may provide the City with long-term options for significantly reducing landfill needs.

Conduct periodic industry roundtable meetings. The Houston area is a world leader in energy related businesses. Some of these businesses have a direct influence on the development of alternative waste technologies, especially related to plastic production and waste management. The SWMD should establish a business roundtable to periodically review the potential of new technologies and encourage private investment.

Illegal Dumping

Illegal Dumping Police and Program Options

The City of Houston has hundreds of illegal dump sites located throughout the City. A number of agencies are responsible for detecting, monitoring and prosecuting illegal dumping in Houston, including the Harris County Environmental Crimes Unit, Houston Police Department (HPD), the Houston Department of Neighborhoods and SWMD. SMWD's primary role is to collect and properly dispose of the illegally dumped material once it has been reported.

Increase the number of crews and provide additional equipment for increased response to illegal dumping sites. In order to be more responsive to citizen complaints regarding illegal dump sites, the City should dedicate staff and equipment to the illegal dumping collection program. Each of the 4 districts should maintain at least two crews dedicated to illegal dump collections.

The MATF identified collection of illegal dump sites as one of its key priority issues.

Photo Source: Houston Chronicle

Increase hours of operation at existing depositories and add new depositories. In order to encourage proper disposal of MSW, the City should increase the hours of operation of the existing depositories. It is recommended that there be a depository located in each City Council district. This would require the construction and operation of 5 additional depositories.

Increase staffing for camera monitoring program – increase number of sites where cameras are located. The HPD and Harris County maintain a current program of monitoring known sites where illegal dumping is taking place. Monitoring is designed to deter individuals from illegal dumping and to assist in identifying individuals responsible for the illegal dumping. It is recommended that the number of these sites be increased.

Public Education Program related to illegal dumping. Develop and implement a public information campaign designed to reduce illegal dumping as well as how to report illegal dumping activities. The campaign should utilize a range of media, including social media, news articles and public service announcements targeted to the diverse cultures and languages in Houston.

Define responsibilities for illegal dumping between the Department of Neighborhoods and the HPD Differential Response Units. The Houston Police Department has Differential Response Teams who perform community policing using both traditional and non-traditional policing methods to address community crime. However, the Police Department does not accept responsibility for addressing illegal dumping using this unit. Therefore, the Department of Neighborhoods is currently taking 311 calls and addressing the issue.

Improve enforcement through broader powers for Code Enforcement and Solid Waste Management staff related to illegal dumping. The Harris County environmental Crimes Unit and the Houston Police Department Environmental Enforcement Unit report illegal dumping activity of more than 5 pounds to the District Attorney. Given the limited resources available to HPD, it is advised the Code Enforcement and Solid Waste staff be given the authority to issue citations for

illegal dumping. The City should also develop a process for accelerated enforcement of illegal dumping ordinances. Often, current court cases related to illegal dumping take between 2 and 4 years to resolve. By this time, the illegal dumping is typically cleaned-up and courts often do not enforce penalties.

PART III – VISION, GOALS AND ACTION PLAN

7.0 Vision, Goals & Objectives

One of the primary responsiblities of the MATF was to establish the vision, goals and objectives for the Plan. These reflect the group's priorities for meeting the City's long-term waste and resource management demands. The goals and objectives provide guideposts for determining if the City is on track to meet Houston's needs.

Plan Vision

The Vision of the SWMD is to provide exemplary service to the Houston community while enhancing our environment and protecting the health of Houston's residents.

Plan Goals

- Achieve financial sustainability for the SWMD.
- Increase reuse, recycling and organics diversion and decrease environmental risks of waste disposal in landfills. Make Houston a zero-waste community.
- Continue to provide quality services to the residents and businesses of Houston.
- Ensure long-term disposal capacity and sustainable solid waste infrastructure.
- Provide solid waste management services in a safe, equitable, responsive, and environmentally responsible manner.

Plan Objectives

Objectives are means to achieve the Plan's goals. The goals and objectives established for the Plan are consistent with the U.S. Environmental Protection Agency's "New Waste Paradigm" (Figure 7-1)." This paradigm focuses on reducing waste through waste prevention and reuse, then recycling, organics management, transformation through energy/resource recovery and finally disposal in a properly constructed and operated landfill.

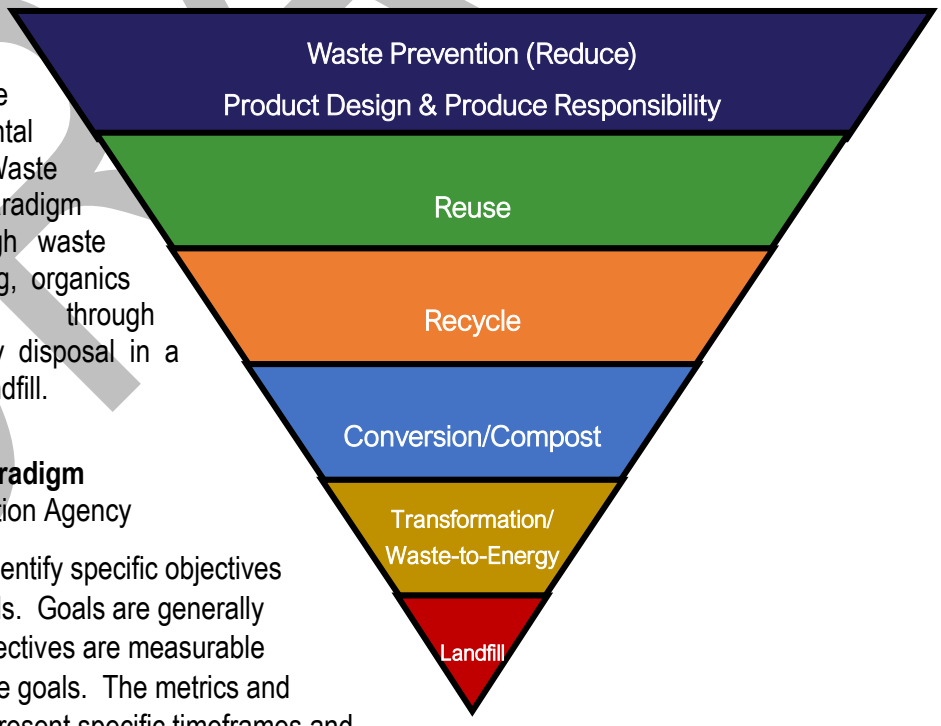


Figure 7-1 Waste Management Paradigm
Source: U.S. Environmental Protection Agency

The tables presented in this section identify specific objectives and metrics to achieve the stated goals. Goals are generally defined as an idea for the future. Objectives are measurable outcomes that are designed to achieve goals. The metrics and milestones presented in this section present specific timeframes and metrics to determine if the SWMD is on-target to succeed in addressing the MATF's goals and objectives. Near-term generally means five years or less; mid-term is five to ten years and long-term is over 10 years.

Table 7-1 Financial Sustainabilty Goals, Objectives and Metrics

Goals	Objectives	Metrics & Milestones
Achieve Financial Sustainability	Establish funding mechanisms that provide long-term financial sustainability for solid waste management needs. Secure alternative funding sources for paying for solid waste management strategies, including grants and partnerships. Provide services utilizing best management practices.	▪ In the near-term, establish monthly service fees to pay for all solid waste management services. ▪ In the near-term, establish a monthly environmental fee to pay for non-residential waste management services. ▪ Continue to secure grants for solid waste programs ▪ Continue to establish partnerships with environmental organizations and the private sector to jointly fund projects. ▪ Immediately, right-size the SWMD to improve operating efficiencies through timely equipment replacements, on-time equipment maintenance and appropriate staff sizing. ▪ Over the long-term, effectively use private sector resources to manage City-owned facilities.

Table 7-2 Assuring Long-term Disposal Goals, Objectives & Metrics

Goal	Objective	Metrics
Assure long-term disposal capacity	Assure long-term disposal capacity, maintaining a minimum of 25-years disposal capacity for waste generated by City residents and businesses.	▪ In the near-term, advocate for the efficient operation of regional landfills (as measured by in-place compaction density) through contracts as a means of extending current capacity. ▪ Over the long-term, assure landfill facilities used by the City meet all state and federal regulations through local ordinances and contracts for service. ▪ Continuously, assure environmental justice is taken into consideration for landfill locations and expansions. ▪ In the long-term, site, permit and construct a City-owned landfill. It is recognized that the process requires a long lead time, therefore planning for a landfill is a near-term requirement. ▪ In the near / mid-term, determine the need for a rail-haul facility to meet the City's long-term solid waste management needs.
	Reduce haul costs by maintaining a system of transfer facilities for both MSW and recyclable materials.	▪ Continue to operate and maintain through public private / partnerships City owned transfer facilities. ▪ In the near-term, develop recyclable material transfer capabilities throughout the City. ▪ In the near / mid-term, permit and build a Northeast Transfer Station.
	Implement resource recovery technologies, including energy from waste for meeting the City's future waste management needs when technically and economically feasible.	▪ Annually, report to the Mayor and City Council the status of resource recovery technologies and their potential application to Houston. These technologies include mass-burn incineration, pyrolysis, gasification and anaerobic digestion. ▪ In the very near-term, establish a public / private framework for monitoring technical advances and what the City can do to support development.

Table 7- 3 Waste Prevention, Recycling & Organics Goals, Objectives & Metrics		
Goal	**Objectives**	**Metrics and Milestones**
Increase Reuse, Recycling & Organics Diversion	Reduce waste from all Houston residents and businesses, while leading by example, to assist in reduction of tons-per-capita disposed by 25% compared to 2020 levels by 2040.	▪ By 2040, reduce waste from all sectors going to regional landfills (will require cooperation from City haulers) by 25%. ▪ By 2040, reduce residential waste collections by 25%. ▪ By 2040 Collection of yard waste reduced through grass-cycling (25%).
	Expand and innovate recycling opportunities to all Houston residents and businesses to increase amounts of materials recycled by 45% between 2020 and 2040; increase types of materials that can be recycled, and reduce contamination to 20% by 2030.	▪ By 2040, achieve a residential recycling rate of 30% (includes yard waste and recyclables). ▪ In the immediate future, establish an accurate, local recycling market database and benchmark. ▪ By 2040, achieve a City-wide recycling rate of 45% (will require a local data collection effort to capture all local recycling). Assumes current is 32% including C&D material. ▪ Continuously work to establish additional markets for recovered materials.
	Enhance multi-family recycling efforts.	▪ In the near-term, establish a dedicated multi-family reduction / recycling program with baseline survey for participation tracking. ▪ By 2025, increase the number of depositories and recycling centers for collecting materials from multi-family households; increased to one depository in each Council district. ▪ Establish a mandatory multi-family recycling ordinance by the year 2025.
	Enhance private sector source reduction and recycling efforts.	▪ In the immediate future, establish a dedicated commercial / institutional source reduction / recycling program with baseline survey for participation tracking. ▪ By 2027, establish a mandatory universal recycling ordinance.
	Preserve landfill capacity and realize environmental and economic benefits by reducing the disposal of organic resources within regulatory and economic constraints.	▪ In the near-term, mulch or compost 100% of recovered organics (yard waste and tree waste). ▪ In the near-term, reduce by 30% organics collection through grass cycling and backyard composting (increased number of attendees at Master Composter courses). ▪ By 2040, recover commercial organic materials through commercial program (survey food processors & food service companies for baseline) - 25% recovery rate by 2040. ▪ In the near / mid-term, assist in the development of organics processing capacity throughout the region.

		▪ In the near / mid-term, identify a candidate site for a food waste facility (similar to transfer or storage facility to serve food waste producers). ▪ Continuously, use of compost, mulch and other recovered organic resources increased throughout the region to support markets and realize environmental benefits. Increased use by City departments. ▪ Secure necessary wastewater treatment permits to allow for all of Houston's sludge to be processed at a composting facility. Negotiate contracts with compost processors to accept biosolids instead of landfilling this waste.

Table 7-4 Service Goals, Objectives & Metrics

Goal	Objective	Metrics & Milestones
Continue to provide quality services to the residents & businesses of Houston	Provide efficient collection of MSW and resources to all Houston residents.	▪ Continuously, provide once-per-week collection of municipal solid waste from residents. Level of service to be commensurate with financial resources available. ▪ Immediately, establish a fleet replacement program that results in no residential collection vehicles older than seven years old. ▪ Immediately, fully staff the SWMD. ▪ Continuously, reduce transportation costs associated with the collection and hauling of wastes through the use of transfer stations. In the near-term, identify transfer options for recyclable materials. ▪ Continuously, evaluate opportunities for the collection of recyclable materials at commercial and multi-family units. ▪ Continuously, provide for the collection program for household hazardous materials through City facilities and point-of-sale centers.
	Provide efficient, safe and responsive services in times of heavy storms or other disaster events.	▪ Continuously, maintain a current disaster debris management plan. ▪ Continuously, maintain active contracts for both managing and collecting disaster debris in emergency situations. ▪ Continuously, maintain available quality collection equipment for storm debris (less than seven years old for major pieces of equipment). ▪ In the near-term, implement the City's Climate Action Plan, Emergency Management Plan and Resiliency Plan.

Table 7-5 Environmental & Illegal Dumping Goals, Objectives and Metrics

Goal	Objectives	Metrics & Milestones
Provide solid waste management services in a safe, equitable, responsive, and environmentally responsible manner.	Reduce litter throughout the City, presenting a more beautiful and healthier Houston. Enhance efforts to reduce illegal dumping throughout the City.	▪ In the near-term, develop partnerships to discourage litter generation through joint public information campaigns. ▪ In the near-term, increase the number of depositories for collection of waste so that there is at least one facility in each council district. In addition to expanding the number of depositories, improve the geographic distribution of environmental service centers for HHW, electronics recycling and other special household wastes. ▪ In the near-term, add staffing and equipment dedicated to illegal dumping clean-up efforts and for homeless camp clean-up. ▪ Immediately, create opportunities for enforcement of illegal dumping for SWMD staff. ▪ Immediately, establish clear lines of responsibility for future illegal dumping enforcement, communications and clean-up.

8.0 Plan Recommendations & Impacts

As shown in Section 6, there are a number of policy and program options available to the City to achieve the MATF goals and objectives. The next step for the City is to establish policy/program plan priorities and implement those strategies. Implementation will require an organizational structure to identify specifically who will be responsible for specific aspects of the Plan. It should be noted that in many instances, plan implementation will require a collaboration of several stakeholders, including the residents of Houston. The Plan's implementation will also require financial resources. As has been stated in this Plan, the City's program is severely underfunded. To achieve goals and objectives, additional funding will be necessary. Once implemented, the Plan's outcomes will include better service to Houston residents, improvements to the local environment and a more secure solid waste infrastructure.

Plan Priorities

Based on an assessment of the City's needs and program options, the following are the high priority actions for the City's SWMD.

1. **Establish a long-term financially sustainable program** that includes both a monthly environmental fee and a monthly service fee.
2. **Right-size the program**. The City will need to continue to make investments in new equipment to replace older equipment and increase staff.
3. **Assure long-term disposal capacity in the region by directly investing in a process to site, permit and construct an MSW landfill in the region.** The City may operate with its own staff or operate the landfill under contract similar to the City's transfer stations.
4. **Work towards a zero-waste management system.** Five specific programs are identified as priorities.
    a. Enhance markets for recyclable materials through cooperation with industry and the City's economic development office.
    b. Focus attention on the multi-family and commercial / institutional sectors. This should begin with public education and coordination, ultimately leading to mandatory ordinances.
    c. Continue to provide residential recycling services, with an emphasis on reducing contamination.
    d. Establish an organics management program that targets the commercial sector including food processors and food service businesses.
    e. Mobilize the entire Houston community to understand that action is required by every household and business to reduce the cost of solid waste management and preserve critical disposal capacity.
5. **Invest in a new North East transfer station** to be located at the NE service center. The SWMD should also immediately fund improvements at existing transfer stations.
6. **Improve illegal dumping clean-up efforts through increases in staff and equipment.** Increase enforcement and penalties paid for violators as part of this process.

The policies and programs recommended in this Plan address all aspects of an integrated resource recovery approach. In recent years, the SWMD has been able to address some of these issues but the SWMD still faces many challenges.

- The current collection program relies too heavily on older equipment and is under-staffed. As noted in the Mayor's Inaugural Address, the City is making strides to replace front-line equipment. There is still a need to continuously update the City's fleet and hire additional staff to reduce overtime costs.

The challenges that face the SWMD in meeting the City's long-term solid waste needs will require both a new approach to funding and a recognition that managing the City's needs will cost more.

- The City continues to be impacted by climate change. The increasing number of damaging storm events has required the SWMD to provide assistance in clean-up efforts and these storms negatively impact regional disposal capacity.
- The region has less than 30 years of remaining disposal capacity. While this may appear to suggest long-term disposal capacity, to secure future landfill capacity a timeframe of 15 years is necessary. And as landfills in the region reach capacity, the City will have fewer options, affecting both access and costs.
- There is increasing public pressure to be more pro-active in providing more environmentally acceptable options for managing waste and resources, including more recycling and organics management.

The Plan is very pro-active in addressing current and future needs. Table 8-1 summarizes the number of new programs recommended and expansions to current programs. There 33 new programs ranging from monthly service fees to new ways to reduce waste generation identified in the Resiliency Plan. Current programs such as public information and illegal dumping clean-ups are proposed to be expanded from their current levels.

Table 8-1
Numbers of New Strategies & Program Expansions

Program Area	New Programs	Expansions of Programs	Total
Financial Assurance	1	1	2
Source Reduction	2	3	5
Recycling	9	5	14
Organics	8	2	10
Collection	2	4	6
Transfer Stations	3	0	3
Energy & Resource Recovery	3	0	3
Assuring Disposal Capacity	3	0	3
Illegal Dumping	2	4	6
TOTAL	33	19	52

Climate and Resiliency Plans

As stated, the City is also implementing both a Climate Action Plan and a Resiliency Plan. Both plans address MSW management. MSW recommendations from these plans are identified below.

Climate Action Plan Recommendations

The City is committed to achieving the Paris Accord standards for climate change. It established a working group to evaluate options for addressing greenhouse gases and programs to reduce these gases significantly by 2040. Below are

specific action items referenced in the DRAFT Climate Action Plan. It is significant that this Integrated Resource Recovery Plan addresses each of these goals.

- T1.2 Convert 100% of the non-emergency, light-duty municipal fleet (cars and trucks) to EV technologies by 2030.
- M1.1 Engage public on waste reduction solutions
- M1.2 Develop, implement, and promote sustainable municipal procurement strategies
- M1.3 Promote upstream solutions to reduce/manage disaster debris
- M2.1 Expand and innovate recycling opportunities to all Houston residents and businesses to increase diversion and recovery, while reducing contamination
- M2.2 Strengthen and support efforts to reduce food waste and create infrastructure for food organics collection and composting
- M2.3 Support and expand market development and diversion infrastructure
- M3.1 Improve efficiency of all landfills, transfer stations and waste transportation
- M3.2 Ensure long-term disposal capacity and solid waste infrastructure

Resiliency Plan

Sections of the City's DRAFT Resiliency Plan that are included in this Plan and include the following.

- Sub-action 32.4: Reduce residential landfill waste
- Sub-action 32.1: Shift to electric vehicles and low/no emission vehicles
- Sub-action 38.1: Increase long-term landfill sustainability
- Sub-action 38.2: Increase renewable energy generated within Houston
- Sub-action 38.3: Advance multi-family and commercial recycling

Organizational Plan

The SWMD is ultimately responsible to the Mayor for implementing the City's solid waste services. However, to implement the Plan as recommended, every aspect of the Houston community will have to participate in the implementation of the Plan. Figure 8-1 presents an organization chart that identifies the key roles of the SWMD and key stakeholders for implementation.

SWMD

For FY 2020, a total of 436.9 FTE positions were budgeted. The Recycling Revenue Fund has a total of 3 authorized positions. The organization chart defines a distribution of staff for the SWMD. Specific responsibilities for each section of the SWMD are presented in Appendix D.

The SWMD has direct responsibilities for the collection, processing, recycling and disposal of residential waste in the City. It also has policy making authority related to solid waste management. Per the City's Code, the SWMD are responsible for the following.

- *Supervise and be responsible for the collection, transportation and disposal of solid waste.*
- *Carry out the policies of the Mayor and City Council in the overall planning effort to develop a reliable and efficient method for solid waste disposal.*
- *Administer and enforce this chapter and related laws.*
- *Have such other duties and responsibilities as may be assigned by the Mayor and City Council.*

- *(Ord. No. 93-514, § 62, 5-5-93; Ord. No. 2015-1032, § 2, 10-21-2015, eff. 1-1-2016)*

The SWMD is currently comprised of three primary functions: Department Management, Maintenance Division and two Operations Divisions. ***Because of the significace of future planning, program management and public outreach and education, it is proposed a fourth primary functional division be established – Planning and Outreach Division.***

One of the primary recommendations of the Plan is to **Right-Size** the organization. To accomplish this, the City will need to continuously work to add staff to improve reliability and to provide the additional services that are outlined in the Plan. ***Without the addition of resources, including staff and equipment, the City will have to actually cut back on the level of services provided.***

Key Stakeholders

- **Citizens of Houston:** The citizens of Houston require a SWMD that can provide reliable services to manage municipal solid waste in order to maintain the health and environment of the community. Houston residents also have a responsibility to actively seek ways to reduce waste generation, reduce the amounts of contamination placed in recycling carts and adhere to SWMD collection ordinances.
- **Mayor & Council:** The executive and the legislative branches of the City direct the SWMD as to the services it provides and its annual budget. The Director of the SWMD reports to the Mayor.

Houston residents need to understand that they are key stakeholders in the success of the Plan. By actively taking steps to ***reduce waste, follow ordinances and become aware of ways to improve recycling,*** Houston residents can ***improve the local environment and reduce the cost*** of solid waste management which is paid for by their tax dollars.

Other City Departments

- **Fleet Maintenance:** The SWMD relies on hundreds of pieces of equipment to provide their services reliably and efficiently. The Fleet Maintenance Department has the responsibility to assist in the procurement of vehicles and maintain them on a regular basis.
- **Procurement:** Each year, the SWMD procures a number of services and materials from private vendors. The Procurement Department has the responsibility to assist the SWMD procure these services including operation of the transfer stations, supplemental collection services and landfill disposal.
- **Budget & Finance:** Assists the SWMD in preparing annual budgets. This department will have a critical role to play in establishing an Enterprise Fund if this recommendation is adopted by the City Council.
- **Emergency Management:** The SWMD is a key player in responding to emergency events such as floods and hurricanes. The SWMD works closely with Emergency Management to respond quickly to these events.
- **Office of Sustainability:** Many of the priorities of the Office of Sustainability and the SWMD are aligned – specifically related to the implementation of the Climate Action Plan. SWMD should work closely in identifying funding sources for programs that are in both this Plan and the Climate Action Plan.

Integrated Resource Recovery Plan Organization Chart

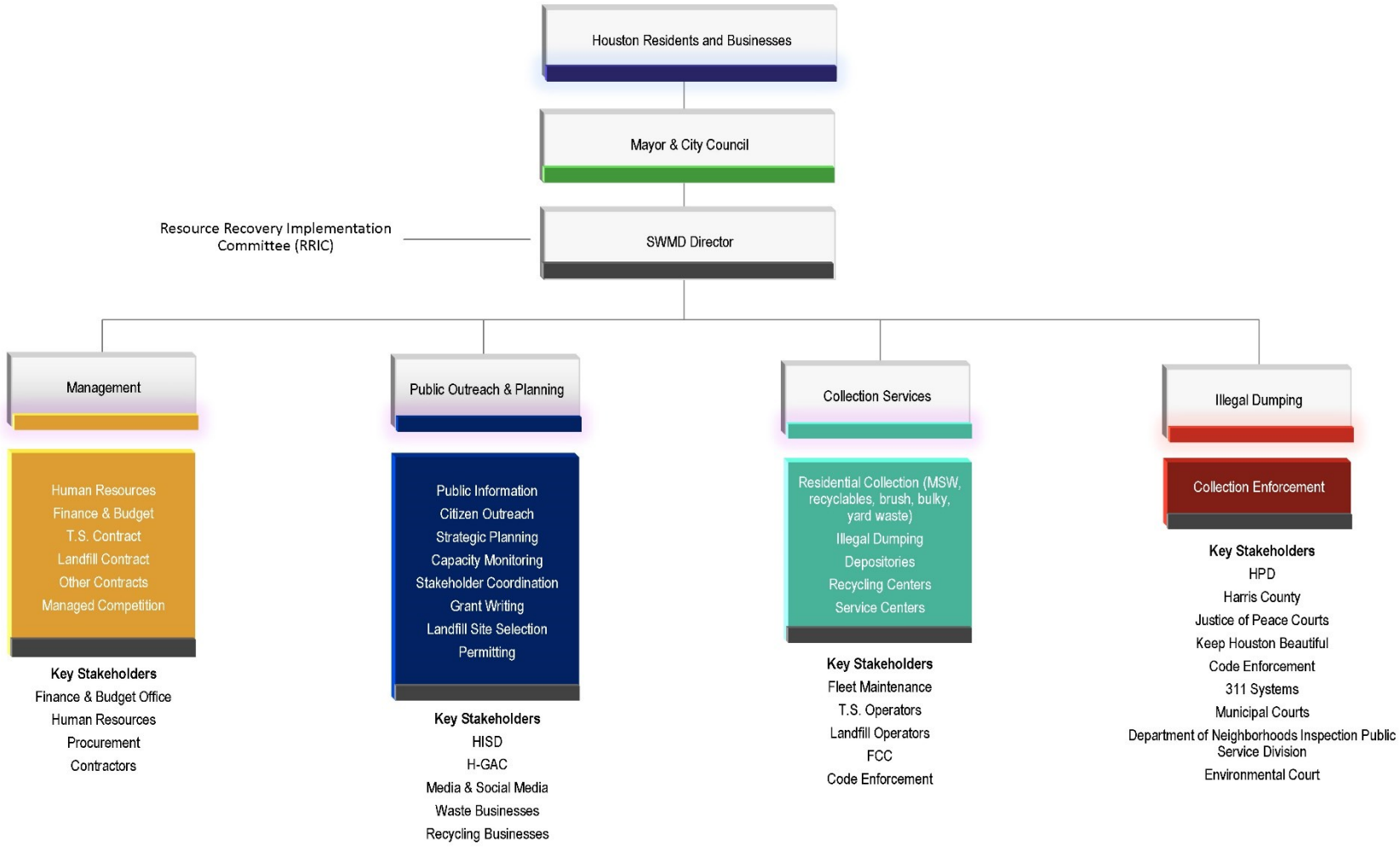


Figure 8-1

- **HPD & Code Enforcement & Department of Neighborhoods:** These agencies have responsibilities to identify illegal dump sites and to enforce City ordinances related to illegal dumping.
- **Office of Economic Development:** Responsible for coordinating with the SWMD in efforts to attract new markets for recyclable materials and other waste management facilities that are consistent with the Plan's goals and objectives.

Other Governmental Entities

- **Texas Commission on Environment Quality:** TCEQ is responsible for permitting MSW facilities in Texas. TCEQ also provides regional grant funds which are distributed in the Houston area through H-GAC. TCEQ also maintains an annual database on landfill capacity.
- **H-GAC:** The H-GAC has regional solid waste planning responsibilities. The H-GAC is also the agency that is responsible for distributing state grants for solid waste and recycling programs. In the past, Houston has been successful in securing grant funds from H-GAC.
- **Harris County:** The County has responsibilities related to illegal dumping enforcement.
- **Other County governments.** County governments have the authority to establish land use ordinances related to solid waste facilities. Brazoria, Fort Bend, Chambers and Waller Counties have established such ordinances and any future MSW facilities must address these regulations.

Environmental & Community

Groups such as Keep Houston Beautiful are able to assist in efforts to increase waste minimization, recycling, organics management and eliminate illegal dumping in the City.

Organizational Issues and Illegal Dumping

One of the findings of the planning effort is the need for a significant restructuring of illegal dumping enforcement responsibilities and accountability. It would be useful to bring all parties together to attempt to more clearly define roles, responsibilities and budgets for identifying illegal dump sites; enforcing local codes and ordinances; and collection of waste found at illegal dump sites. The one clear responsibility is that the SWMD has the responsibility to collect waste at these sites once they have been reported.

Private Businesses

There are a number of areas where the private sector can assist in achieving City solid waste management goals. It is in businesses' best interest to have successful waste management strategies since they are responsible for 85% of the City's waste generation. This is also the sector that is responsible for manufacturing and selling products that become waste. Business organizations such as the Greater Houston Partnership, the American Chemistry Council and others should be long-term partners in implementing the Plan.

The SWMD Contractors

- **Republic –** responsible for management and operations at the City's three transfer stations. Also, they own and operate the McCarty Road Landfill and the Blue Ridge Landfill which are used by the City for MSW disposal.
- **Waste Management –** owner and operator of the Atascocita landfill and C&D landfills the City uses. The City has contracts to use these landfills.
- **FCC –** owner and operator of the FCC Material Recovery Facility. The City has a long-term contract with FCC to accept the City's single stream recyclable materials. The facility will be turned over to the City in 2021. FCC also hauls biosolids from Houston's wastewater treatment facilities.
- **Other contractors** include Texas Pride Disposal which is providing supplemental recycling collection services.

Resource Recovery Implementation Committee (RRIC)

It has been extremely valuable to have the MATF assist in the development of the Plan. Members provided unique insights into community needs and information on the status of the solid waste, recycling and organics industries. It is recommended that once the Plan is approved by the City Council, a Resource Recovery Implementation Committee be established. The RRIC should be comprised in a manner similar to the MATF; however, representatives from certain industries should acknowledge when potential conflicts of interest arise related to specific recommendations. The RRIC would have the responsibility to accomplish the following.

- Provide further insight relative to the actual implementation of programs and policies.
- Provide additional resources needed to gain public insight related to program implementation.
- Report to City Council on the progress of the Plan's implementation.

Financial Plan

Three of the main objectives of the Plan were to accomplish the following, which will have a significant impact on the SWMD's future funding:

- Right-sizing the SWMD's services requiring a greater number of vehicles and crews to provide reliable and efficient collection of waste;
- The need to improve existing facilities and build new facilities to meet the needs of a growing population; and
- A program that is financially sustainable through an enterprise fund supported by a monthly fee and an environmental fee.

In addition to these actions, the community's demand for a more environmentally sustainable solid waste program will require funding. This includes funding the following:

- A more aggressive public education/information program;
- Greater efforts to recover resources through recycling and organics management; and
- A more aggressive illegal dumping enforcement and collection effort.

The programs and policies identified in this section of the Plan, will require funding if they are to be successful. It should be noted that many of the "high fiscal impact" items will be implemented over a long-period of time and may require bond funding.

There are revenue streams that should be incorporated into the Enterprise Fund in addition to both monthly service fees and an environmental fee. These revenues streams include the following:

- Grants provided to the SWMD for programs from outside entities;
- Revenues from the sale of recycled materials per FCC contract;
- Royalty payments from the City's transfer stations;
- Potential tipping fees or royalties from a City-owned landfill; and
- City's newly adopted cart lease program.

As the City begins to implement specific strategies for each of these programs, a more defined budget can be calculated. To review how the above programs and policies might impact the City's budget, the Project Team evaluated the costs for other mature programs and the fees that they are charging for service. In Texas, monthly fees vary depending on the level of services provided and if there are opportunities to subsidize program costs through landfill tipping fees or royalties on City-owned facilities. A review of other cities shows the range for monthly service fees is between $14.94 per month to $42.85 per month. Monthly Environmental Fees range are $0.50 to $8.95 per month.

Monthly Environmental Fee

It is recommended as a first step in implementing the Plan, that a monthly environmental fee be established. The fee would be used to fund the following programs.

- Illegal Dumping and Litter Control
- Neighborhood Drop-off Expansion (new facilities and longer hours)
- Homeless Encampment Clean-up
- Inspections and Enforcement
- Container Lease and Management
- Keep Houston Beautiful
- Long-term Disposal
- Equipment Readiness / PSHS
- Long-term Disposal

The estimated monthly Environmental Fee will apply to all Houston households and businesses. The projected fee, and total revenue generation is shown in Table 8-2

Based on the assumptions presented in this table, approximately $43.9 million could be raised. Table 8-2 presents the recommended fee structure for various segments of the community. Table 8-3 provides a summary of the programs that would be funded through the monthly environmental fee as well as the amount of funding each program would receive from the fee.

Table 8-2
Proposed Monthly Fee by Service Segment

Segment	Monthly Fee	Units	Total Annual Fee Generation (million)
Direct Service Single Family	$5.61	390,000	$26.2
Multi-family	$2.13	474,457	$12.0
Non-service single family	$2.13	87,483	$2.2

Sponsorships	$2.13	49,000	$1.2
Business	$1.86	100,000	$2.2
Total			$43.9

Table 8-3
Programs and Revenues funded from Monthly Environmental Fee

Program	Direct Service (million)
Illegal Dumping & Litter	$8.0
Neighborhood Drop-off Expansion (new facilities and longer hours)	$3.2
Homeless Encampment Clean-up	$3.5
Inspections/Enforcement	$4.8
Container Lease & Management	$5.3
Keep HoustonBeautiful	$1.6
Long-term Disposal	$1.8
Equipment Readiness / PSHS	$15.6
Total Annual Generation	**$43.9**

To establish both the monthly fee and the enterprise fund, the following steps will be required.

- A detailed capital investment plan will have to be prepared.
- An assessment of the impacts of projected transfer station and disposal costs will have to be determined.
- A detailed budget for specific program implementation must be developed.
- Modification for any policies which might impact the number of households impacted by the fee (specifically adjustments for low-income households).
- The policy related to sponsorship households will have to be determined.
- Establish protocols for collecting fees, most likely through the water department.
- Determination of fund reserve balance requirements must be finalized.

To establish the Enterprise Fund, the City will need to transfer assets from the General Fund to the newly created Enterprise Fund. These assets include the collection fleet, transfer stations, depositories and service centers. The Enterprise Fund could issue bonds to pay for the transfer of these assets.

It is possible also to phase-in the proposed fees over a period of years.

Monthly Service Fee

As the program evolves, it is recommended that a monthly service fee be implemented. The Monthly Service Fee would be applied to residents who receive collection services from the City. This type of fee is similar to the fee that residents

pay for water and wastewater service on a monthly basis. Table 8-4 presents recommendations for a monthly service fee to be charged to residents and businesses across the City. Section 6 of this Plan provides background on the estimated funding requirements for the fee. Table 8-2 presents preliminary calculations for a fee. ***The actual fee established will require a careful evaluation of the SWMD's long-term capital plan and which programs of the Plan are adopted.***

The MATF did express concern for the impact that the monthly service fee would have on low-income residents. It is proposed that a program similar to Houston W.A.T.E.R. Program, which provides assistance to low-income individuals be established, or the existing program be supplemented to provide assistance with payment of the solid waste monthly fee.

Table 8-4
Estimated Monthly Residential User Fee

	FY 2020	Inflation Adjustment	FY 2021
FY 2020 SWMD Budget	$ 84,956,973	3%	$ 87,505,682
FY 2020 Recycling Revenue Fund Budget	$ 4,934,277	3%	$ 5,085,305
Rolling Stock Capital Requirement	$ 9,609,310[1]	3%	$ 9,897,589
Other Capital Requirement (Debt)	$ 2,126,228[2]		$ 2,126,228
Other Costs	$ 9,822,241[3]	3%	$ 10,116,908
Total Costs	$ 111,449,028		$ 114,728,713
Households	396,730	1.28% [4]	401,808
Estimated Cost/HH/Month	$ 23.41		$ 23.79

1. Per Table 7-3, Capital Needs - Vehicles
2. Per Table 7-4, Capital Needs – Other
3. Per Table 7-5, Other Costs
4. Household annual growth rate per Waste Generation Forecast

Impact on the Waste Stream

The Plan is intended to work towards zero waste. While zero waste is currently not attainable on a City-wide basis, the City's program is intended to make strides to reducing waste through public education, recycling services and ultimately mandatory ordinances. The programs identified in this Plan will also reduce the toxicity of the waste stream through increased collection opportunities for HHW and public education strategies.

Reduction in waste quantities requiring disposal will have the following impacts.

- Waste reduction will reduce the amounts of waste that has to be disposed at either a transfer station or landfill. These contracts are on a per-ton basis. Therefore, there is a one-for-one ratio of waste reduction and costs for disposal.
- The impacts on fleet are more difficult to determine, however. A reduced quantity of waste will allow trucks to collect more homes per route. Yet a 10% reduction in waste generation does not necessarily equate to a 10% reduction in

fleet needs. Vehicle routing has to take into consideration travel times to facilities, weekly peak quantities, and other factors. If enough reductions in waste generation can be achieved, the number of vehicles could be reduced.

- Waste reduction will extend the duration of time before additional landfill capacity will be needed.
- Waste reduction will reduce the generation of greenhouse gases.

In forecasting future waste generation and recovery rates, there are a number of variables that could impact future needs. These variables include the following:

- Changes in population and economic activity;
- Changes in the types of materials that are used for material packaging;
- Changes in material markets;
- Changes in technologies associated with waste collection, disposal, processing and recycling; and
- Future storm events.

Residential Waste Reductions

To understand future residential solid waste needs, the Project Team evaluated current waste generation rates for the City's residential sector and applied those rates to future increases in households served. This "base case" assumes no change in the disposal rate but does take into account growth in the number of households served. Based on a review of the City's program, a residential recycling rate of 15-20% is achieved. This includes both residential recycling, recovery of organics in the form of yard waste and tree waste and materials recovered at depositories and recycling centers. This base case scenario also assumes an average disposal rate of 1,170 pounds per capita per-year.

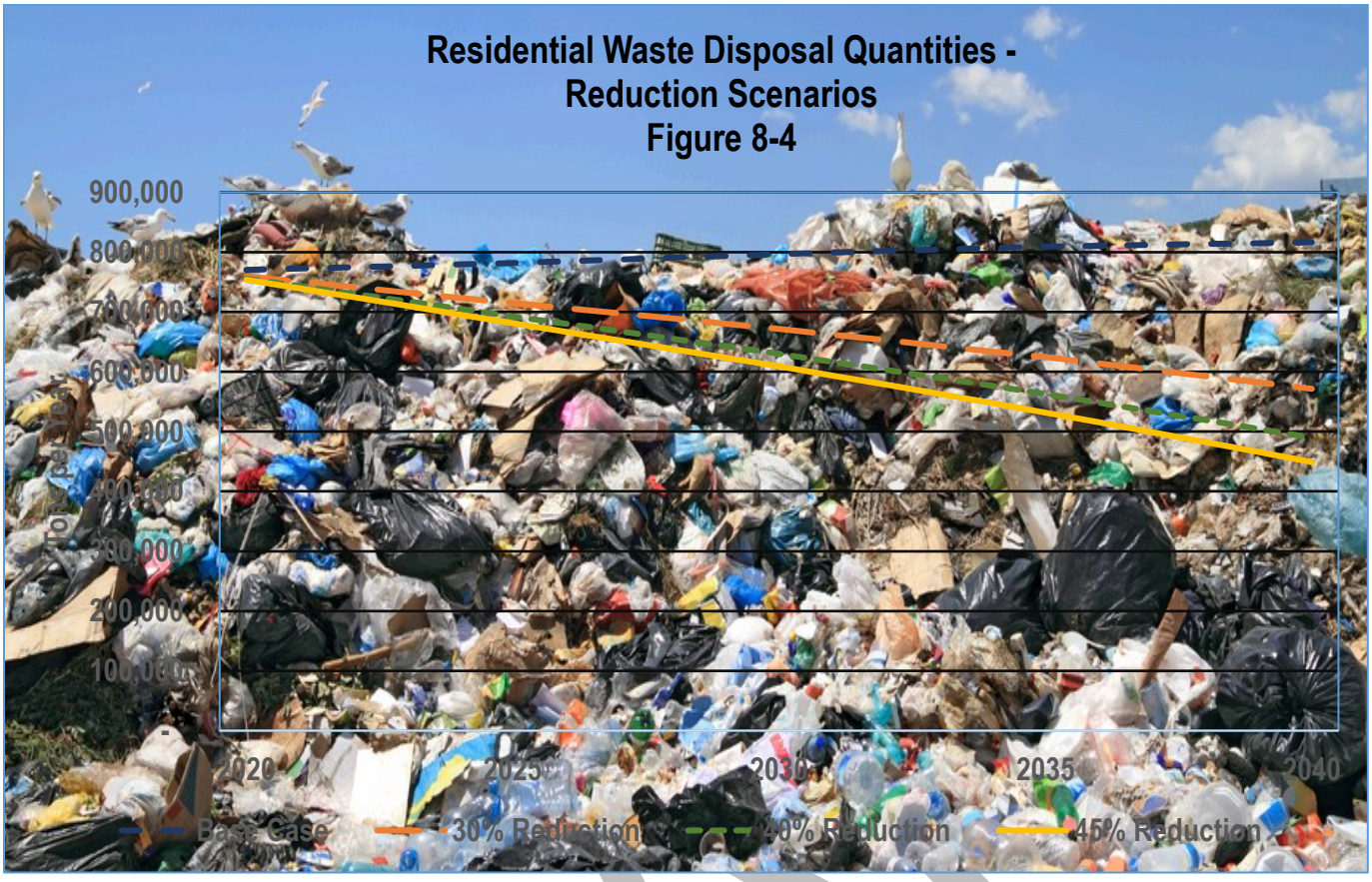
Table 8-5 presents a range of potential reductions that could be achieved in Houston with the residential programs later in this section. It is anticipated that the reductions would be achieved over time. The results of these reductions are presented in Figure 8-2. Figure 8-3 presents the cumulative effect for the planning period 2020 -2040. Assuming no change in the current program, the amount of waste projected to require disposal over the planning period is 16.7 million tons. If the City were to achieve a 45% reduction by 2040, the amount of waste requiring disposal would be 12.7 million tons; a 4 million ton reduction would be achieved over the planning period. ***The reductions can be achieved if the City invests the resources to implement the necessary programs. They have been achieved in other communities in Texas which have dedicated substantially more to source reduction and recovery programs.***

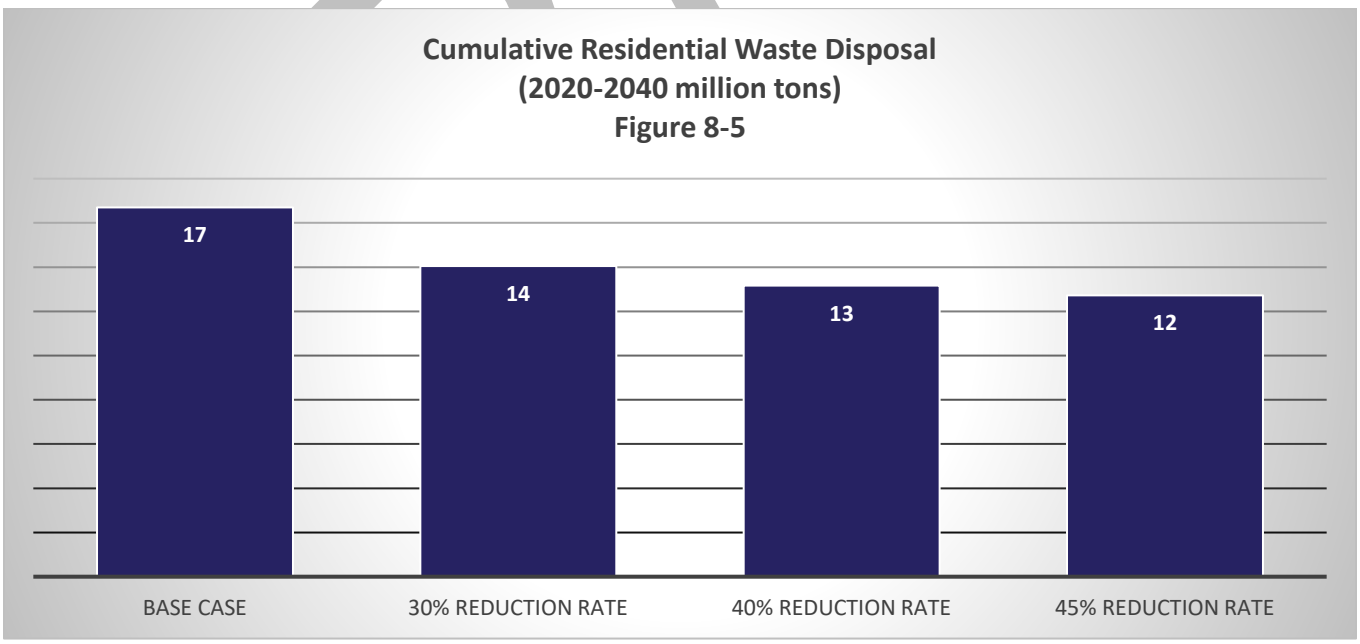
The data in Tables 8-5 as well as Figures 8-4 and 8-5 illustrate that the City can make significant reductions in the amounts of waste generated, but also indicates that even with significant reductions, there will be a continued need for landfill disposal to meet the City's needs. Table 8-6 and 8-7 present a preliminary "menu" of programs required to achieve low, medium, and high reductions and recover rates. Descriptions of these policies and programs are in Section 6, as well as the tables at the end of this Section. The menu is intended to illustrate that it will require a combination of programs to achieve waste reduction and recycling goals. As the City implements the Plan, it will evaluate the current needs and identify which strategies best meet waste reduction and recovery goals, while also staying within budget. Obviously, this presents conceptual program results. Actual reductions and diversions will depend on the resources dedicated to these strategies and the level of local participation.

Table 8-5
Range of Waste Reductions in Residential Waste Stream

Scenario	Short-term (2020-2025)	Mid-term 2025-2030	Long-term 2030-2040
Base Case	15%	15%	15 %
Low	20%	25%	30%
Medium	22%	30%	40%
High	25%	35%	45%

Table 8-6 Residential Waste Minimization and Recycling Programs			
Actions Minimization / Recovery Rates	Low 20-30%	Medium 22-40%	High 25-40%
Source Reduction			
Public Information (SR1)	●	●	●
Private Sector Collaboration (SR2)		●	●
City Internal Program (SR3)	●	●	●
City Procurement (SR4)	●	●	●
Pay as You Throw Rates (SR-5)			●
Recycling			
Recycling Collection (R-1)	●	●	●
Alternative Markets (R-2)		●	●
Residential Sector Education & Enforcement (R-3)	●	●	●
Increased Depositories (R-4)		●	●
Environmental Education (R-5)	●	●	●
More Drop-off Locations (R-6)		●	●
Increased HHW Collection (R-7)		●	●
Expand material recovery (R-11)		●	●
Data Collection (R-14)		●	●
Data Trends (R-15)		●	●
Organics			
Collection of Organics (O-1)	●	●	●
Brush Collection (O-2)	●	●	●
Food Waste Recovery for Low-income (0-3)		●	●
Develop capacity (O-4)			●
Mandatory participation (O-5)			●
Biosolids Composting (O-6)			●
Compost Market Development (O-7)	●	●	●
Grass clipping enforcement (O-8)	●	●	●
Expand Master Composter Program (0-9)	●	●	●
Lead by Example (0-10)		●	●
Increase drop-off locations (O-11)		●	●
Food waste collection (O-12)			●


Residential Waste Disposal Quantities -
Reduction Scenarios
Figure 8-4
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
2020
2025
2030
2035
2040
Base Case
30% Reduction
40% Reduction
45% Reduction


Cumulative Residential Waste Disposal
(2020-2040 million tons)
Figure 8-5
17
14
13
12
BASE CASE
30% REDUCTION RATE
40% REDUCTION RATE
45% REDUCTION RATE

City-wide Reductions

Currently, the City's residential, commercial, and industrial sectors generate a combined 4.2 million tons per year. By the year 2040, the estimated quantities of waste requiring disposal will reach 5.4 million tons due to increases in population and economic activity. Based on data collected as part of the Waste Generation Analysis, it was also determined that the City is now diverting 2.0 million tons which is expected to increase to 2.6 million tons in 2040. The 2040 projection assumes no major change in recycling policies or practices by the commercial sector. These diversions are due in large part to a significant quantity of construction / demolition material being diverted (approximately 1.5 million tons in 2019). Other significant reductions in landfill needs are occurring in the recovery of organics and recyclable materials.

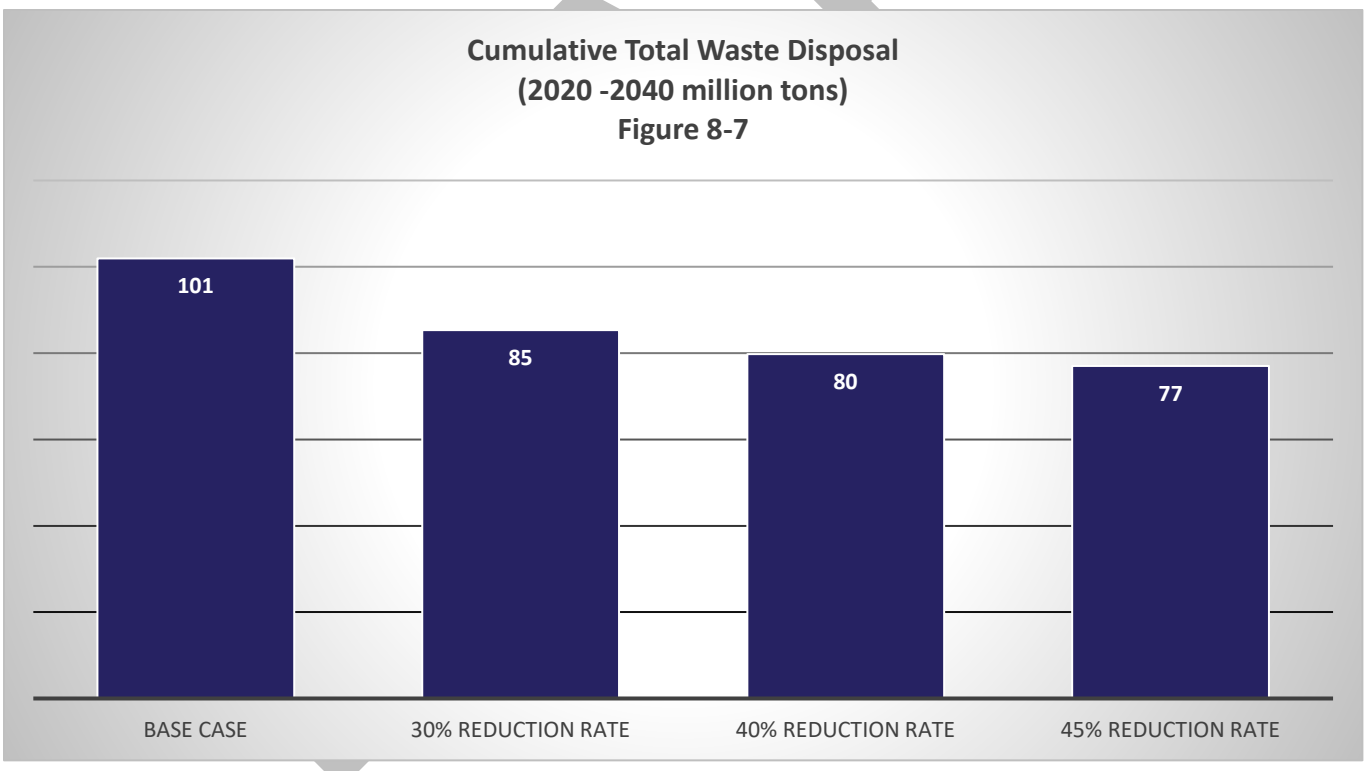
Houston's current 4.2 million tons of waste represents 57% of the total amount of waste generated in the H-GAC region. A major reduction in Houston's waste generation can have a significant impact on extending current landfill capacity. This will require a City-wide effort to not only reduce the amounts of waste generated by the commercial sector, but to convince manufacturers and retailers to design products in a manner that results in less waste generation and greater recovery through recycling. Figure 8-4 presents projected waste disposal needs; Figure 8-5 presents cumulative waste disposal under these scenarios.

Even with the 30% reduction rate, the City's total waste disposal needs decrease from a base case of 102 million tons over the planning period to 83 million tons, a 19 million ton decrease. With the highest waste reduction scenario (45%), the City disposal needs drop to 77 million tons over the planning period, a 25 million ton decrease. The H-GAC region disposes approximately 7 million tons per year. A 25 million ton decrease in waste disposal needs could extend landfill capacity by approximately 3 to 4 years.

To achieve more success in extending capacity, the City of Houston should, to the extent practical, work on a regional basis with its partners in the H-GAC region to adopt many of its strategies to reduce disposal needs.

Table 8-7 Residential, Commercial & Institutional Waste Minimization and Recycling Programs			
Actions Minimization / Recovery Rates	**Low 20-30%**	**Medium 22-40%**	**High 25-40%**
Source Reduction			
Public Information (SR1)	●	●	●
Private Sector Collaboration (SR2)	●	●	●
City Internal Program (SR3)	●	●	●
City Procurement (SR4)	●	●	●
Pay as You Throw Rates (SR-5)			●
Recycling			
Recycling Collection (R-1)	●	●	●
Alternative Markets (R-2)	●	●	●
Residential Sector Education & Enforcement (R-3)	●	●	●
Increased Depositories (R-4)		●	●
Environmental Education (R-5)	●	●	●
More Drop-off Locations (R-6)		●	●
Increased HHW Collection (R-7)		●	●
Mandatory Multi-family Program (R-8)		●	●
Mandatory Business Recycling Program (R-9)			●
Green Building Code (R-10)			●
Expand material recovery (R-11)		●	●
Technical Assistance – Multi-family (R-12)	●	●	●
Technical Assistance – Businesses (R-13)	●	●	●
Data Collection (R-14)		●	●
Data Trends (R-15)		●	●
Organics			
Collection of Organics (O-1)	●	●	●
Brush Collection (O-2)	●	●	●
Food Waste Recovery for Low-income (0-3)		●	●
Develop capacity (O-4)			●
Mandatory participation (O-5)			●
Biosolids Composting (O-6)			●
Compost Market Development (O-7)		●	●
Grass clipping enforcement (O-8)	●	●	●
Expand Master Composter Program (0-9)	●	●	●
Lead by Example (0-10)	●	●	●
Increase drop-off locations (O-11)		●	●
Food waste collection (O-12)			●


Total Waste Disposal Quantities -
Reduction Scenarios
Figure 8-6
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
Tons per Year
2025
2040
Base Case
30% Reduction
40% Reduction
45% Reduction


Cumulative Total Waste Disposal
(2020 -2040 million tons)
Figure 8-7
101
85
80
77
BASE CASE
30% REDUCTION RATE
40% REDUCTION RATE
45% REDUCTION RATE

Program Metrics

Through the planning process, the Project Team and the MATF identified a number of program goals and objectives. It is critical that as the City adopts the recommendations of the Plan, that periodic reporting back to City Council and citizens be made as to the progress toward accomplishing these goals and objectives. In order to do this, a number of program metrics are recommended. Some of the metrics presented below can be obtained from existing data; some of the data will require the City to solve issues with its current data management program; and some of the data will require periodic sampling and surveying of both the residential and commercial sectors. Table 8-8 presents a summary of key metrics to follow as the City implements this Plan.

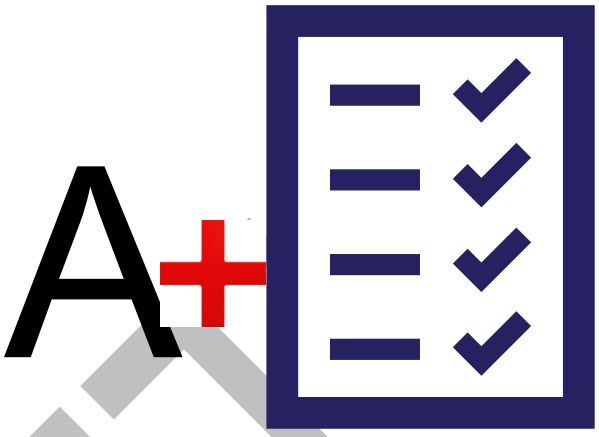


Table 8-8
Key Program Metrics

Program	Metric	Current	Short-term Objective (1-5 years)	Mid-term Objective (5-10 years)	Long-term Objective (10-20)
Source Reduction	Residential Waste Generation (lbs./hh/day)	8.9	7.5	6.0	5.0
Source Reduction	Regional disposal rate (lbs./capita/day)	7.1	6.0	5.0	4.5
Recycling	Residential Recovery Rate	7%	15%	25%	30%
Organics	Recovery of yard waste and brush for compost or mulch recovery rate	7%	10%	15%	15%
Collection	Fleet Age (average age of fleet)	7	5	4	3.5
Collection	Missed Collections	Unknown	1/1000	1/1000	1/1000
Transfer Stations	Availability of transfer stations within 20 min of collection routes	20	20	20	20
Disposal	Available capacity over 25 years for MSW	30	25	25	25
Disposal	Control over future disposal capacity for City needs	Minimal	Site Ownership	Permit	Landfill Ownership
Disposal	Landfills in compliance with TCEQ and other environmental regs.	Compliant	Compliant	Compliant	Compliant

Action Plan

The following Action Plan presents recommendations for achieving the goals and objectives established by the MATF. The Plan presents specific programs and policies for addressing the following:

- Financial Assurance
- Waste Minimization
- Recycling
- Organics Management
- Collection
- Transfer Stations
- Disposal Capacity
- Illegal Dumping

Several new initiatives are identified in this Plan. Some of these action items, such as the development of a new Northeast Transfer Station and the managed competition program have been recently initiated and are in the very early stages of development. These new initiatives are critical to the SWMD's ability to achieve the goals and objectives established by the MATF. With these new responsibilities, it is critical that the Council fund the programs and provide additional staff. Without such additional resources, it will not be possible to effectively implement a number of the new initiatives or program expansions.

The programs and policies identified below have been presented to the MATF along with an analysis of the potential impacts these policies and programs will have on the waste stream, their technical feasibility and potential cost impacts. The following tables provide a summary of these issues and the following figures provide an implementation chart which highlights when programs and policies should be implemented. The timetable for implementing these programs and policies is affected by the level of staff resources available to plan and manage these programs. The Strategic Analysis Report prepared for this Plan provides greater detail on the implementation steps and impacts associated with both policies and programs. Short-term actions are those that need to be implemented in years 1-5; Mid-term are years 5-10; and Long-term are years 10-20.

Financial Sustainability Action Plan Recommendations

Table 8-9
Financial Sustainability Program Recommendations

Financial Program	Definition	Priority	Program Status	Timeframe	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Enterprise Fund and Monthly Fees (FA1)	Establish an Enterprise Fund and pay for the program with a Monthly Residential Fee and a Monthly Environmental Fee	High	New	Short-term	Minimal to Medium due to Pay as You Throw Rates if adopted	High	M3.2	38.2	Provides SWMD with critical long-term funding at levels which provide more system reliability.
Managed Competition (FA2)	Evaluate the results of the Managed Competition Assessment and Recommendations	High	Existing	Short-term	Minimal	Unknown			Contract currently underway to evaluate SWMD and managed competition.
Continue to Secure Grants (FA3)	Continue to seek and secure grants for programs through H-GAC and other organizations.	Medium	Existing	Short-term (ongoing)	Medium	Revenue Generating	M3.2	38.2	The SWMD has been successful in leveraging its program with financial grants in the past.

Table 8-10 Waste Minimization Program Recommendations									
Waste Minimization Program	**Definition**	**Priority**	**Program Status**	**Timeframe**	**Impact on Waste Stream**	**Financial Impacts**	**Climate Action Plan**	**Resiliency Plan**	**Major Issues**
Public Information (SR1)	Expand public information programs	High	Expansion	Short-term (ongoing)	Medium	Medium	M1.1 and M2.3	38.1	Improved public information. Education is needed across all aspects of the SWMD Program.
Private Sector Collaboration (SR2)	Collaborate with the private sector to reduce packaging and the use of non-recyclable materials	High	New	Short-term (ongoing)	Low - Medium	Minimal		38.1	The private sector is primarily responsible for much of waste generated. Improved packaging and product design can significantly reduce waste.
City Internal Program (SR3)	Expand the City guidelines on management of its resources through source reduction, reuse, recycling efforts for all City agencies and offices	High	Expansion	Short-term (ongoing	Low	Minimal	M1.2	38.1	City needs to demonstrate leadership in the areas of waste minimization and recycling.
City Procurement (SR4)	Expand the City purchasing / procurement guidelines to expand on source reduction, reuse for City service and product providers	Low	Expansion	Short-term (ongoing)	Low	Minimal	M1.2	38.1	City needs to demonstrate leadership in areas of waste minimization and recycling.
Pay as You Throw Rates (SR-5)	Implement a Pay-as-You-Throw curbside collection system where setting out more garbage costs more, setting out less garbage costs less	Low	New	Short-term	Low to Medium	High		32.4	This will allow garbage collection to more closely align with other utilities where users pay based on usage.

Table 8-11 Recycling Program Recommendations									
Recycling Program	Definition	Priority	Program Status	Timeframe / Program Status	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Recycling Collection (R-1)	Continue to provide every two week collection of recyclable materials	High	Existing	Short-term (ongoing)	Low – Medium	High	M2.3	32.4	The City currently provides once every two week collection of recyclable materials. In the future evaluate going to once per week and adding or reducing materials as markets change.
Alternative Markets (R-2)	Develop alternative markets for recyclable materials	High	New	Mid-term (ongoing)	Medium	Medium		38	To expand recycling in the City, markets for materials need to improve. The City can assist through its economic development programs.
Residential Sector Education & Enforcement (R-3)	Adopt recycling ordinance to deal with contamination including public information and enforcement	High	New	Short-term (ongoing)	Low – Medium	Medium	M2.1	32.4	Current contamination rates for residential recycling are 30%-40%. This creates issues for collection and processing of recyclable materials. May have severe consequences if not addressed.
Increased Depositories (R-4)	Add more depositories and recycling centers throughout Houston	High	Expansion	Short-term to Mid-term	Low	Medium	M2.1	32.4	Increase the number of depositories so there is one per Council district. For increasing recycling and reducing illegal dumping. Evaluate hours of operation as well.
Environmental Education (R-5)	Include more information regarding environmental impacts in City education materials (e.g. upstream decisions for consumers)	High	Expansion	Short-term (ongoing)	Low	Low			Implementation can take place as part of overall education program.
More Drop-off Locations (R-6)	Add more drop off locations for recyclables, chemicals and electronics	High	Expansion	Short-term / Mid-term	Low	Medium	M2.1	32.4	The goal of the action item is to place a depository location in every council district. Requires 5 new depositories.

Table 8-11 Recycling Program Recommendations									
Recycling Program	Definition	Priority	Program Status	Timeframe / Program Status	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Increased HHW Collection (R-7)	Add more collection events for household hazardous wastes	Medium	Expansion	Short-term	Low	Medium		32.4	City provides these services currently. MATF recommends additional collection events.
Mandatory Multi-family Program (R-8)	Adopt a mandatory recycling ordinance for multifamily housing complexes with phased approach (education then enforcement)	Medium	New	Mid-term	High	Low	M2.1	38.3	Following education effort, adopt ordinance requiring owners of multi-family housing to provide recycling opportunities to residents.
Mandatory Business Recycling Program (R-9)	Adopt a mandatory recycling ordinance for businesses and institutions with phased approach (education then enforcement)	Medium	New	Mid-term	High	Low*	M2.1	38.3	Following education effort, adopt ordinance requiring business owners to provide recycling opportunities to residents.
Green Building Code (R-10)	Implement a 'green building code" to require source reduction, reuse and recycling initiates, including C&D for new construction or renovation projects.	Low	New	Mid-term	High	Medium	M2.1	32.4	A Green Building Code is designed to require waste minimization and recycling by the commercial sector and can include mandatory recycling in construction and day-to-day business practices.
Expand material recovery (R-11)	Expand types of materials collected and reused in city operated facilities; reuse of materials beyond current building materials, electronics and chemicals	Low	Expansion	Mid-term	Low	Low	M2.2	32.4	City to evaluate marketability of additional materials for collection and the potential of adding materials to either the curbside program or depositories.
Technical Assistance – Multi-family (R-12)	Implement a voluntary technical assistance program to assist multi-family complexes in setting up on-site recycling programs.	Low	New	Short-term	Low	Low	M1.1	32.4	City to provide technical assistance to multi-family building owners and residents on how to reduce waste; availability of city depositories; and how to implement recycling programs.
Technical Assistance – Businesses	Implement a voluntary technical assistance program to assist business	Low	New	Short-term	Low	Low	M1.1	32.4	City to provide technical assistance to businesses on how to establish recycling

Table 8-11 Recycling Program Recommendations									
Recycling Program	Definition	Priority	Program Status	Timeframe / Program Status	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
(R-13)	setting up reuse and recycling programs								programs. Coordination with commercial sector is important.
Data Collection (R-14)	Implement reporting requirements to better track private sector recycling	Low	New	Short-term	Low	Low	M3.2	32.4	Work with private haulers to collect data related to waste generation and recycling patterns in City to evaluate where future focus should be directed.
Data Trends (R-15)	Establish a more informative data management system to better track trends and provide more transparent and useful data	High	New	Short-term	Low	Low	M3.2	32.4	Develop internal data management system to better track City's performance in residential waste reduction and recycling efforts.

Table 8-12 Organics Program Recommendations									
Organics Program	Definition	Priority	Program Status	Timeframe	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Collection of Organics (O-1)	Continue collection of separate yard waste on a weekly basis	High	Existing	Short-term (ongoing)	Low to Medium	Medium		32.4	City currently provides this service.
Brush Collection (O-2)	Continue separate collection of brush material every other month	High	Existing	Short-term (ongoing)	Low	Medium		32.4	City currently provides this service. It May need enforcement related to non-brush material collected on brush only days.
Food Waste Recovery for Low-income (0-3)	In coordination with local health department encourage greater food recovery to feed the hungry	High	New	Short-term	Low	Low	M2.2		SWMD to work in conjunction with local relief organizations and health department to develop guidelines that would promote greater food donations from commercial restaurants.
Develop capacity (O-4)	Encourage development of additional organics processing capacity within the City for a broader range of food residuals, and biosolids	High	New	Short-term to Mid-term	High	Medium	M2.2	38.4	This will require coordination between food waste generators, City and private compost firms. May require City to invest in some transfer infrastructure or assist in selecting sites for food waste compost capacity.
Mandatory participation (O-5)	Adopt a mandatory recycling ordinance for organics collection, with phased in compliance (education, then strict compliance)	High	New	Mid-term	Medium	High	M2.2	32.4	This is the mandatory residential collection of organics, including food waste, yard waste and brush.
Biosolids Composting (O-6)	Encourage diversion from the landfill of biosolids generated at City wastewater treatment plants to processing facilities	Medium	New	Short-term	Low	Low		38.1	Biosolid (sludge) can be composted but not all composting facilities are able to accept this material. City to coordinate efforts between treatment plants and compost facilities.

Table 8-12 Organics Program Recommendations									
Organics Program	Definition	Priority	Program Status	Timeframe	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Compost Market Development (O-7)	Encourage use of locally produced compost, mulch and soil blends outside City projects	Medium	New	Short-term	Low	Low	M1.2	32.4	City to encourage use of compost and mulch in Houston area. Market development should lead to more capacity.
Grass clipping enforcement (O-8)	Enforce current ordinance prohibiting placement of grass clippings in City collection carts	Medium	New	Short to Mid-term	Low	Low		38.1	In order to reduce quantities of waste going to landfill, enforce yard waste ban in trash carts.
Expand Master Composter Program (0-9)	Provide greater support and expand availability of Master Composter Program to build support of organics diversion and for public education	Medium	Expansion	Short-term	Low	Low	M1.1	32.4	This should be tied to a comprehensive public information campaign.
Lead by Example (0-10)	Lead by example by encouraging the use of locally produced compost, mulch and soil blends at City projects and facilities	Medium	New	Short-term	Low	Low	M1.2	38	The City has the potential to be a significant market for compost and mulch through parks projects, transportation projects and landscaping throughout the City.
Increase drop-off locations (O-11)	Increase the number and availability of manned brush/tree waste drop-off locations	Low	Expansion	Short to Mid-Term	Low	Medium	M2.1	32.4	For brush, this is low priority, but for recycling and illegal dumping, it is high priority.
Food waste collection (O-12)	Collect residential food residuals with yard waste and address appropriate processing capacity – requiring a third cart	Low	New	Mid-term	Low	High	M2.2	32.4	Separate collection of food waste at the residential sector will require increased collection service, contracts for processing and enhanced public information program.

Figure 8-12 – Organics Program Implementation Schedule

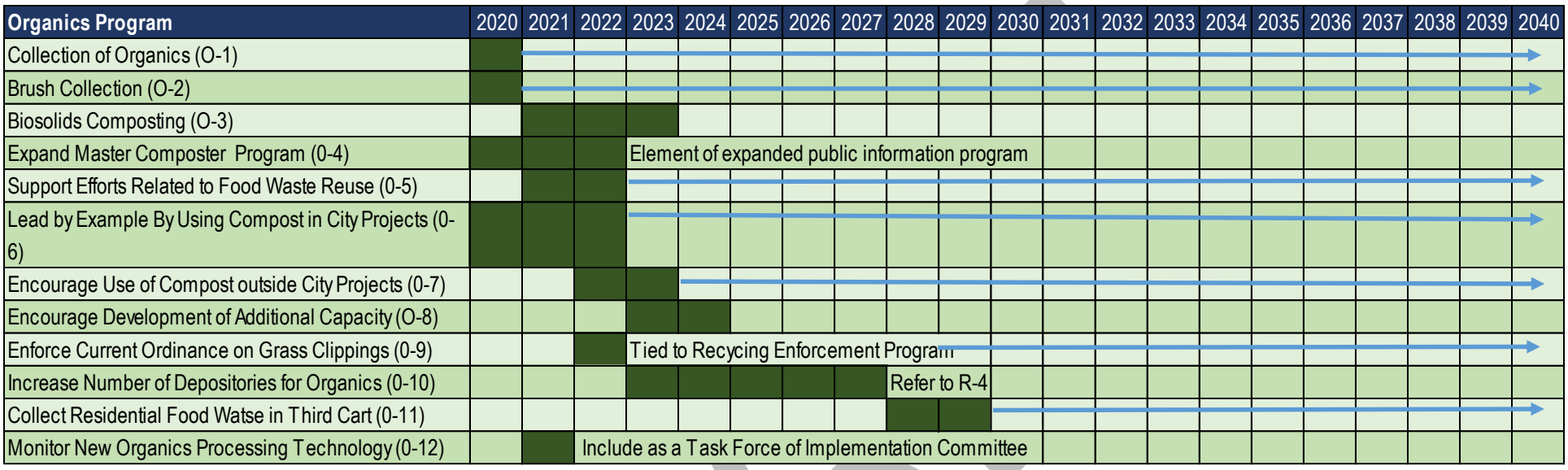


Table 8-13 Collection Program Recommendations									
Collection Program	Definition	Priority	Program Status	Timeframe	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Right-size collection (C-1)	Right-size the collection program by adding routes and periodically evaluating program	High	Expansion	Short-term	Low	High	NA	NA	In order to provide more reliable service, the City needs to modify its routes in order to address issues such as increased housing density, traffic and other factors.
Replace older vehicles (C-2)	Replace older vehicles on a scheduled basis. Will require near-term accelerated replacement program	High	Expansion	Short-term	Low	High	NA	NA	Goal is to have fleet with trucks no older than 7 years. This will reduce maintenance costs and increase system reliability. Reduces reserve requirements.
Enhance period maintenance (C-3)	Enhance periodic maintenance of vehicles to improve reliability	High	Expansion	Short-term	Low	Medium	NA	NA	With the replacement of older trucks, maintenance can focus more attention on maintaining active maintenance program for fleet to reduce downtimes. May require additional fleet staffing.
Implement data Management (C-4)	Implement data management program for collection fleet and provide management support to evaluate data for more efficient routing and accountability	High	Expansion	Short-term	Low	Low	NA	NA	Management of the collection program will require ongoing program of monitoring system performance. City has system in-place; however, it requires attention by vendor to make it more effective.
Slow-Down to Get Around (C-5)	Enforce recently adopted Slow-Down to Get Around Law	Medium	New	Short-term	Low	Low	NA	NA	Newly adopted state law treats solid waste collection crews in the same manner as first responders and construction workers with regard to traffic safety rules.

Table 8-13 Collection Program Recommendations									
Collection Program	Definition	Priority	Program Status	Timeframe	Impact on Waste Stream	Financial Impacts	Climate Action Plan	Resiliency Plan	Major Issues
Continuously evaluate new collection vehicles (C-6)	Continuously evaluate alternative fuels and vehicle technologies including CNG and electric vehicles	Medium	Existing	Mid-term to Long-term	Low	High	T1.2, M3.1	32.1	Alternative technologies include compressed natural gas (CNG) and electric vehicles (EV). This requires new trucks, a new fleet fueling infrastructure and significant changes to fleet maintenance. Benefit is cleaner air. The Mayor is currently evaluating a report on fleet options including CNG & EV.
Contract Outlying Areas (C-7)	Contract for collection services in areas of the City that are difficult to efficiently collect waste	Medium	New	Short-term / Mid-term	Low	Low	NA	NA	To improve residential collection efficiency, the City should evaluate routes outside its primary loop and contract out service to private haulers.
Evaluate managed competition (C-8)	Evaluate management competition analysis currently being undertaken for collection program	Medium	Existing	Short-term	Low	Low	NA	NA	The City has a current contract to evaluate managed competition of solid waste services. SWMD will evaluate recommendations with Finance, the Mayor and City Council.

Table 8-14 Transfer Station Recommendations									
Program	**Definition**	**Priority**	**Program Status**	**Timeframe**	**Impact on Waste Stream**	**Financial Impacts**	**Climate Action Plan**	**Resiliency Plan**	**Major Issues**
Transfer Station contracts (T-1)	Negotiate contract for the operation of the City's three transfer stations	High	Existing	Short-term	Low	High	NA	NA	In 2020, the City selected contractors for operation of transfer stations. The City will need to monitor the contracts and prepare for future negotiations once the term has been reached.
Invest in transfer stations (T-2)	Make necessary capital improvements to the transfer stations – continuously monitor site repair needs and fund	High	Existing	Short-term / Mid-term	Low	High	NA	NA	City is responsible for maintaining the three transfer stations. These facilities are approximately 20 years old and will require significant investments ($8-$10 million) in repairs and improvements.
Northeast Transfer Station (T-3)	Design, permit and construct a new transfer station to be located at the NE Service Center – contract operations	High	Existing	Short to Mid-term	Low	High	NA	NA	The City has initiated steps to design, permit and construct a new NE Transfer Station to be located at the NE Service Center.
Recyclable Materials Transfer (T-4)	Design and construct recyclable materials transfer capabilities	High	New	Short-term / Mid-term	Low	High	NA	NA	The contract with FCC to process single stream materials means that recyclable materials have to be hauled from all sectors of the City to this facility located in NE Houston. Having transfer capabilities for recyclables would reduce program costs.
New Transfer Capacity (T-5)	Identify sites for two additional transfer stations	Medium	New	Mid-term / Long-term	Low	High	NA	NA	As the City grows and traffic worsens, the City should identify additional locations for transfer stations. These locations will take into consideration landfill locations, traffic, existing land use and EJ.
Rail Haul (T-6)	Evaluate the potential for developing rail haul capacity in conjunction with transfer stations	Medium	New	Mid-term / Long-term	Low	Medium	NA	NA	As disposal capacity is reduced, one of the options available to the City is reliance on rail haul. This would require conversion of transfer stations, contracts with both rail and alternative disposal sites.

Figure 8-13 – Transfer Station Plan Implementation

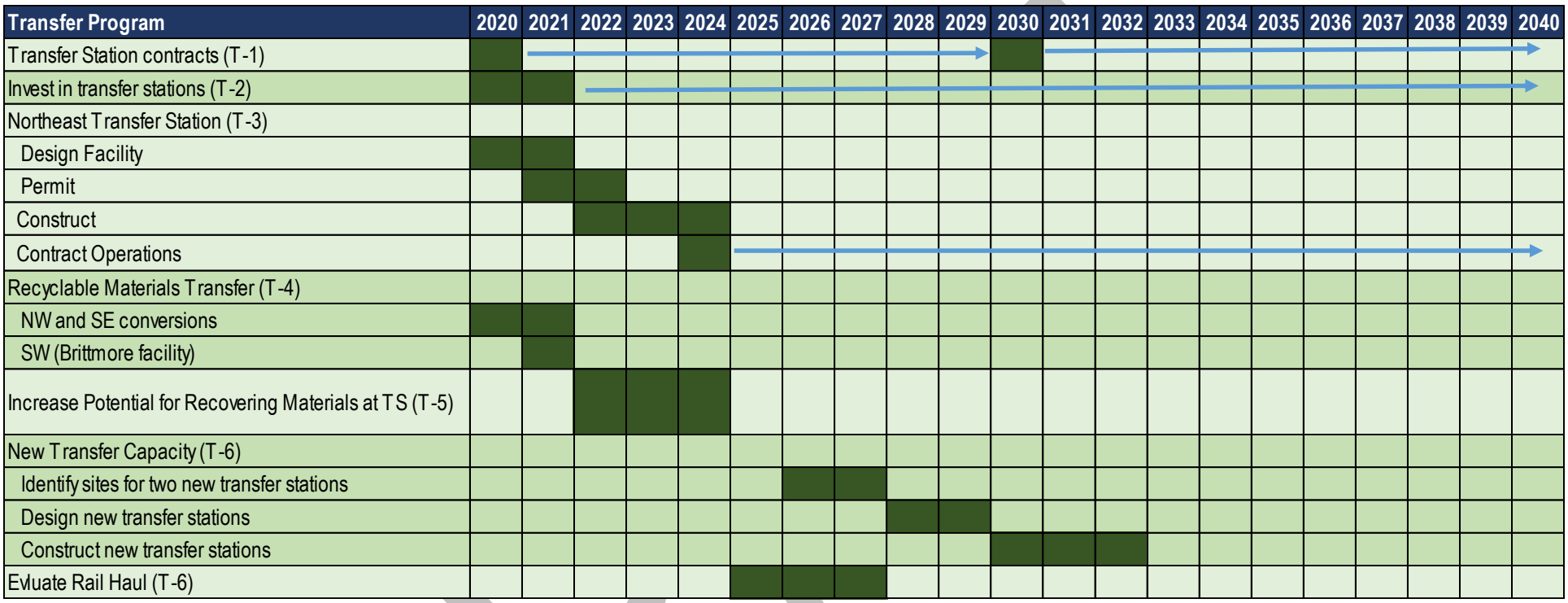


Table 8-15 Energy & Resource Recovery Recommendations									
Program	**Definition**	**Priority**	**Program Status**	**Timeframe**	**Impact on Waste Stream**	**Financial Impacts**	**Climate Action Plan**	**Resiliency Plan**	**Major Issues**
Promote landfill gas recovery (E-1)	Promote the use of landfill gas technology by the region's landfills	Medium	New	Short-term	Low	Low	M3.1	38.1	The MSW landfills the City currently relies on do have gas to energy systems.
Evaluate new technologies (E-2)	Evaluate the potential for developing partnerships for energy recovery technologies	Medium	New	Short-term / Mid-term / Long-term	High	Low	M3.1	38.1	Alternative technologies such as pyrolysis, gasification and anaerobic digestion have the potential to significantly impact disposal needs. Factors affecting these technologies include reliability, capital costs, low competing disposal costs and relatively low energy prices.
Periodic industry evaluations (E-3)	Conduct periodic industry roundtable meetings to identify options for local development	Medium	New	Short-term	Uncertain	Low	NA	NA	The American Chemistry Council (ACC) is very active in supporting new technologies to resolve plastic waste problem. City should coordinate with ACC to identify strategies that could work in Houston.

Table 8-16 Assuring Disposal Recommendations									
Assuring Disposal Program	**Definition**	**Priority**	**Program Status**	**Timeframe**	**Impact on waste Stream**	**Financial Impacts**	**Climate Action Plan**	**Resiliency Plan**	**Major Issues**
Negotiate Disposal Contracts (AD-1)	Negotiate contract for disposal of waste generated from City's residential program	High	Existing	Short-term	Low	High	NA	NA	The City relies on private sector for landfill disposal. The City has negotiated for future landfill use in 2020. These contracts will need to be monitored.
Monitor capacity (AD-2)	Monitor regional capacity and prepare periodic reports to Mayor and Council	High	Existing	Short-term / Long-term	Low	Low	M3.2	NA	The region has approximately 30-40 years remaining capacity, however this could change dramatically if there were future storm events or landfill expansions or closures.
City Landfill (AD-3)	The City should evaluate whether to own a landfill – if the answer is yes, site, design, permit and construct a regional landfill	High	New	Mid-term / Long-term	Low	High	NA	NA	The City's reliance on the private sector reduces certain risks, however, its dependence also poses significant future risks regarding available disposal capacity.
Contract disposal services (AD-4)	In lieu of the City not building a landfill, continue to contract with private operators for disposal services	High	New	Mid-term / Long-term	Low	High	NA	NA	Based on available disposal capacity and risk analysis, it may be prudent to continue use of private landfills for future disposal needs.
Identify Resource Recovery Opportunities (AD-5)	Coordinate with landfill owners to identify opportunities to use sites for potential resource recovery opportunities	Medium	New	Mid-term / Long-term	Medium	Low	NA	38.1	Landfill locations are often ideal for resource recovery alternatives due to existing waste infrastructure and site access.

Figure 8-14 – Assuring Disposal Program Implementation Schedule

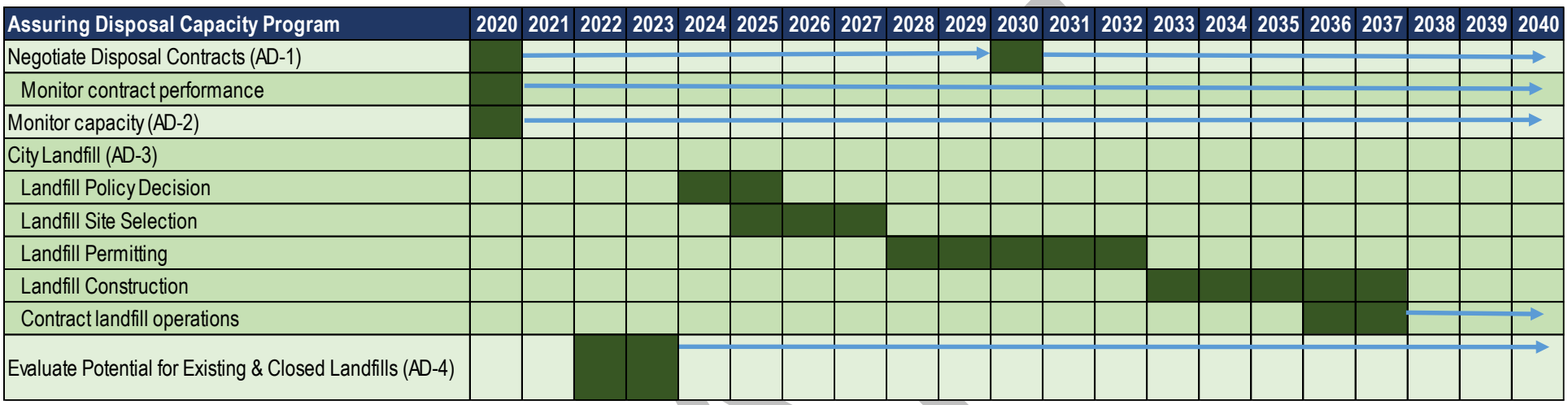


Table 8-17 Illegal Dumping Program Recommendations									
Program	**Definition**	**Priority**	**Program Status**	**Timeframe**	**Impact on Illegal Dumping**	**Financial Impacts**	**Climate Action Plan**	**Resiliency Plan**	**Major Issues**
Increase collection crews (IL-1)	Increase the number of trucks and crews assisted to cleaning up Illegal dumps	High	Expansion	Short-term / Long-term	High	Medium	NA	39.4	Additional crews will have the ability to more aggressively clean-up illegal dump sites.
Increase staffing at depositories (IL-2)	Increase staffing at depositories to enable them to be open seven days per week and extended hours per day- Evaluate the potential for additional depositories	Medium	Expansion	Short-term / Long-term	Medium	Low	NA	NA	Additional access in terms of sites and staffing was recommended for recycling and organics management as well.
Increase camera surveillance (IL-3)	Increase staffing of the camera surveillance program currently managed by the Harris County Environmental Crimes Unit	High	Expansion	Short-term / Long-term	High	Medium	NA	NA	Camera surveillance has been identified as an effective means of illegal dumping enforcement.
Public information campaign (IL-4)	Institute a comprehensive multilingual and ongoing public education program including billboards, announcements, and public service announcements	High	Expansion	Short-term / Long-term	High	Medium	NA	NA	This should be a focused aspect of an overall public information / outreach effort.
Organizational (IL-5)	Clearly identify responsibilities for illegal dumping between the Department of Neighborhoods and the Police Department's Differential Response Team	High	New	Short-term	High	Low	NA	NA	Significant organizational changes are recommended for the Illegal Dumping Program with greater authority to Code Enforcement to issue fines. Consider SWMD staff having same authority.
Improved Enforcement (IL-6)	Give Code Enforcement or others the authority to issue fines outside the Justice of the Peace Courts and the Environmental Courts - Rapid penalties for illegal dumping will serve as a deterrent against illegal dumping	High	New	Short-term	High	Medium	NA	NA	Clearly defining responsibilities and emphasizing the level of priority associated with illegal dumping enforcement is critical to program's success.

PART IV

Appendices

Appendix A – Acronyms & Glossary

Appendix B – Facility Maps and Tables

Appendix C – MATF Tables

Appendix D – Organizational Responsibilities

Appendix A – Acronyms & Glossary

Acronyms

ATRS	**American Textile Recycling Service**
BOFA	Batteries, Oil, Paint and Antifreeze recycling)
C&D	**Construction & Demolition**
CA	Civic Associations
CEO	Chief Executive Officer
CY	Calendar Year
ESC	Environmental Service Center
ETJ	Extra Territorial Jurisdiction
FEMA	Federal Emergency Management Agency
FTE	Full Time Equivalent
FY	Fiscal Year
GBRC	Green Building Resource Center
HARC	Houston Advanced Research Council
H-GAC	Houston – Galveston Area Council
HH	Households
HHW	Household Hazardous Waste
HOA	Homeowner Association
HPD	Houston Police Department
kWh	Kilowatt-hour
MATF	Mayor's Advisory Task Force
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NA	Not Applicable
PCD	per capita per day
SF	Single Family
TCEQ	Texas Commission on Environmental Quality
TPD	Tons per Day
TPY	Tons per Year
TS	Transfer Station
TxDOT	Texas Department of Transportation
UP	Union Pacific

Glossary

Brush	Cuttings or trimmings from trees, shrubs, or lawns and similar materials.
Collection system	The total process of collecting and transporting solid waste. It includes storage containers; collection crews, vehicles, equipment, and management; and operating procedures. Systems are classified as municipal, contractor, or private.
Commercial solid waste	All types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes.
Compost	The stabilized product of the decomposition process that is used or sold for use as a soil amendment, artificial topsoil, growing medium amendment, or other similar uses.
Composting	The controlled biological decomposition of organic materials through microbial activity.
Construction or demolition waste--	Waste resulting from construction or demolition projects; includes all materials that are directly or indirectly the by-products of construction work or that result from demolition of buildings and other structures, including, but not limited to, paper, cartons, gypsum board, wood, excelsior, rubber, and plastics.
Disposal	The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste (whether containerized or uncontainerized) into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater.
Facility	All contiguous land and structures, other appurtenances, and improvements on the land used for the storage, processing, or disposal of solid waste.
Garbage	Solid waste consisting of putrescible animal and vegetable waste materials resulting from the handling, preparation, cooking, and consumption of food, including waste materials from markets, storage facilities, handling, and sale of produce and other food products.
Hazardous waste	Any solid waste identified or listed as a hazardous waste by the administrator of the United States Environmental Protection Agency under the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, 42 United States Code, §§6901 *et seq*., as amended.
Household waste	Any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas); does not include brush.
Industrial solid waste	Solid waste resulting from or incidental to any process of industry or manufacturing, or mining or agricultural operations.
Landfill	A solid waste management unit where solid waste is placed in or on land. Landfills identified in this Plan are subject to TCEQ regulations related to location restrictions, design, operations, closure and post-closure care.

Municipal solid waste	Solid waste resulting from or incidental to municipal, community, commercial, institutional, and recreational activities, including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial solid waste.
Municipal solid waste facility	All contiguous land, structures, other appurtenances, and improvements on the land used for processing, storing, or disposing of solid waste. A facility may be publicly or privately owned and may consist of several processing, storage, or disposal operational units, e.g., one or more landfills, surface impoundments, or combinations of them.
Post-consumer waste	A material or product that has served its intended use and has been discarded after passing through the hands of a final user. For the purposes of this subchapter, the term does not include industrial or hazardous waste.
Processing	Activities including, but not limited to, the extraction of materials, transfer, volume reduction, conversion to energy, or other separation and preparation of solid waste for reuse or disposal, including the treatment or neutralization of waste, designed to change the physical, chemical, or biological character or composition of any waste to neutralize such waste, or to recover energy or material from the waste, or render the waste safer to transport, store, dispose of, or make it amenable for recovery, amenable for storage, or reduced in volume.
Recyclable material	A material that has been recovered or diverted from the nonhazardous waste stream for purposes of reuse, recycling, or reclamation, a substantial portion of which is consistently used in the manufacture of products that may otherwise be produced using raw or virgin materials. Recyclable material is not solid waste. However, recyclable material may become solid waste at such time, if any, as it is abandoned or disposed of rather than recycled, whereupon it will be solid waste with respect only to the party actually abandoning or disposing of the material. For Houston residents, recyclable materials include: ▪ Aluminum foil and pie plates and tin cans (must be clean) ▪ Cardboard ▪ Newspaper ▪ Phone books ▪ Paperboard, e.g. cereal and tissue boxes ▪ Office paper, junk mail, envelopes and junk mail ▪ Shredded paper is not acceptable
Recycling	A process by which materials that have served their intended use or are scrapped, discarded, used, surplus, or obsolete are collected, separated, or processed and returned to use in the form of raw materials in the production of new products. Except for mixed municipal solid waste composting, that is, composting of the typical mixed solid waste stream generated by residential, commercial, and/or institutional sources, recycling includes the composting process if the compost material is put to beneficial use.

Sludge (biosolids)	Any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water-supply treatment plant, or air pollution control facility, exclusive of the treated effluent from a wastewater treatment plant.
Solid waste	Garbage, rubbish, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, municipal, commercial, mining, and agricultural operations and from community and institutional activities.
Source-separated recyclable material	Recyclable material from residential, commercial, municipal, institutional, recreational, industrial, and other community activities, that at the point of generation has been separated, collected, and transported separately from municipal solid waste (MSW), or transported in the same vehicle as MSW, but in separate containers or compartments.
Special waste	Any solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires special handling and disposal to protect the human health or the environment. If improperly handled, transported, stored, processed, or disposed of or otherwise managed, it may pose a present or potential danger to the human health or the environment.
Transfer Station	A facility used for transferring solid waste from collection vehicles to long-haul vehicles (one transportation unit to another transportation unit). It is not a storage facility such as one where residents can dispose of their wastes in bulk storage containers that are serviced by collection vehicles.
White goods	Discarded large household appliances such as refrigerators, stoves, washing machines, or dishwashers.
Yard waste	Leaves, grass clippings, yard and garden debris, and brush, including clean woody vegetative material not greater than six inches in diameter, that results from landscaping maintenance and land-clearing operations. The term does not include stumps, roots, or shrubs with intact root balls.

Appendix B – Facilty Maps & Tables

City Recycling Facilities and Depositories

Material Recovery Facilities

Composting Facilities

Transfer Stations

Landfills

Figure B-1 – Recycling Centers and Neighborhood Depositories (Source: City of Houston)

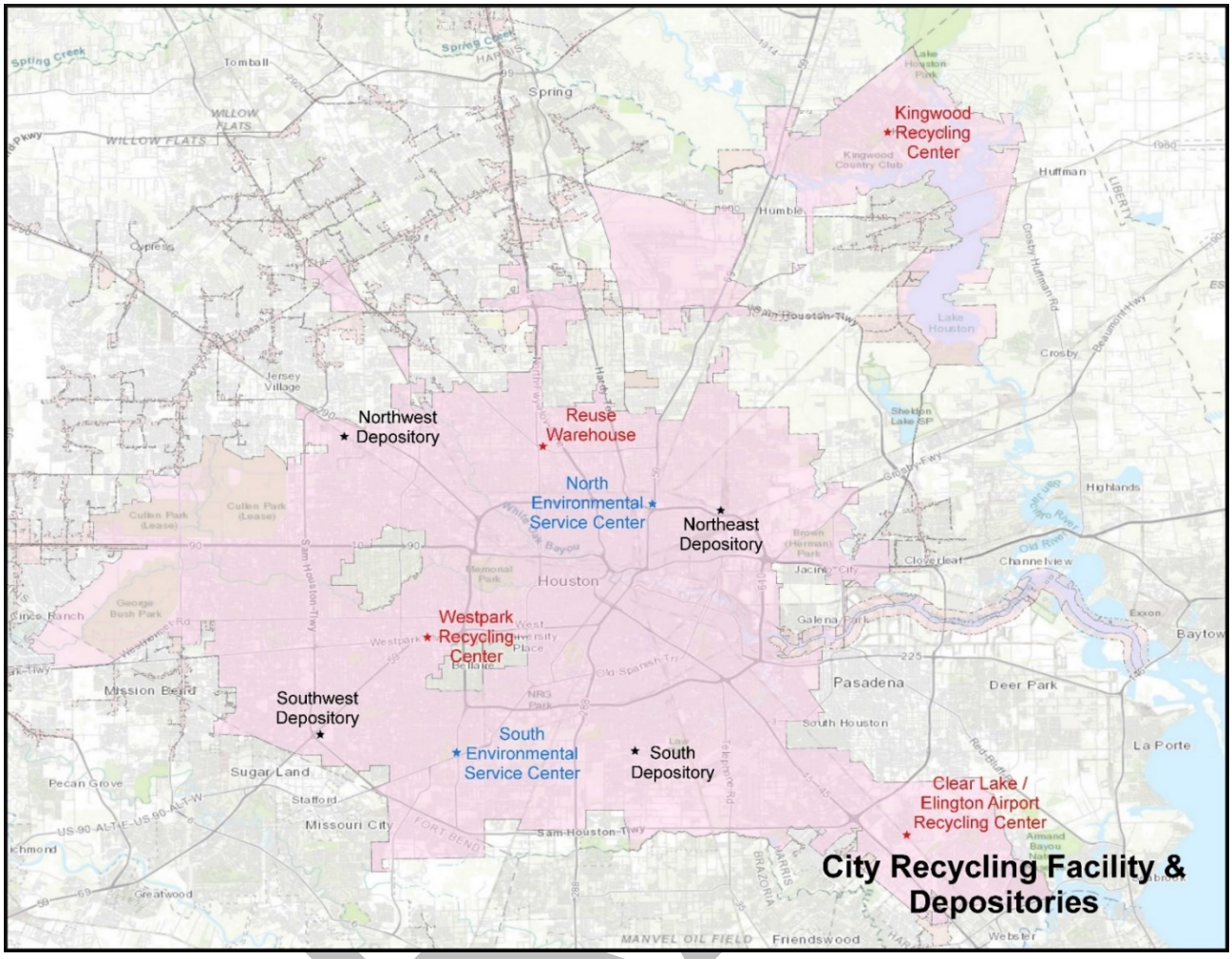


Table B-1 Drop-Off Location Materials (Tons)		
	CY 2017	CY 2018
Neighborhood Depositories		
North	459.15	482.36
Northwest	265.74	227.81
Northeast	132.16	136.60
South	88.21	65.61
Southwest	148.39	113.88

Table B-1 Drop-Off Location Materials (Tons)		
	CY 2017	CY 2018
Southeast	126.79	138.17
City Recycling Centers		
Westpark Recycling Center	1,261.09	629.54
Clear Lake/Ellington Airport	481.23	232.78
Kingwood Recycling Center	359.54	291.81
Total (Tons)	**3,322**	**2,319**

Table B-2 Reuse Warehouse Donations, 2017 & 2018 (in Pounds)		
	CY 2017	CY 2018
Bitumen	3,148	40,880
Cardboard	42,021	20,000
Ceramic	28,483	19,683
Concrete	179,219	170,561
Doors	34,315	45,302
Glass	33,883	17,876
Masonry	185,542	209,863
MEP	25,224	52,765
Metal	185,271	53,670
Miscellaneous	4,804	3,995
Plastic	409,014	31,063
Soil	45,785	178,471
Wood	208,166	144,598
Total (Pounds)	**1,384,875**	**988,727**

Table B-3 Chemical Swap Shop Materials Reused/Recycled (in Pounds)		
	FY 2016	FY 2017
All Materials Collected[1]	**871,569**	**854,004**
Total # of Customers[2]	**5,433**	**5,408**
Material Reused/Recycled		
Antifreeze	16,648	8,557
Bandit Signs	28,800	20,149
Batteries	4,288	13,974
Cardboard	11,580	7,020
Cooking Oil	18,550	20,690
Electronics Collections	70,795	60,855
Motor Oil	33,169	31,483
Plastic Buckets	-	-
Reuse Books	722	1,701
Reuse Chemicals	17,964	18,467
Reuse Paint[1]	85,957	84,871
Scrap Metal	61,802	38,069
Shredco Paper[3]	-	4,600
Tires	5,244	3,418
Total (Pounds)	**355,519**	**313,854**
% of Materials Reused/Recycled	**40.79%**	**36.75%**

Table B-4 MRF Capacity in H-GAC Region				
MRF	Address	Owner	2017 Tons Recovered	Capacity Throughput
Gasmer MRF	4939 Gasmer Drive Houston	WM	78,000	120,000
Houston Clay Road MRF	9590 Clay Road Houston	WM	105,000	204,000
Westside (Brittmore) MRF	1200 Brittmore Road Houston	WM	87,000	120,000
Global Waste Services	7172 E Mt Houston Road Houston	WCA	na	na
Houston Sort Center	5757 B Oates Road Houston	Republic	37,580	50,000 tpy
Independent Texas Recyclers	6810 Irvington Boulevard Houston	Independent Texas Recyclers	na	na
FCC	9170 Ley Road Houston	FCC	Opened March 2019	145,000 tpy

Figure B-2 Regional Reyclcing Centers (Source: H-GAC)

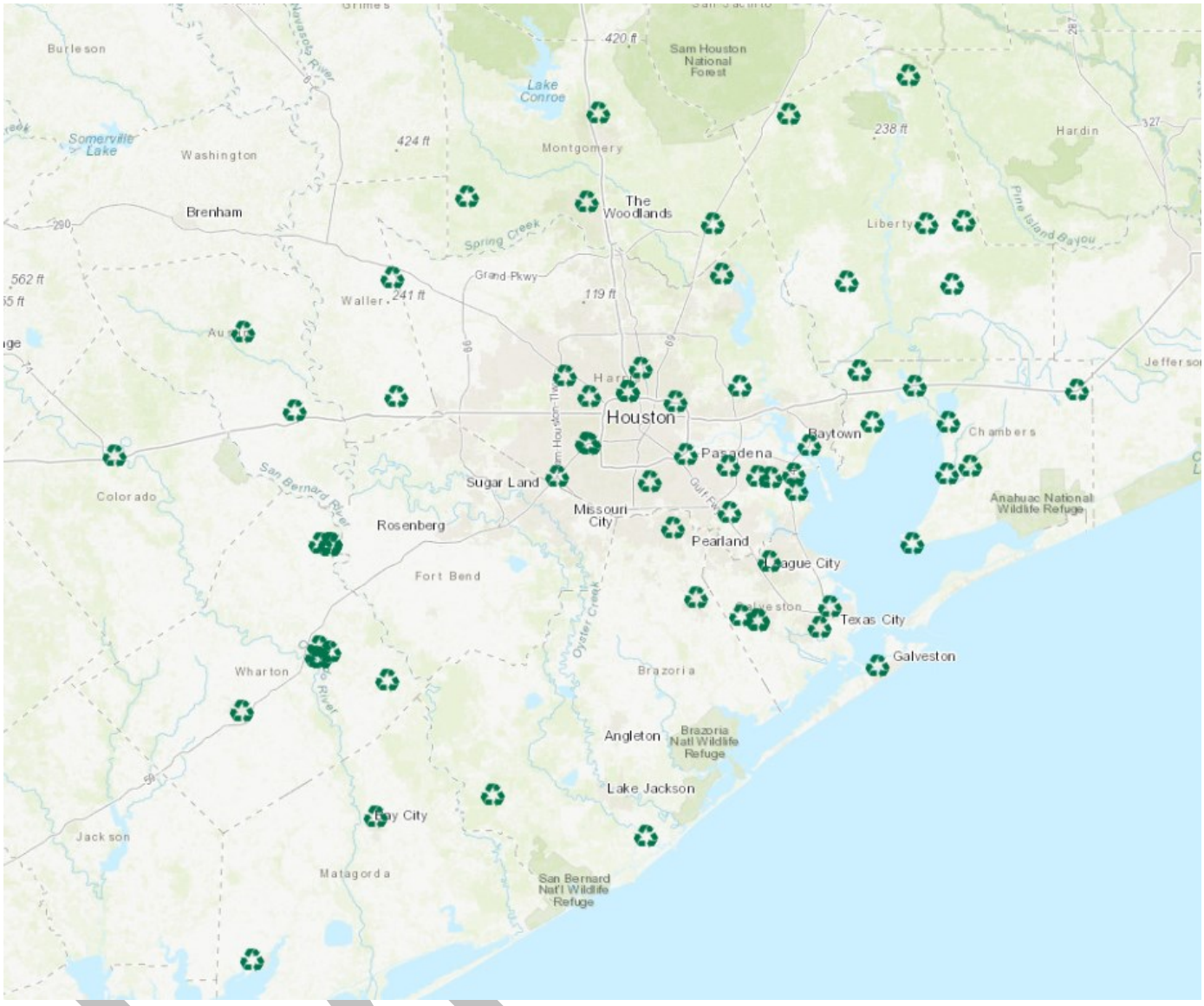


Figure B-3 Material Recovery Facilities (Soruce: TCEQ)

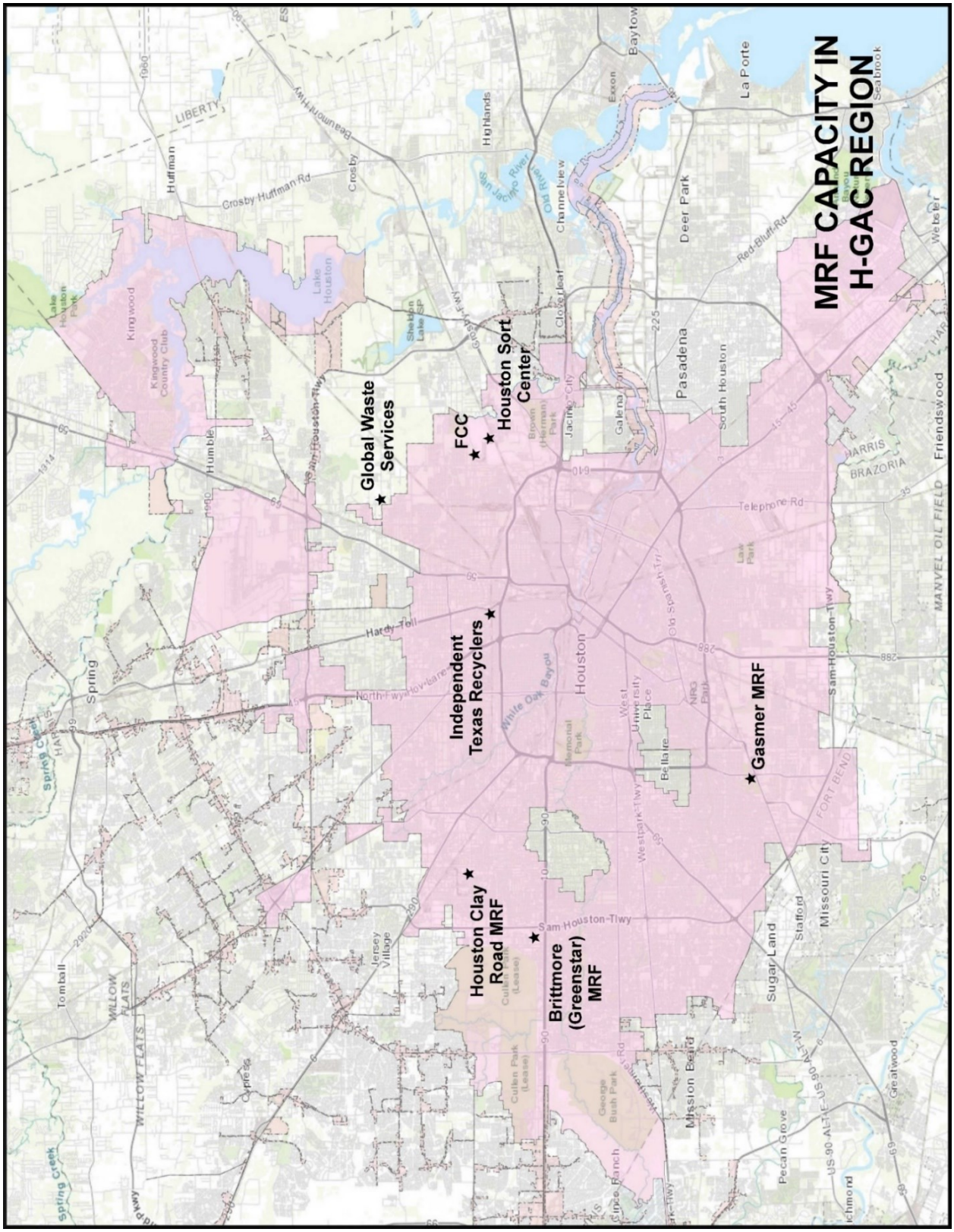


Table B-5 Organics and Capacity of Major Facilities			
		Throughput (Tons/yr)	Capacity (Tons/yr)
In Houston			
	Living Earth/Letco (7 sites)		375,000
	The Ground Up		100,000
	Lone Star Disposal		5,000
	Farm Dirt Compost		1,000
	Total In Houston	**>235,000**	**481,000**
Outside Houston			
	New Earth (2 sites)		350,000
	Nature's Way		50,000
	Living Earth/LETCO (7 sites)		375,000
	WMI Coastal Plains		40,000
	Don Tal		NA
	Kirsch		NA
	Total Outside Houston	**>613,500**	**>815,000**

Figure B-4 – Compost Facilities (Source: TCEQ)

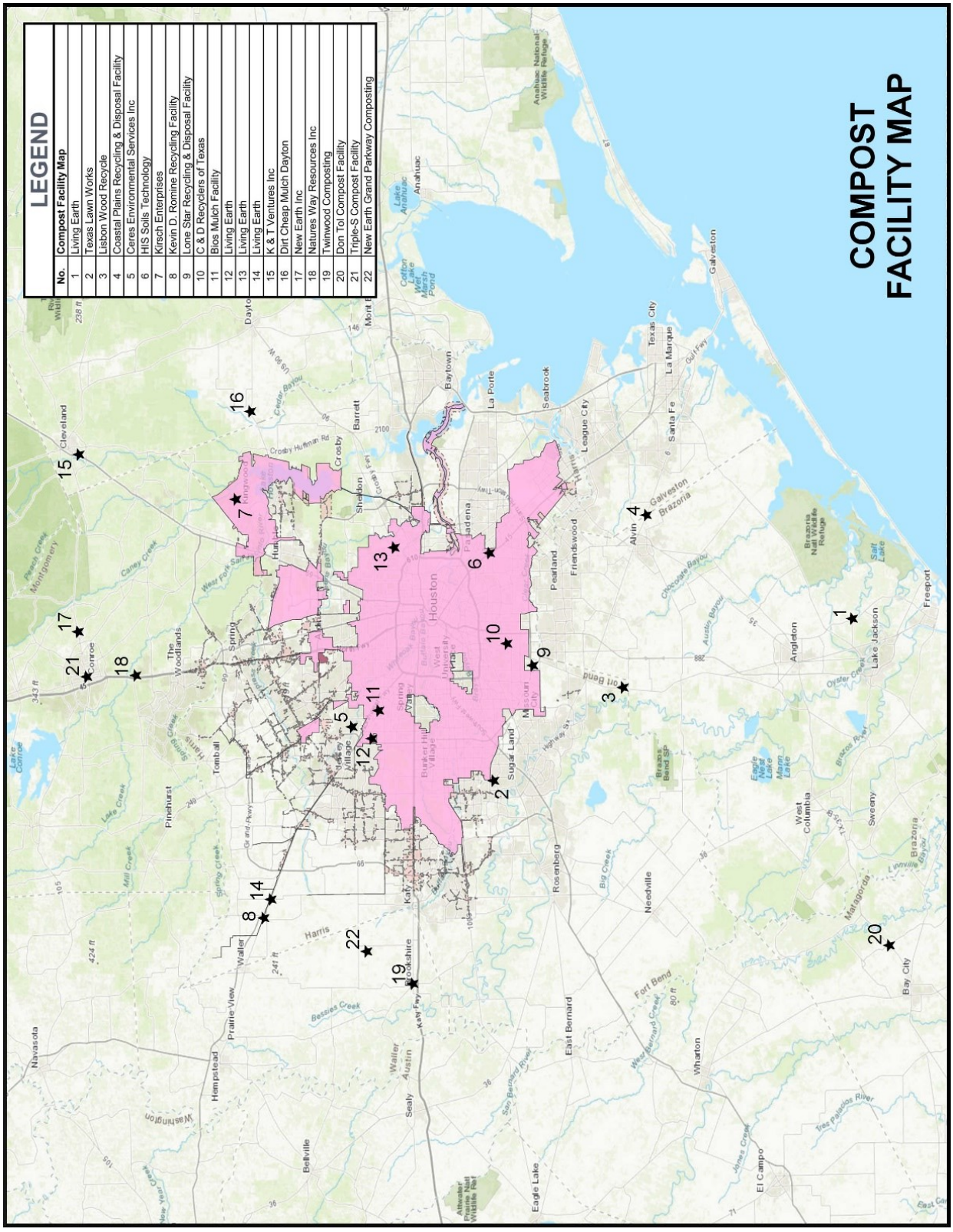


Figure B-5 Living Earth Facilities (Source: Living Earth)

Table B-6 H-GAC Transfer Stations							
	Name	2011 (TPY)	2015 (TPY)	2016 (TPY)	2017 (TPY)	Permitted Capacity (TPD)	2017 (TPD)
1	Houston SW Transfer Station	311,435	292,856	271,317	244,213	2,000	783
2	Houston NW Transfer Station	162,482	226,364	220,391	217,157	2,000	696
3	Houston SE Transfer Station	194,793	219,022	229,169	241,632	2,000	774
	City Transfer Station Total	**668,710**	**738,242**	**720,877**	**703,002**	**6,000**	**2,253**
4	Egbert Transfer Station	53,420	56,282	66,579	65,010	800	208
5	Excell Type V Transfer Station	43	17,515	14,622	12,110	1,000	39
6	Hardy Road Transfer Station	242,425	405,600	440,999	444,048	2,500	1,423
7	Koenig Street Transfer Station	107,954	157,777	145,461	123,166	2,500	395
8	Lone Star Recycling & Disposal	-	199,982	262,705	284,473	6,000	912
9	Ruffino Hills Transfer Station	218,146	422,691	407,809	389,326	2,000	1,248
10	R&J Transfer Station	-	-	-	4,598	125	15
11	Sam Houston Recycling Center TS	76,210	169,183	151,202	179,600	1,500	576
12	Sprint Recycling Center NE	25,723	128,800	20,450	19,473	1,000	62
13	Tanner Road TS	23,076	54,961	67,998	60,499	2,200	194
	Houston Private Sector TS	**746,997**	**1,612,791**	**1,577,825**	**1,582,303**	**19,625**	**5,071**
	City TS Total + Private Sector TS	**1,415,707**	**2,351,033**	**2,298,702**	**2,285,305**	**25,625**	**7,325**
14	Mid America Contractors	0	0	0	16,411	NA	45
15	City of Deer Park Transfer Station	-	16,092	18,254	17,541	NA	56
16	City of Galveston Transfer Station	80,765	90,163	94,891	97,560	NA	313
17	City of Hempstead TS	0	126	68	89	NA	
18	City of Huntsville Transfer Station	0	0	0	42,570	NA	136
19	Matagorda County TS	5,702	5,462	6,628	6,704	NA	21
20	City of Weimar	0	0	0	36,997	NA	118
21	Country Waste Inc.	8,747	7,959	6,540	6,451	NA	21
	Outside Houston TS Total	**95,214**	**119,803**	**126,381**	**224,323**		**711**
	Total Transfer Station	**1,510,921**	**2,470,836**	**2,425,083**	**2,509,628**		**8,036**

Note: Totals for Houston transfer stations may vary from Table 6-1 due to differences in reporting periods.

Table B-6 (cont.) Permitted Transfer Stations – Not Operational				
	Name	Permit Status	Not Constructed or Inactive	County
22	Ralston Road TS	Issued	Not Constructed	Harris
23	Tall Pines TS	Issued	Not Constructed	Harris
24	Nexus Material Recovery & TS	Issued	Not Constructed	Harris
25	Holmes Road TS	Issued	Not Constructed	Harris
26	GW TS	Issued	Not Constructed	Harris
27	FCC Materials Recovery Facility*	Issued	Opened in March 2019	Harris
28	City of Sealy Transfer Station	Issued	Inactive	Austin
29	Sprint Fort Bend County TS	Issued	Inactive	Fort Bend
30	Gulfwest Waste Solutions TS	Issued	Not Constructed	Chambers
31	K2 Waste Solutions	Issued	Not Constructed	Liberty
32	Pintail Landfill TS	Issued	Not Constructed	Waller

Source: TCEQ *FCC is permitted as a transfer station; however, it will function as an MRF. Became operational in March 2019.

Figure B-6 Regional Transfer Stations (Source: TCEQ)

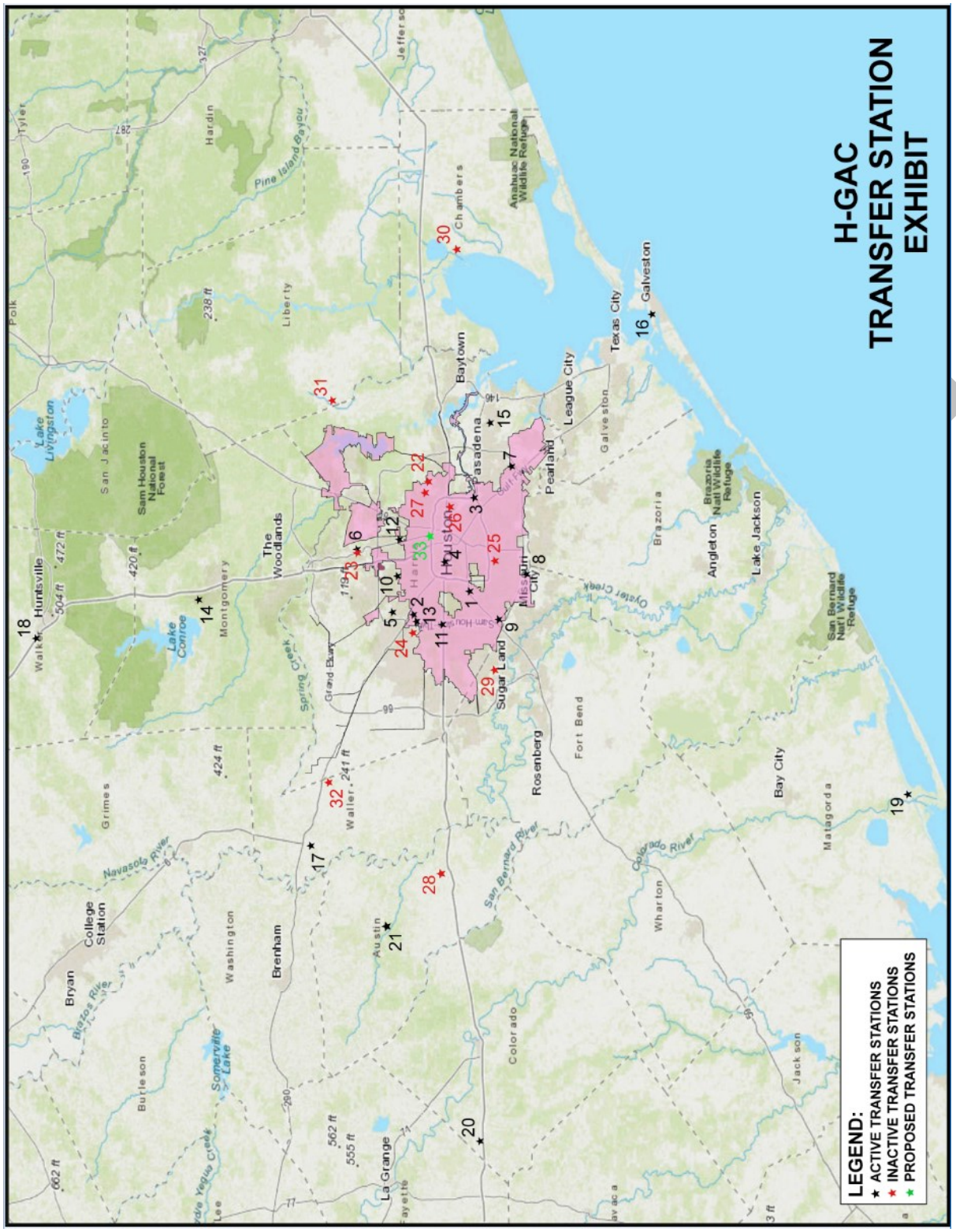


Figure B-7 Regional Landfills (Source: TCEQ)

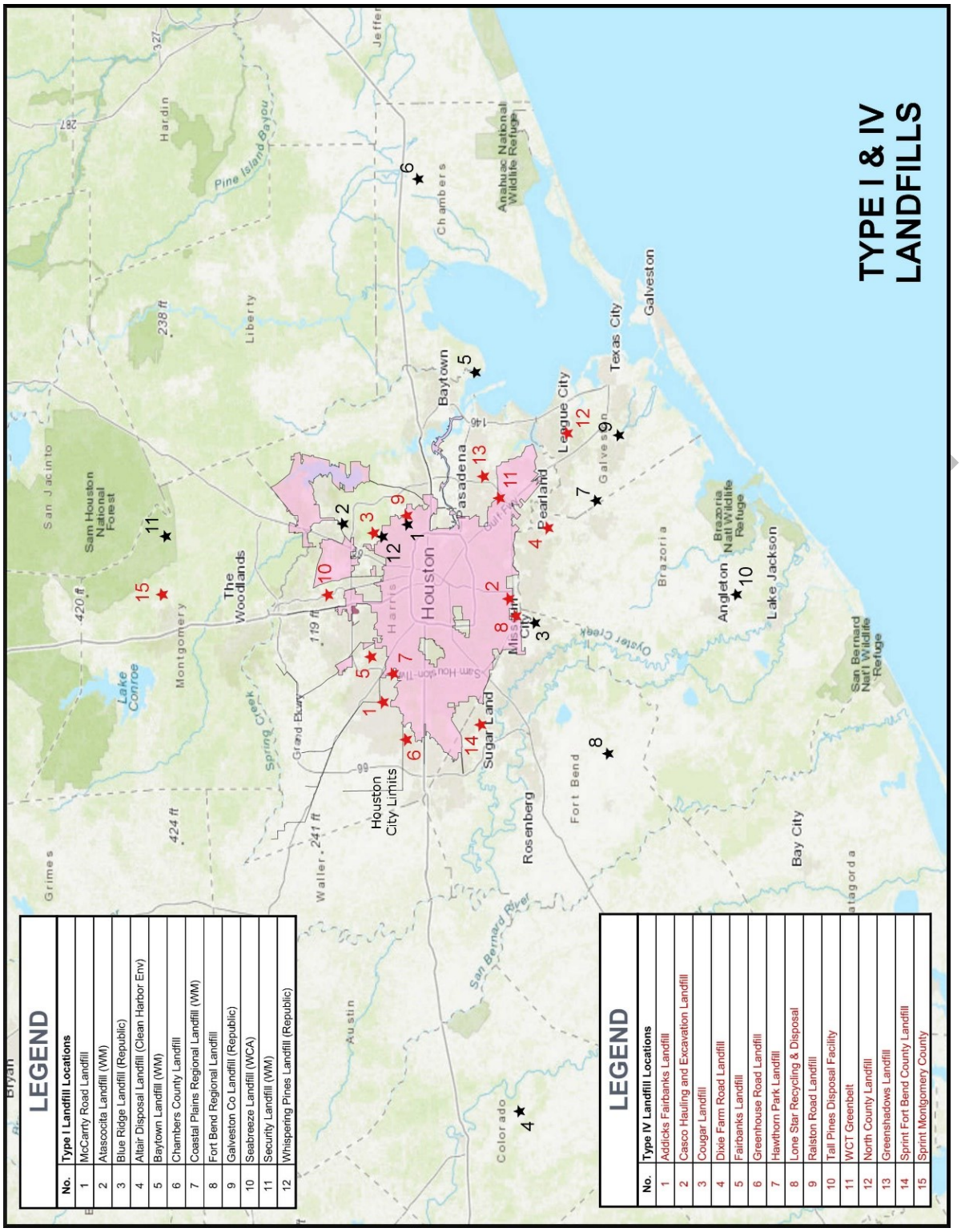


Table B-7 Type I Landfills – Ownership & Capacity				
Landfill	Owner	Remaining Capacity Tons	Remaining Capacity Cubic Yards	Remaining Capacity Years (2017)
McCarty Road	Republic	23,748,385	21,472,319	16
Atascocita	Waste Management of Texas	29,228,482	38,458,529	24
Blue Ridge	Blue Ridge Landfill TX, LP	87,275,249	142,373,978	88
Houston Primary Landfills		**140,252,116**	**202,304,826**	**37**
Altair Disposal Services Landfill	Altair Disposal Services, LLC	221,083	368,471	5
Baytown Landfill	USA Waste of Texas Landfills, Inc.	7,076,882	8,958,079	23
Chambers County	Chambers County	10,481,597	17,469,329	402
Coastal Plains Recycling and Disposal Facility	Waste Management of Texas	11,459,041	12,062,148	22
Fort Bend Regional Landfill	Fort Bend Regional Landfill, LP	31,476,496	35,973,138	29
Galveston County Landfill	Galveston County Landfill TX LP	27,813,032	37,084,042	53
Seabreeze Environmental Landfill	Seabreeze Recovery Inc.	18,667,822	21,334,654	28
Security Landfill RDF	TX LFG Energy, LP	9,350,389	12,848,470	24
Whispering Pines Landfill	Whispering Pines Landfill Tx, LP	10,902,299	10,902,299	10
Houston Secondary Landfills		**127,448,641**	**157,000,630**	**40**
Total*		**267,700,757**	**359,305,456**	**37**

Table B-8 Type I Landfills – Annual Throughput							
Historical Throughput	2010	2015	2016	2017	2018	2010% Market Share	2018% Market Share
McCarty Road	1,793,086	1,426,088	1,116,310	1,364,814	1,619,174	30%	23%
Atascocita	939,804	1,242,928	1,253,621	1,209,440	1,248,556	16%	17%
Blue Ridge	516,629	1,060,899	1,176,325	1,244,016	1,115,761	9%	16%
Subtotal	**3,249,519**	**3,729,915**	**3,546,256**	**3,818,270**	**3,983,491**	**55%**	**56%**
Altair Disposal Services Landfill	37,786	34,708	54,897	48,629	48,764	1%	1%
Baytown Landfill	343,409	314,510	289,103	315,000	259,473	6%	4%
Chambers County	30,753	22,690	22,901	26,091	41,960	1%	1%
Coastal Plains Recycling and Disposal Facility	523,005	421,864	456,613	521,025	455,410	9%	6%
Fort Bend Regional Landfill	567,146	1,012,929	1,076,624	1,080,773	1,282,304	10%	18%
Galveston County Landfill	258,025	403,513	357,493	393,882	154,927	4%	2%
Seabreeze Environmental Landfill	546,014	487,123	523,376	686,618	571,974	9%	8%
Security Landfill RDF	372,515	408,828	447,184	364,400	315,401	6%	4%
Whispering Pines Landfill	48	30	20	24	41,248	0%	0%
Subtotal	**2,678,701**	**3,106,195**	**3,228,211**	**3,436,442**	**3,171,461**	**45%**	**44%**
Total	**5,928,220**	**6,836,110**	**6,774,467**	**7,254,712**	**7,154,952**	**100%**	**100%**

Table B-9 Type IV Landfill Capacity					
Landfill	Address	Tons of Capacity	Cubic Yards of Capacity	2017 Tons	Years Remaining Capacity
Addicks Fairbanks Landfill	6415 Addicks Fairbank Rd, Houston	47,633	75,608	56,929	1
Casco Hauling and Excavation Landfill	1306 E Anderson Rd, Houston	549,300	1,220,007	97,147	5.7
Cougar Landfill	8601 Mount Houston Rd., Houston	44,119	63,050	16	4
Dixie Farm Road Landfill	4649 Dixie Farm Road	817,564	1,858,100	48,519	17
Fairbanks Landfill	8205 Fairbanks N Houston Rd, Houston	13,029,083	17,751,880	176,600	37
Greenhouse Road Landfill	3510 Greenhouse Road, Houston	4,113,628	5,484,837	124,622	21
Greenshadows Landfill	70 Jana Lane, Pasadena, TX	2,141,828	2,549,795	101,900	19
Hawthorn Park Landfill	10550 Tanner Road, Houston	0	0	16	4
Lone Star Recycling & Disposal	4107 S Sam Houston Pkwy, Houston	5,479,259	10,958,517	303,486	16.1
North County Landfill	2015 Wyoming Street, League City	2,423,923	3,689,381	20	50
Ralston Road Landfill	6632 John Ralston Road, Houston, TX	1,092,410	1,456,546	127,157	3.5
Sprint Fort Bend County Landfill	16007 W Bellfort, Sugar Land	7,258,243	13,904,680	307,236	24
Sprint Montgomery County	17851 Highway 105 E, Conroe	20,292,681	40,585,362	8,857	50
Tall Pines Disposal Facility	18710 E Hardy Rd, Houston	1,318,835	1,758,447	344,369	3
WCT Greenbelt	600 Old Genoa Red Bluff Rd, Houston	2,215,513	2,954,017	155,381	12
Total		60,824,019	104,310,227	1,852,255	32

Table B-10 Historic Type IV Disposal Rates					
Name	2010	2015	2016	2017	2018
Addicks Fairbanks Landfill	45,536	100,600	129,328	56,929	32,953
Casco Hauling and Excavation Landfill	30,255	64,255	83,589	97,147	105,009
Cougar Landfill	114,201	16	16	16	1,423
Dixie Farm Road Landfill	34,574	42,092	48,961	48,519	123,599
Fairbanks Landfill	4	16	53,813	176,600	349,005
Greenhouse Road Landfill	54,066	107,114	123,931	124,622	171,287
Greenshadows Landfill	91,443	108,350	110,199	101,900	132,147
Hawthorn Park Landfill	109,034	201,177	151,350	16	12
Lone Star Recycling & Disposal	102,449	249,208	323,610	303,486	431,611
North County Landfill	12,304	30	24	20	51,442
Ralston Road Landfill	65,623	119,002	114,814	127,157	135,654
Sprint Fort Bend County Landfill	240,543	333,444	339,836	307,236	336,377
Sprint Montgomery County				8,887	255,269
Tall Pines Disposal Facility	223,881	338,122	316,931	344,369	425,407
WCT Greenbelt	162,006	144,883	135,280	155,381	240,888
Total	1,285,919	1,808,309	1,931,682	1,852,285	2,792,082

Appendix C

MATF Pollling

Table C-1 What are top 5 solid waste management issues? (use 5 dots and sticky notes for items not on the table)						
Issue (1 – most significant / 5 least significant)	**1**	**2**	**3**	**4**	**5**	
Disposal capacity is running out	2	1	3	1	1	26
Increasing consumerism and increased generation per capita		1	1		1	8
Insufficient program funding	12		1		1	64
Labor and fleet issues		4	1	1		21
Environmental impacts of waste disposal	1			1		7
MSW impacts on climate change		1		2		8
Recycling and organics market availability	2				1	11
Need for greater residential waste diversion			1	2		7
Lack of diversion in the commercial sector					2	2
Increased frequency and impacts of severe storms		2	3		1	18
Lack of Product Producer Responsibility	1					5
Difficulty in recycling materials due to packaging trends						0
Illegal Dumping			2	4	1	15
Others (describe on sticky note and rank)		1				4
Partnership with private sector						0
Contamination Education					6	6
Equity	1					5
Points	5	4	3	2	1	

The top five issues were:

1. Insufficient Program Funding
2. Disposal Capacity running out
3. Labor and Fleet Issues
4. Increased frequency of storms
5. Illegal dumping

Table C-2 What are the biggest risks (biggest concerns for the future) for the City's solid waste program? (use 5 dots and sticky notes for items not on the table)						
Risk (1 – most significant / 5 least significant)	**1**	**2**	**3**	**4**	**5**	
Running out of disposal capacity	7	3	1	2	1	55
Inability to collect garbage because of fleet		2	2	1		16
No markets for recyclable materials	5			2	2	31
No markets for compost						0
Inability to provide all services due to insufficient funding	11	1	4	1		73
Storm event (flooding / hurricane)	1	1	1	1	2	16
Inability to collect garbage because of staff availability		2	2	2	1	19
Landfill closures		1				4
Worsening traffic conditions		2	1	1	1	14
Points	5	4	3	2	1	

The five major risks identified by the Task Force were:

1. Inability to provide all service due to insufficient funding
2. Running out of landfill capacity
3. No market for recyclable materials
4. Inability to collect garbage because of staff availability
5. Storm events and Inability to collect garbage because of fleet issues

Table C-3 The City relies solely on the General Fund for funding operations and new truck purchases which is providing insufficient funding for the sustainability of the Solid Waste Department. How willing are you to support the recommendation for a monthly residential user fee?					
	Strongly Support	Support	Neutral	Disagree	Strongly Disagree
How willing are you to support the recommendation for a monthly residential user fee?	9	3			

All members of the CTF supported a monthly residential fee for solid waste services. There was discussion during the topic that for many services that are provided by the City that certain services are available to single-family residents and multi-family residents. These services include access to depositories and recycling centers. Also, programs such as illegal dumping clean-up benefit the broader community, not just residents of single family households.

Table C-4 If you are willing to support a user fee, how much would you be willing to pay on a monthly basis for your City provided solid waste and recycling services?					
	Lower than $18	$18.00 per month (Current - via General Fund)	$18.01 - $23.00 per month	$23.01 - $28.00 per month	More than $28.01 per month for expanded services
How much would you be willing to pay on a monthly basis for your City provided solid waste and recycling services?	1		6	4	1

Table C-5 Prioritize potential initiatives the City should consider for source reduction, reuse, recycling and diversion. Each attendee receives 10 dots to place next to initiatives they most support.	
The City Should:	
Develop alternative markets	20
Lead by example through expanding the City guidelines on source reduction, reuse, recycling efforts for all City agencies and offices	5
Lead by example through expanding the City purchasing/procurement guidelines to expand on source reduction, reuse, recycling requirements for City service and product providers	7
Expand education/promotion on source reduction, reuse, recycling for residents, including working with non-profits and private sector to leverage existing efforts	17
Include more information regarding environmental impacts in City education materials (e.g. upstream decisions for consumers)	5
Implement a "green building code" to require source reduction, reuse and recycling initiatives, including C&D, for new construction or renovation projects	4
Add additional materials to recycling programs (e.g. textiles)	2
Adopt mandatory residential recycling ordinance, with strict code enforcement to issue citations for placing recyclables in garbage containers	9
Use Code enforcement at the curb to issue citations for contamination in recycling containers, and instruct collection vehicle operators to leave the recycling container unemptied if tagged for contamination	13
Implement a Pay-as-You-Throw curbside collection system where setting out more garbage costs more, setting out less garbage costs less	4
Add more drop off locations for recyclables, chemicals and electronics	9
Add more collection events for household hazardous wastes	6
Expand types of materials collected and reused in City-operated reuse of materials beyond current building materials, electronics and chemicals	1
Implement a voluntary technical assistance program to assist multifamily complexes in setting up on-site recycling programs	1
Implement a voluntary technical assistance program to assist businesses in setting up on-site recycling programs	3
Adopt a mandatory recycling ordinance for multifamily complexes, with phased in compliance (education, then strict compliance)	6
Adopt a mandatory recycling ordinance for businesses, with phased in compliance (education, then strict enforcement)	5
Implement reporting requirements to better track private sector recycling	3
Establish more informative data management systems to better track trends and provide more transparent and useful data	5

Programs that received the highest rankings included:

1. Development of alternative markets for recycled materials
2. Use Code enforcement at the curb to issue citations for contamination in recycling containers, and instruct collection vehicle operators to leave the recycling container unemptied if tagged for contamination
3. Expand education/promotion on source reduction, reuse, recycling for residents, including working with non-profits and private sector to leverage existing efforts.
4. Add more drop off locations for recyclables, chemicals and electronics
5. Adopt mandatory residential recycling ordinance, with strict code enforcement to issue citations for placing recyclables in garbage containers

Table C-6 MATF members were given the opportunity to place up to 5 Dots on the table.	
Organics	
Encourage diversion from the landfill of biosolids generated at City wastewater treatment plants to processing facilities	12
Encourage use of locally produced compost, mulch and soil blends outside City projects	5
Increase number and availability of manned brush/tree waste drop off locations	2
Provide greater support and expand availability of Master Composter program to build support of organics diversion, and for public education	9
Lead by example by encouraging use of locally produced compost, mulch and soil blends at City projects and facilities	7
Collect residential food residuals with yard waste and address appropriate processing capacity – requiring a third cart	2
Enforce current ordinance prohibiting placement of grass clippings in city collection carts	3
Encourage development of additional organics processing capacity within the City for a broader range of food residuals, and biosolids	4
In coordination with local health department, encourage food recovery to feed the hungry	3
Adopt a mandatory recycling ordinance for organics collection, with phased in compliance (education, then strict compliance)	4

The major program priorities related to organics included the following:

1. Encourage diversion from the landfill of biosolids generated at City wastewater treatment plants to processing facilities
2. Provide greater support and expand availability of Master Composter program to build support of organics diversion, and for public education
3. Lead by example by encouraging use of locally produced compost, mulch and soil blends at City projects and facilities
4. Encourage use of locally produced compost, mulch and soil blends outside City projects

Table C-7 Based on your personal experience – what is the City doing well and what needs most improvement? Use one dot per row.						
City Activity	Doing Great	Good	Average	Needs Improvement	Needs significant Improvement	5 great 1 Need SI
Garbage Collection	4	4	1			4.3
Recycling Collection		3	5	3		3.0
Yard Waste Collection		1	6			3.1
Junk Waste Collection			5	1	1	2.6
Tree Waste Collection			6			3.0
Environmental Service Centers		2	1	2	2	2.4
Illegal Dumping Clean-up			1	3	5	1.6
Depositories, Recycling Centers		1	3	7	1	2.3
Public Information		2	2	4	3	2.3
Points	5	4	3	2	1	

Table C-8 What do you consider major issues related to disposal capacity?				
Challenges	Very Significant	Significant	Not a Concern	Score
MSW Landfill capacity being 30-40 years	4	4		20
C&D Landfill capacity being 20-30 years	5	3		21
City has no control over new capacity	3	2	1	14
Anticipated cost increases of disposal	5	2		19
Selecting sites for new landfills	9	1		29
Environmental justice related to new facilities	4	2	1	17
Environmental impacts of landfills	3	4	1	18
Distances waste will have to be hauled when close-in landfills reach capacity	8	2		28
Points	3	2	1	

Major issues related to landfills for the CTF included:

1. Selecting sites for new landfills
2. Distances waste will have to be hauled when close-in landfills reach capacity
3. C&D Landfill capacity being 20-30 years.
4. MSW landfill capacity being 30-40 years.
5. Anticipated cost increases of disposal
6. Environmental impacts of landfills

Table C-9 What are top 5 solid waste management issues? ((STAFF Responses) (use 5 dots and sticky notes for items not on the table)						
Issue (1 – most significant / 5 least significant)	1	2	3	4	5	Score
Disposal capacity is running out	0	1	4	3	1	23
Increasing consumerism and increased generation per capita						0
Insufficient program funding	8	1				44
Labor and fleet issues		7				28
Environmental impacts of waste disposal				1		2
MSW impacts on climate change						0
Recycling and organics market availability			1			3
Need for greater residential waste diversion			1	1	2	7
Lack of diversion in the commercial sector			1	1		5
Increased frequency and impacts of severe storms						0
Lack of Product Producer Responsibility				2		4
Difficulty in recycling materials due to packaging trends					1	1
Illegal Dumping	1		1	1	4	14
Others (describe on sticky note and rank)						
Points	5	4	3	2	1	

Appendix D Organizational Responsibilities

The following describes the responsibilities of each division of the SWMD related to implementation of the Plan.

Department Management

- Deparment management
- Support, i.e. accounting and billing
- Contract management
- Human resources management
- Policy development
- Coordination with key stakeholders
- Disaster management
- Route selection
- Public information / education programs*
- Response to 311 calls
- Planning*

**responsibilities moved to new Planning and Outreach Division*

Maintenance Division

- Maintains the Department's facilities/sites
- Provides leadership and administrativ reosurces need to maintain vehicle equipment
- Maitnanence repair services as well as fuel for operations
- Facility inspections

Operations Centers Division

- Collection planning
- Collection services to residents
- Special services as required by Management, City Council, Mayor
- Daily equipment and staffing assignments
- Route management
- Code enforcement responsibilities
- Reporting to management
- Illegal dumping collection

Proposed Planning & Outreach Division

- Project Planning
- Landfill Monitoring & New Site Development
- Minimization & Recycling Grant Administration
- Public Outreach
- Waste Minimization Program Management
- Recycling Program Management
- Organics Program Management
- Program Performance Evaluations