PREPARED FOR:
HOUSTON-GALVESTON AREA COUNCIL

Organics Collection and Processing Best Management Practices

FINAL Report | September 2010

R·W·BECK
An SAIC Company

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Section 1
EXECUTIVE SUMMARY

1.1 Project Purpose

The Houston-Galveston Area Council (H-GAC) retained R. W. Beck, Inc. (R. W. Beck) in January 2010 to develop an Organics Collection and Processing Best Management Practices Manual (Manual). This Manual is designed to assist local governments and private companies in the Houston-Galveston area to enhance organics diversion efforts in the region. In addition to this Manual, R. W. Beck will conduct a workshop for local governments and other industry professionals in September 2010.

Organics, such as food scraps and yard trimmings, represent a large portion of the waste disposed of in the H-GAC region. However, diversion efforts for organics have historically been limited due to the different collection strategies and processing needs for this material stream. H-GAC staff recognized the need for training and education on organics diversion and management strategies for local governments and private companies in the region.

While there is no available waste characterization data for the H-GAC region, Table 1-1 shows generation, recovery, and disposal of organic materials as estimated by the U.S. Environmental Protection Agency (EPA). As shown in the table, organics – such as wood, food waste, and yard trimmings – make up approximately 35 percent of the waste stream on a national basis.

Table 1-1
Generation, Recovery and Disposal of Organics (In Millions of Tons)

	Generated	Recovered	Disposed	Percent of Waste Disposed
Wood	16.39	1.58	14.81	8.9%
Food Waste	31.79	0.80	30.99	18.6%
Yard Trimmings	32.90	21.30	11.60	7.0%
Total	81.08	23.68	57.4	34.4%

Source: U.S. EPA Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts & Figures 2008

1.2 Report Organization and Content

This Manual is organized into seven chapters plus an appendix. This section provides an overview of the content of each section.

Section 2: Current Organics Management Practices in the H-GAC Region

It is important for this Manual to be a useful and applicable tool for local governments and private companies in the H-GAC region. Therefore, R W. Beck conducted interviews with local governments and private companies in the region to understand the following questions.

- **What are the current organics management practices in the H-GAC region?** Section 2 summarizes the current management practices for organics, including residential and commercial programs.
- **What are the key issues that need to be addressed in this Manual?** Based on the findings of the interviews, R. W. Beck identified the need to address the following specific issues in this Manual. Beside each topic is the section and page where the topic is discussed. This list is not a comprehensive list of topics that are included in the Manual, but it represents topics that were specifically identified in the interview process.
  - What is the potential economic benefit to commercial customers that participate in food scrap diversion? See Section 4-6.
  - What are cost drivers for residential yard trimmings programs? See Section 3.3.6.
  - How should recent efforts to capture landfill gas (LFG) for energy conversion impact policy decisions related to organics diversion? See Section 7.4.3.
  - What is the best way to collect food scraps from small commercial generators? See Section 4.

Section 3: Single-Family Residential Collection of Organics

The most common residential organics program in place in the H-GAC region is curbside collection of residential yard trimmings (i.e., brush, leaves and grass). A central focus of Section 3 is to provide best management practices for residential curbside yard trimmings programs, such as the following:

- Materials;
- Set out options, including containers;
- Collection vehicles;
- Set outs;
- Collection frequency; and
- Factors that impact cost.

However, the H-GAC region is comprised of a variety of communities that are in various stages of development for residential organics programs. Therefore, Section 3 also includes discussion of drop-off collection for communities that elect to implement that type of program. In addition, for those communities with mature residential yard trimmings programs, this Section contains discussion of best management practices for integrating food scraps into existing curbside yard trimmings programs.

Section 4: Non-Residential Collection of Organics

This section describes best management practices for collection of organic materials from commercial generators, including the following:

- Materials;
- Potential generators;
- Interior collection containers;
- Docking area design considerations;
- Exterior collection containers;
- Vehicles and collection frequency;
- Factors that impact cost;
- Other keys for success.

Section 5: Developing a Processing Site

This section provides a comprehensive overview of regulatory, site development and design, and capital requirements to develop a composting site. This Manual is focused on windrow composting as the composting method; however, many of these requirements are applicable to any composting site, regardless of the composting method.

Section 6: Operating a Processing Facility

This section provides a comprehensive overview of best management practices for operating a windrow-composting site, such as the following:

- Basic concepts;
- Composting methods and technologies;
- Compost process and monitoring;
- Staffing needs;
- Health and safety considerations;
- Nuisance control; and
- Marketing of end products.

Although this section focuses on windrow composting, it also includes an introduction to basic composting concepts as well as a summary of other potential composting technologies.

Section 7: Municipal Role in Organics Management

This section describes many non-operational roles that may be performed by municipalities with regard to organics management. Oftentimes, local governments must do more than provide service, but they must also procure service providers, make policy decisions, work with various stakeholders, and perform many other functions in order to ensure a successful organics diversion program. This section provides recommendations for local governments that seek to do the following in support of their organics diversion programs:

- Develop public-private partnerships;
- Achieve political acceptance;
- Develop ordinances; and
- Pursue funding for composting.

Section 8: Recommendations for Regional Implementation

There are many public and private entities that need to participate in order to implement organics diversion within the H-GAC region. This section provides recommendations for regional government (e.g., H-GAC), local governments, and commercial generators in the region to advance organics diversion.

Appendix: Case Studies

R. W. Beck developed case studies describing organics efforts in the following local governments:

- Appendix A: Little Rock, Arkansas
- Appendix B: Alameda County Waste Management Authority (Stopwaste.org)
- Appendix C: Denton, Texas
- Appendix D: McAllen, Texas

1.3 Acknowledgements

The Project Team for this engagement consisted of staff from R. W. Beck and Overgaard and Associates.

R. W. Beck would like to acknowledge the critical contributions from key staff at the organizations and local governments that were utilized as case studies for this Manual. These individuals and organizations are listed below:

- Brian Mathews, Robin Plutchok, and Rachel Balsley, Alameda County Waste Management Authority (Stopwaste.org)
- Gary Foss and Ron Risi, Recology
- Andy Schneider, City of Berkeley, California
- Shirlene Sitton, Vance Kemler, and Gayla Wright, City of Denton
- Roy Custodio and Chris Lash, City of McAllen
- Warren Atkins, City of Little Rock

Section 2
CURRENT ORGANICS MANAGEMENT PRACTICES IN THE H-GAC REGION

2.1 Overview

It is important for this Manual to be a useful and applicable tool for local governments and private companies in the H-GAC region. Therefore, R W. Beck conducted interviews with local governments and private companies in the region to understand the following questions.

- What are the current organics management practices in the H-GAC region?
- What are the key issues that need to be addressed in this Manual?

2.2 Interview Process

R. W. Beck worked with H-GAC to identify seven private service providers to participate in the interview process. These companies include haulers and processors of organics, as well as companies that offer both hauling and processing services. R. W. Beck contacted all of the companies listed and conducted interviews with five of the seven companies.

- Living Earth Technology
- Liquid Environmental
- Novus Wood Group
- Republic Services
- Texas Landscape Products
- Waste Connections
- Waste Management

R. W. Beck also worked with H-GAC to identify local governments to participate in the interview process, as listed below. R. W. Beck interviewed four of the six cities.

- Houston
- Huntsville
- Pasadena
- Sugar Land
- Texas City
- The Woodlands Township

R. W. Beck also contacted a representative from HEB grocery stores to provide a business perspective for commercial food scrap collection in the H-GAC region. HEB is actively diverting produce and other food scraps at several stores in the Houston market.

The remainder of this section summarizes the findings of the interviews with local governments, private service providers, and businesses. R. W. Beck kept the results of individual interviews confidential; all responses have been aggregated and summarized for the purposes of this Manual.

2.3 Residential Current Practices

There are many communities within the H-GAC region that have developed curbside brush and yard trimmings programs for residential customers. This material is set out separately by residents to be collected and diverted.

Interview participants expressed several key reasons that residential yard trimmings programs are developed in the region, including:

- Increase residential diversion;
- Preserve regional landfill capacity; and
- Reduce cost of landfill disposal.

Although there are several communities in the region that have residential yard trimmings programs in place, there are many communities that do not provide residential yard trimmings diversion programs. In addition, there are currently no communities within the region that have developed collection programs for food scraps.

The following describes the typical design of a residential yard trimmings program in the region.

2.3.1 Collection Frequency

Based on interviews, most residential yard trimmings programs provide collection of material on a weekly, every other week, or monthly basis. No quarterly, semi-annual, or seasonal programs were identified. In some cases, collection is provided for large brush on a monthly basis while collection of bagged yard trimmings (leaves and grass) is provided on a weekly basis.

Because of the subtropical climate in the H-GAC region, as well as the extended growing season, larger quantities of residential yard trimmings are generated as compared to other areas of the country. Therefore, most programs have been developed to provide more frequent collection than may occur in other regions.

2.3.2 Collection Method and Vehicles

The collection method and vehicles for yard trimmings varies based on the type of material. Following is a description of the most typical collection method in the region for brush and yard trimmings.

- **Large brush –** Collected loose or bundled with knuckleboom or grapple trucks.
- **Yard trimmings** – Collected using rear-loading collection vehicles with either bags or customer-provided containers.

2.3.3 Containers

Residential yard trimmings (excluding large brush) are collected in either compostable bags or customer-provided containers in the region. Many interview participants also discussed the advantages and disadvantages of using automated carts for residential yard trimmings collection.

Compostable Bags

The City of Houston requires residents to set out yard trimmings in resident-provided compostable plastic bags. The City partnered with local retailers to ensure the availability of the bags. Interview participants noted that, because the City of Houston has required these bags, they are more available in the region and may be a feasible option for yard trimmings collection in other communities.

Compostable plastic bags, according to interview participants, are approximately three times the cost of a conventional plastic bag. However, they are comparable in cost when compared to paper (Kraft) bags that have been used in other communities for yard trimmings collection as shown in Section 3.3.2 of this manual. In addition, clear compostable bags enable collection personnel to inspect material before it is loaded into the collection vehicle. Some communities, including Houston, require residents to purchase the bags. Other communities are considering providing the bags directly to residents on an annual basis as part of the residential services provided by the community.

Automated Carts

Automated carts, such as are commonly used in residential refuse and recycling collection, are a very efficient way to collect solid waste and recyclables. Some haulers expressed a preference to collect residential yard trimmings using automated carts because of the collection efficiency and labor cost benefits. However, these carts have not been widely utilized in the H-GAC region for yard trimmings collection because of the following reasons:

- Residents have concerns about managing and storing three carts (one each for refuse, recycling, and yard trimmings).
- Residents can generate very large amounts of yard trimmings, exceeding the typical capacity of an automated cart, which is no larger than 96 gallons.
- Bags are more consistent with how residents typically manage yard trimmings.

Costs for automated carts are shown in comparison to the cost for compostable bags in Section 3.3.2 of this Manual.

2.3.4 Quality of Material

Interview participants did not express concerns about the quality of material being collected through residential yard trimmings programs. Collection personnel typically make a visual inspection of material before loading it into the collection vehicle. In the City of Houston, for instance, the compostable bags required by the program are clear, which allows for visual inspection. Collection staff is also able to inspect loose set outs of brush and yard trimmings.

Area processors noted in the interviews that they do not experience issues with contamination because they reject any loads that contain trash.

2.3.5 Education and Outreach

Education related to residential yard trimmings is typically part of the overall education effort for solid waste and recyclables services. Websites, direct mail, utility bill inserts, newspaper ads, and other typical media are used to instruct residents on proper participation in yard trimmings programs.

In addition, some communities are able to integrate yard trimmings recycling education into a broader environmentally-sound landscaping program. These programs typically encourage utilizing native plants in landscaping, water conservation, grasscycling (leaving grass clippings on the lawn after mowing), backyard composting, and other landscaping practices.

2.3.6 Contracts

Most municipal contracts for yard trimmings collection and processing services in the region are bundled as part of the agreement for solid waste and recycling service. In fact, most contracts for yard trimmings service do not require the collection contractor to take the yard trimmings material to any particular facility but allows the hauler flexibility in where the material is processed.

Although most communities do not have a separate agreement with the processor, larger communities in the region benefit from having contracts directly with the processing company.

2.3.7 Impacts on Other Services

Implementing a residential yard trimmings program does have an impact on the other services, primarily refuse service, provided to residents. When residential yard trimmings programs are implemented, the amount of refuse is reduced. In addition, some communities have experienced an overall reduction in the amount of material generated for collection. The collection practices required by residential yard trimmings collection programs, such as compostable bags, can incentivize residents to find other ways to manage material. This reduction in waste generated reduces disposal costs to a community, particularly in the H-GAC region because of the dependence on private landfills in the region.

2.3.8 Key Challenges

Although most residential yard trimmings programs in the region have been successful, interview participants identified the following key challenges for residential organics diversion.

- It is difficult to ensure that landscaping companies that work for residential customers recycle yard trimmings material. These companies remove yard trimmings after working for a particular customer and are typically not restricted on where they can dispose of or recycle material.
- Residents are not accustomed to the additional cost of compostable bags.
- If conventional plastic bags are used for collection, it can result in significant operational challenges for the composter.
- Inexpensive landfill disposal reduces the economic incentive to divert material.
- Communities must be dedicated to keeping residential material clean for a program to be successful.
- Communities are sometimes hesitant to provide a yard trimmings program since it often results in a higher service rate.

2.4 Commercial Current Practices

Commercial organics (primarily food scraps) diversion programs have recently been developed in the H-GAC region, but have not yet become widespread. The following describes the design of commercial food scraps collection in the region.

Commercial food scrap diversion is a very customer-driven service and is typically designed based on the specific needs of the customers. Because of this, there is a wide variety of ways that the service is being performed in the region. This section summarizes the key design elements of programs in the region, but there is no “typical” program, as can be seen with residential yard trimmings collection.

Interview participants noted that commercial food scrap recycling has largely been driven by individual customers requesting service. Programs have not been actively marketed by area haulers. Grocery stores and other large companies participate in food scrap diversion as part of overall company environmental efforts and in order to achieve corporate-wide goals to reduce the environmental impact of operations.

2.4.1 Materials

There is one compost facility in the region, Nature’s Way Resources that accepts commercial food scraps on a large-scale basis. This facility accepts a wide range of pre- and post-consumer food scraps, as well as industrial food processing waste, including the following:

- Vegetative material (produce);
- Meats and fish;
- Oil and grease;
- Dairy materials; and
- Liquid feedstocks.

2.4.2 Collection Frequency

Frequency of collection for commercial food scraps in the region varies based on the following factors:

- **Seasonality** – More frequent collection (two to four times per week) is needed in warmer months.
- **Climate** – The climate of the H-GAC region requires at least weekly collection of commercial food scraps.
- **Volume –** Large volumes demand more frequent collection.
- **Location** – Customers in more dense, populated areas may request more frequent collection to avoid nuisance issues.

2.4.3 Collection Method and Vehicles

There are various collection methods and vehicles that are being used in the region to collect commercial food scraps. Certain companies have chosen to offer this service as a roll-off only service due to lack of route density that is needed to run a front-load route. In addition, interviewees stated that there are some technical challenges to using front-load collection vehicles for food scraps. These trucks may not be water tight, which can result in leaks. Also, packer trucks are more difficult to clean after collecting food scraps.

In order to serve all commercial food scrap generators in the region, including small generators like restaurants, collection best management practices for front-load containers needs to be addressed.

2.4.4 Containers

The appropriate container for a customer depends on the following factors:

- Volume and type of material;
- Docking space available;
- Desired collection frequency; and
- Location of the customer, whether a dense or remote area.

Based on interviews, roll-offs and small (two to four cubic yard) front-load containers are currently being used to collect commercial food scraps in the region. Interviewees also emphasized the importance of regular container washing for commercial food scrap programs.

2.4.5 Quality of Material

Pre-consumer food scraps generated from grocery stores, food product manufacturing, and other commercial sources are typically very clean and free from contamination. Pre-consumer refers to food scraps generated from food preparation activities before coming into contact with the consumer. However, there have been significant issues in the region with the quality and cleanliness of *post-consumer* food scraps. In other words, food scraps generated from plate scrapings after coming into contact with the consumer. In some instances, this material has been heavily contaminated with glass and plastic. Interview participants expressed that post-consumer food scraps may be a challenging material stream to recycle in the region because of general lack of awareness of organics recycling and composting issues.

2.4.6 Cost of Service

Customers in the region are price sensitive regarding food scrap collection and composting. Currently, the price of commercial food scrap collection is directly dependent on the customer's proximity to the food scrap composting facility. Customers that are located in a reasonable hauling distance to Nature's Way Resources, which is located in Conroe, Texas, have experienced disposal cost savings due to participating in food scrap diversion.

2.4.7 Key Challenges

Interview participants identified the following key challenges for commercial food scrap collection in the region.

- Customers can struggle to train staff on proper source separation of food scraps.
- Some areas do not have adequate docking (or parking) space for additional containers to collect commercial food scraps.
- There is only one facility in the region that can accept commercial food scraps, and it is located in the far northern portion of the region. Additional composting infrastructure is needed before commercial food scrap composting can become more widespread.
- There are not enough commercial front-load food scrap customers in concentrated areas to develop dedicated routes for this service.

2.5 Current Processing Infrastructure and Markets

Although the infrastructure for composting food scraps is limited in the region, the infrastructure to manage brush and yard trimmings is very developed. There are many companies that develop mulch products and soil blends.

Based on discussions with interviewees, the markets for mulch and soil blends in the region are very developed. There is high demand for mulch from both bulk customers (e.g., landscaping companies) and retail customers. Area residents typically use mulch on an annual basis in their home gardening and landscaping.

Although demand for high-quality compost has been steadily growing, historically demand has not been strong. Some interview participants speculate that the soil in the H-GAC region is suitable for growing without the use of compost. Demand for high-end compost product is needed to further incentivize the development of compost facilities that accept food scraps.

2.6 Issues to Address in Manual

Based on the findings of the interviews, R. W. Beck identified the need to address the following specific issues in this Manual. Beside each topic is the section and page where the topic is discussed. This list is not a comprehensive list of topics that are included in the Manual, but it represents topics that were specifically identified in the interview process.

- What is the potential economic benefit to commercial customers that participate in food scrap diversion? See Section 4-6.
- What are cost drivers for residential yard trimmings programs? See Section 3.3.6.
- How should recent efforts to capture landfill gas (LFG) for energy conversion impact policy decisions related to organics diversion? See Section 7.4.3.
- What is the best way to collect food scraps from small commercial generators? See Section 4.

Section 3
SINGLE-FAMILY RESIDENTIAL COLLECTION OF ORGANICS

3.1 Overview

Organic material—including brush, yard trimmings, food scraps, and paper—represent a large portion of the single-family residential solid waste stream. In initiating efforts to divert organics, many communities have chosen to begin with the single-family residential stream. In addition, many of the communities in the United States that boast the highest recycling rates can attribute much of their success to a strong organics recycling program.

As described in Section 2 of this Manual, the most common residential organics program in place in the H-GAC region is curbside collection of residential yard trimmings (i.e., brush, leaves and grass). A central focus of this Section is to provide best management practices for residential curbside yard trimmings programs. However, the H-GAC region is comprised of a variety of communities that are in various stages of development for residential organics programs. Therefore, this Section also includes discussion of drop-off collection for communities that elect to implement that type of program. In addition, for those communities with mature residential yard trimmings programs, this Section contains discussion of best management practices for integrating food scraps into existing curbside yard trimmings programs.

3.2 Drop-off Collection

Residential drop-off collection sites for organics provide citizens with a way to divert organic materials by allowing residents to bring them to the site, often at no charge. This option provides a solution to yard trimmings diversion that has potentially low infrastructure requirements.

A drop-off collection program for organics can vary significantly in complexity. It could simply be a roll-off container into which residents can place yard waste, which is later hauled to a composting facility. Alternatively, it could be a composting operation that has a drop-off area for residents on site. Drop-off areas may be staffed or unstaffed. Having a staff person on-site adds to operational costs, but also results in lower contamination rates and added convenience for residents, which may help boost participation. Communities should consider whether their composting facility would be willing and able to accept material from an un-staffed drop-off location.

While drop-off sites can be a relatively low-cost means of developing a yard trimmings recovery program, because self-hauling to a drop-off site is less convenient than curbside collection, particularly for bulky materials such as yard trimmings, drop-off collection sites generally see lower participation rates than other organics collection approaches. It is also important to note that material types are often more limited at drop-off collection sites, depending upon how well staffed the site is. In general, a drop-off site would not be ideally suited for the delivery of food scraps.

Additional information regarding drop-off programs may be found on the Recycling Workshop Resources page of the H-GAC website (link in footnote). [1]

Advantages

- Potentially lower capital and operating costs than curbside collection, depending on the size and infrastructure developed at the drop-off site.
- Residents can deliver organic material immediately after it is generated, alleviating the need for at-home storage.
- Can be beneficial for residents that generate large quantities, as residents are typically not limited in how much material they are allowed to bring at one time.
- Can be co-located with other recycling infrastructure, such as drop-off centers for electronics, household hazardous waste, or traditional recyclables.

Disadvantages

- Lower potential for participation and diversion than curbside due to lower convenience than curbside programs.
- Not recommended for food scrap diversion.

3.3 Curbside Yard Trimmings Collection

The most common approach to residential organics recycling in the H-GAC region is curbside collection. Curbside collection programs are more convenient for residents than drop-off programs, and yield significantly higher diversion rates than drop-off collection programs. This Section describes best management practices for the implementation of curbside yard trimmings collection.

Communities may choose to offer different programs for different types of residential yard trimmings. For instance, leaves, grass, and small limbs or brush may be able to be collected on a regular basis using a container or bag system. However, large tree waste, stumps, and untreated wood may be more appropriate for periodic collection (monthly, quarterly, or semi-annually). This Section discusses program options for both types of residential yard trimmings.

There may be communities within the region or outside of the region that have developed programs for residential yard trimmings that are not represented in this Manual. The intent of this Manual is to describe industry best practices that are most applicable to the H-GAC region.

[1] http://www.h-gac.com/community/waste/management/recycling/recycling_workshop_resources

3.3.1 Materials

Common materials accepted in curbside yard trimmings programs include the following:

- Leaves;
- Grass;
- Brush;
- Large and small limbs; and
- Tree stumps.

Some communities have chosen to exclude grass from residential yard trimmings and require that residents leave grass clippings on the lawn after mowing (“grasscycling”). Not only is this an effective source reduction method, but most lawnmowers are self-mulching, allowing residents to conveniently leave grass clippings on their lawn. Grasscycling as a source-reduction method is discussed in more detail in Section 3.5.

3.3.2 Set Out Options

The following describes set out options for residential yard trimmings collection.

Loose

There are some areas in Texas, including Texas City, as well as in other states that have implemented residential yard trimmings programs utilizing “loose” collection. In other words, no container is required to set out material. Vacuum trucks (for loose leaves), grapple trucks, or another type of vehicle may be used for this collection.

The advantages of loose collection include:

- No need for purchasing containers;
- Convenience for residents (no need to bag leaves, containerize other yard trimmings);
- No need to de-bag leaves/other yard trimmings at the compost facility; and
- Materials may be able to be reduced in volume on route using leaf vacuum systems with chippers and tow-behind chippers for brush.

The disadvantages of loose collection include:

- Loose materials may blow into the street and into storm drains, creating the potential for significant stormwater drainage issues;
- This method is not convenient/feasible where there is parking on the street;
- It is not feasible to incorporate food;
- Scheduling may not benefit all residents equally, as some residents’ collection may be scheduled for early in the season, before all leaves have fallen;
- Multiple collections may be necessary to collect all materials; and

- There is a need for good education and outreach so residents will know when to be prepared for a loose collection.


Id

Figure 3-1: Example of Vacuum Truck for Loose Collection of Leaves

Figure 3-2: Example of Loose Collection of Brush
(Using a Chipper for Volume Reduction)

In some cases, communities may supplement a weekly or bi-weekly containerized yard trimmings collection program with a seasonal or post-storm event loose yard waste collection. This provides residents with added convenience at times when the generation of yard trimmings peaks, and still allows for a more regularly scheduled option that could potentially incorporate food scraps at some point.

R. W. Beck does not recommend that communities implement loose collection of organics as the only option for yard trimmings. Particularly, grass clippings are not well suited for loose collection.

Container Options

For regular yard trimmings collection, residents are typically required to use a container to set out material. There are many options with regard to containers, including the following:

- **Customer-provided rigid containers:** Residents are required to collect material in customer-provided metal or plastic garbage cans. Container size is generally limited to 30 gallons to manage the container weight for collection crew safety. Programs may also limit the number of containers that can be set out.
- **Program-provided automated carts:** Residents use a rolling cart, provided by the local government or hauler, to set out material. Carts are typically 60 to 95 gallons in size. The local government or hauler will typically pass this cost through to the resident through the solid waste service fee. To enable residents to set out more material during the growing season, some communities may allow residents to set material outside of the cart in compostable bags or in bundles.

  

  Containers are most suitable for leaves, grass, and small amounts of brush. Therefore, regardless of the type of container selected by a community, there is often a need to allow residents to set out brush and branches outside of the container. Branches are typically required to be cut and bundled, with a length, diameter, and weight limit. For set out limit information, see Section 3.3.4.
- **Compostable paper bags:** Residents are required to set out material in kraft paper garden bags. Bags are approximately 30 gallons and cost between $0.50 and $1.00 per bag at major retail outlets and industry wholesalers. In some parts of the country, municipalities and/or their haulers have specially printed bags made, the price of which incorporates the cost to operate the composting program (much like a pay-as-you-throw (PAYT) trash program).

  
- **Compostable plastic bags:** Residents are required to set out material in compostable plastic bags. Local governments may also require that bags be clear to allow material to be inspected prior to collection. Bags are widely available in the Houston-area due to the City of Houston's implementation of a compostable bag program. Many brands are available from various retailers and industry wholesalers, and the cost is typically $0.50 to $1.00 per bag. Compostable plastic bags are also compatible with PAYT programs, in which residents would only

  

be allowed to set out a certain number of bags for collection.

Some programs may allow residents to use regular plastic (e.g. non-compostable) bags for their yard trimmings, however this practice requires de-bagging at the processing site, generates additional waste, poses the threat of contamination, and is therefore not recommended by R. W. Beck as a best management practice.

Advantages and Disadvantages of Set out and Container Options

Table 3-1 provides a summary of the different container options, and the advantages and disadvantages associated with each option.

Table 3-1
Comparison of Residential Yard Trimmings Container Options

Container	Pros	Cons
None (Loose) Works Best When: Used for seasonal high-volume generation, to supplement regular, containerized collection	▪ Convenient for residents ▪ Not necessary to purchase containers ▪ Trimmings may be reduced in volume as collection occurs	▪ Yard trimmings may blow into street and clog storm drains ▪ Potential confusion over scheduling of loose collection ▪ Not possible to collect food scraps ▪ Timing of collection may not be optimal for some residents (e.g., before all leaves fall) ▪ Unattractive piles on streets
Customer-Provided Rigid Container Works Best When: Community needs a low-cost option for residents; Refuse collection is also manual or utilizes rear-loaders	▪ Low cost to residents ▪ Can adjust set outs based on season	▪ May be more challenging to enforce set out limits ▪ Compatible with manual and rear loading collection vehicles, which require more personnel ▪ Less attractive on collection day ▪ Injuries to staff or non-collection can occur if residents do not comply with container limits
Program-Provided Rolling Cart Works Best When: Carts are used for refuse and/or recycling collection; Community desires to include food scraps in the program in the future; Customers generate similar volumes of yard trimmings	▪ Compatible with automated (or semi automated) collection, which can be more efficient than manual collection, and is safer for personnel ▪ Allows for future program expansion to include food scraps ▪ Many residents find wheeled carts easier to manage ▪ Set outs are uniform in appearance	▪ May need to supplement with out-of-cart set outs, additional bags, or loose collection during times of heavy volume, which mitigates benefits of automated collection ▪ Residents will potentially have and store three rolling carts, which may be problematic for some residents ▪ Cart represents additional cost to residents that are typically passed through via the solid waste service fee.

Container	Pros	Cons
Compostable Paper Bags Works Best When: Yard waste generation varies widely between customers; and service provider prefers bags to carts; Processor does not allow compostable plastic bags	▪ Can adjust set outs based on quantity generated ▪ Uniform set outs ▪ No empty containers are left on side of street after collection ▪ Paper bags are easily composted ▪ Set out limits more easily implemented (number of bags)	▪ Bags cost residents and are more expensive than other compostable bag options ▪ Manual collection vehicles require more personnel
Compostable Plastic Bags Works Best When: Yard waste generation varies widely between customers; Customers and service provider prefer bags to carts	▪ Can adjust set outs based on quantity generated ▪ Set outs are uniform in appearance ▪ No empty containers are left on side of street after collection ▪ Set out limits more easily implemented (number of bags) ▪ Allows for inspection of material at curbside, if clear bags are used	▪ Customer confusion can occur with conventional plastic bags, and may lead to increased contamination at compost facility ▪ Bags cost residents ▪ Manual collection vehicles require more personnel ▪ Some composting operators report mixed success with compostable plastic bags ▪ Generally less durable than paper bags; must educate residents on how to use properly so they do not decompose.

Factors to Consider

There are many factors that should be considered when a community selects a container option for residential yard trimmings collection. Some of the key factors that should be considered are as follows.

- **Collection system and containers used for other aspects of residential collection –** Many residents find it simpler to have similar collection schedules and containers for the various materials collected. Often containers are similar in appearance and functionality but are color-coded to differentiate the material type to be deposited in each one. Further, if all organics are collected in one cart, using a relatively large cart may be acceptable.
- **Anticipated material generation –** It is important to understand the extent to which residents generate organic waste, whether there is a wide range in quantity of yard trimmings generated, whether there are a significant number of households that would not generate yard trimmings, or if households are serviced by professional landscapers who manage the yard trimmings. It is important to consider how a program could be structured so that it is equitable, given such dy Enamics.
- **Available processing facilities –** Before an organics collection program can be implemented, it is important to know where the materials will be processed. In

addition, what is the capacity of the processing facility? What types of materials will the facility accept, and what are the specifications? What is the allowable contamination rate of material?

- **Available collection infrastructure/equipment –** As described above, and below in Section 3.3.3 the types of collection vehicles available, or potentially available (either by the public entity or local private haulers) will influence the types of containers that can be utilized for yard trimmings/organics collection. Note that some communities use split-body vehicles to reduce the number of vehicles traveling on a given road during a week. Split-body trucks can hold two separate material streams in one vehicle, and can be used in a number of ways. However, it should be noted that these vehicles are generally only advantageous for smaller cities that sort or process the two separate material streams in one location.
- **Future program plans –** Knowing the direction of your community's future organics management program can help shape your current program more effectively. For example, if your community is certain it would like to add food scraps to its organics collection program, then a containerized collection program can be implemented from the start, helping to shape citizens' habits and expectations, making future transitions easier.
- **Available resources and commitment –** Knowing that there are adequate resources and political will to back an organics collection program will help ensure its success. A strong solid waste management plan that shows commitment to such a program will be helpful. Documenting the successes of a program as it unfolds, and translating benefits into terms that matter most to your community (landfill air space saved, dollars saved in disposal fees, etc.) can help strengthen support for the program.
- **Payment options/history of program structure for customer –** In some communities, customers are averse to service fees whereas other communities see fees for services as more equitable. The prevailing mindset of the community, and the political will of elected officials, may influence how your community chooses to structure its program. As mentioned above, some communities have successfully implemented pay-as-you-throw (PAYT) programs for the collection of yard trimmings, in which the cost of the program is incorporated into the price for a special printed yard waste bag that residents purchase. In other communities, residents are provided with a specific number of bags at no additional cost, and must pay for additional bags beyond the base number. This type of system can be perceived as more equitable, as some residents generate little or no yard trimmings, while others generate a significant amount. PAYT for yard trimmings is most commonly used with specially-printed bags, but can also be used with tags (placed on containers or bundles). For a PAYT yard trimmings recovery program to be effective, the per-bag fee must be less costly than disposal, or be combined with a landfill ban on yard trimmings.

3.3.3 Collection Vehicles

The following describes options for vehicles for yard trimmings collection.

Regular Yard Trimmings Collection

The type of vehicle operated for yard trimmings collection is closely related to the type of container chosen by a community. For example, bagged yard waste is typically collected using rear loader collection vehicles since the bags must be manually placed into the vehicle's hopper. Depending on the set out rates and volumes, a two or three person crew would be required. Table 3-2 shows the typical vehicles that are used to provide collection for each type of container.

Table 3-2
Collection Vehicles for Residential Yard Trimmings

Container	Typical Vehicle
Customer-Provided Rigid Container	Rear-load collection vehicle
Program-Provided Rolling Cart	Automated side-loader or rear loader with semi-automated lifter
Compostable Paper Bags	Rear-load collection vehicle
Compostable Plastic Bags	Rear-load collection vehicle

As is described in more detail below, there are a myriad of collection vehicles on the market. Some have split bodies, which allow for the collection of two separate material streams simultaneously. Split-body collection vehicles are available in both manual and automated collection options, and can also be outfitted with semi-automated lifters.

Loose and Large Yard Trimmings Collection

Special collection vehicles are used for the collection of loose and large-scale yard trimmings. Options include the following, summarized in Table 3-3.

Table 3-3
Typical Collection Vehicles for Loose and Large-Quantities of Yard Trimmings

Waste Type	Typical Vehicle
Loose leaves	Vacuum truck
Stumps/piles of large limbs	Knuckleboom or grapple truck
Brush	Pickup truck (or larger truck) with tow-behind chipper

City of Houston's Yard Trimmings Recycling and Tree Waste Programs

The City of Houston, the nation's fourth largest city, recently made significant changes in the way that residential organics are managed. The City does not own a landfill, so increasing disposal costs, as well as the need to preserve regional landfill capacity, were important factors in deciding to make this change.

City Council approved an ordinance on September 2, 2009 requiring that residents set out yard trimmings – including leaves, grass, and brush – into compostable plastic bags. Residents are not permitted to set out yard trimmings in their automated refuse containers. Yard trimmings were previously allowed to be set out in conventional plastic bags. Prior to the ordinance, solid waste crews cut and opened each bag and emptied the contents into the vehicle hopper.

The City estimates that this separate yard trimmings collection will save the City approximately $1.5 million per year in disposal fees. In addition, there was a 56 percent reduction in material generated from yard trimmings collection. The requirement to use compostable bags resulted in residents managing materials in alternate ways, such as grasscycling and backyard composting.

In addition to modifications to the curbside yard trimmings program, the City of Houston identified the need to modify its monthly heavy trash collection. This program, in which residents set out commingled brush and bulky material once per month for disposal, generated approximately 300,000 tons per year of refuse. The City estimated that approximately 30 to 40 percent of this material was yard trimmings ("tree waste"). In order to divert this material from disposal, the City modified its heavy trash program to alternate between tree waste and junk waste collection. Even months of the year are junk waste only and odd months of the year are tree waste only.

The change from heavy trash to junk waste/tree waste collection required no operational changes besides a change in hauling or the processing/disposal location for the collection vehicles. The cost of the program modification was primarily educational. The City spent approximately $300,000 on education costs for the tree waste program.

3.3.4 Set Out Limits

In designing residential yard trimmings programs, communities should consider set out limits for material. Communities typically implement set out limits to enhance operational efficiency, protect the health and safety of collection and processing workers, and to ensure equity in the level of service provided to customers. Set out limits might include limiting the following:

- Number of bags;
- Volume of containers;
- Size of bundles;
- Weight of containers or bags; or
- Cubic yards of loose material.

3.3.5 Frequency

There are many options for the frequency of collection of yard trimmings, including the following:

- **Call-In Collection** – Residents call in to request collection when they are in need of a yard trimmings collection. Residents are typically given a certain number of call-ins annually that are included in the base service rate.
- **Seasonal Collection –** Collection provided during the growing season only.
- **Periodic Collection** (Monthly, Quarterly, Semi-Annual, or Annual) – Residents are provided with periodic collection of yard trimmings on a scheduled basis.
- **Weekly and Every-Other-Week Collection** – Residents can set out yard trimmings weekly or every-other-week, usually on the same day of the week that refuse and recycling are collected, as applicable.

Collection that is more frequent is more costly, however is likely to result in the highest level of diversion of yard trimmings. For example, if residents do not have collection of yard trimmings available for several weeks or months, they may decide to include yard trimmings with their refuse in order to avoid stockpiling. However, some residents may not require weekly collection of yard trimmings (or may not require weekly collection on a year-round basis); therefore, there may be a relatively low set out rate on weekly routes, which can result in lower collection efficiency.

Table 3-4 provides a summary of potential collection frequency options including when they are best applied and the advantages and disadvantages of each.

Table 3-4
Options for Collection Frequency

Collection Frequency	Advantages	Disadvantages
Call-In Works Best When: Great diversity exists in yard trimmings generated in a community; Residents prefer on-call vs. scheduled collection	▪ Focuses resources on heaviest seasons ▪ Residents can have collection at their convenience when they choose to generate material ▪ Greater control of set outs	▪ Food scraps could not be included ▪ Residents may not make the effort to request a collection – may result in relatively low rate of diversion.
Seasonal Works Best When: Growing season in a community is relatively short; Little to no yard trimmings are generated during non-growing seasons	▪ Focuses resources on heaviest seasons ▪ Results in good collection efficiency because service is provided in the heaviest season	▪ Residents may generate material out of season ▪ Seasonal use of personnel and equipment ▪ Food scraps could not be included
Periodic *(monthly, quarterly, semi-annual, or annual)* Works Best When: Residents have space and willingness to "stockpile" yard trimmings; Yard trimmings generation is concentrated vs. ongoing	▪ Less costly and resource intensive than weekly or every other week collection ▪ Effective way to collect large material that is not generated on an ongoing basis	▪ Food scraps would likely not be included

Collection Frequency	Advantages	Disadvantages
Every-Other-Week Works Best When: Yard trimmings generation is relatively ongoing throughout the year; Residents have PAYT refuse rates	▪ Convenient for residents ▪ Lower operating costs than weekly ▪ Likely to result in higher diversion rates than less frequent collection	▪ Higher operating cost ▪ Potential for low route density ▪ Food scraps more challenging to include
Weekly Works Best When: Yard trimmings generation is relatively ongoing throughout the year; Residents have PAYT refuse rates; A community wants to integrate food scraps	▪ Convenient for residents ▪ Likely to result in higher diversion rates than less frequent collection. ▪ Food scraps could be included	▪ Highest operating cost ▪ Potential for low route density

3.3.6 Factors that Impact Cost

Cost can often be a factor that prevents local governments from implementing dedicated yard trimmings collection. This section provides an understanding of factors that can increase the cost of a yard trimmings program. Utilizing this information can enable local governments to implement yard trimmings collection in the most cost effective manner.

- **Provide the program on a citywide basis.** In some circumstances, local governments may choose to offer yard trimmings collection on a subscription basis. Under a subscription-based plan, residents may choose whether to enroll in a curbside collection program for an additional fee. On the contrary, in citywide programs, all residents a receive service as part of the base level of service, and the cost for the service is included in the monthly base rate. Citywide programs result in a lower cost per home than subscription-based programs because of improved collection efficiency and the ability to spread the cost of the service over a greater number of units.
- **Limit collection frequency.** Frequency of collection also impacts costs, as described above, with more frequent collection being more costly. Some communities are able to limit the cost of yard trimmings collection by providing the service every other week.
- **Implement set out limits.** If set outs are unlimited, then during peak generation times, routes may be less efficient than during lighter generation periods. In addition, if using a contracted service provider for yard trimmings collection, unlimited set outs makes it difficult for the contractor to accurately predict the cost of service. Contractors may make pricing for service more conservative (e.g., higher) if no set out limits are in place.
- **Local governments provide carts.** Local governments can lower the cost to the resident of yard trimmings collection by purchasing carts directly instead of requiring the hauler to provide them. Rolling carts for yard trimmings collection

cost between $45.00 and $55.00 per cart. If local governments purchase carts directly, as opposed to the hauler providing the carts, it can significantly reduce the cost to the residents as reflected in the solid waste fee. Local governments are typically able to obtain a lower cost of capital to finance the containers. In addition, local governments may finance the cost of the containers over the useful life of the container (10 to 15 years), whereas haulers will need to finance the cost of the containers over the life of the contract (often five to seven years). Last, haulers understandably need to earn a rate of return on the purchase of containers, whereas local governments will only need to recover the direct cost.

- **Minimize hauling distance.** Another factor impacting program costs is distance to the processing site. In some cases, organics are transferred into long-haul trailers to be delivered to large-scale processors located relatively far away. Transfer and delivery to a distant facility add to costs, as does direct-haul transport to relatively farther sites. If hauling distance prohibits the development of a yard trimmings program, local governments may consider working with the private sector to develop a processing site in the area.

3.4 Curbside Food Scrap Collection

Many communities in the H-GAC region and in Texas have developed successful residential yard trimmings diversion programs. For these communities, the opportunity may exist to enhance residential diversion by including food scraps in existing residential yard trimmings programs. This is an approach that is being used by many communities on the West Coast as well as in Canada.

This section provides an understanding of the best management practices for integrating food scraps into existing residential yard trimmings programs for communities in the H-GAC region. Before communities consider this practice, it will be important to take note of the following:

- Most communities that have developed successful curbside food scrap collection efforts had very successful, mature yard trimmings programs in place. Therefore, it is important for communities in the H-GAC region to fully develop yard trimmings programs before taking the next step into food scrap collection.
- Some communities that have incorporated food scrap collection into their yard trimmings collection program have had to increase the frequency of collection of organics to weekly. However, in some cases communities have been successful at reducing the frequency of rubbish collection and/or the collection of recyclables to every-other-week.
- With the exception of the northern portion of the area, there is currently a lack of composting infrastructure in the H-GAC region that would make it challenging for any community to implement an organics program incorporating residential food scraps.
- Even if communities anticipate that it will be a long time before they are able to implement residential food scraps, steps can be taken to ensure that yard trimmings

programs are developed in such a way that food scraps and other organics can be smoothly integrated into the program in the future.

3.4.1 Materials

Food Scraps

The types of materials included in a curbside food scraps program depends upon the operational capabilities of the processing facility being used. Organics collection programs can potentially include all food scraps that can are generated by residential households, including:

- Fruits and vegetables;
- Pasta and bread;
- Egg shells, seafood and shells;
- Meat and fish (including bones);
- Dairy products; and
- Coffee grounds, filters, and tea bags.

Paper

Organics collection programs can also include food-soiled paper, including the following:

- Pizza boxes;
- Take-out containers and cups; and
- Paper towels and napkins.

Although food scrap programs can be very inclusive with materials that are accepted, very few curbside food scrap programs in the United States are able to accept pet waste (including animal bedding), diapers, or sanitary products due to the risk of pathogens and plastics contamination (in the case of diapers and sanitary products). In addition, most programs are not able to accept palm fronds. It is important for local governments to work closely with the processor before beginning a food scraps program to ensure that both parties understand what materials are acceptable.

3.4.2 Containers

Many residential food scrap collection programs enhance the convenience of separating food scraps by providing residents with curbside containers as well as smaller containers in which to temporarily store food scraps in the kitchen.

Interior Collection Containers

Most local governments with food scrap programs provide each resident with a household kitchen pail. The household container is usually a small one-to two-gallon bucket with a sealable lid, which is placed in the kitchen to hold scraps generated each day. Residents may be asked to use biodegradable plastic liners or may be instructed to not use liners. If liners are to be used, the local government should ensure that they:

- Have been tested and are successfully biodegrade;
- Are acceptable to the processor; and
- Are conveniently available with local retailers.

Some local governments do not allow the use of plastic liners due to consumer confusion with conventional plastic. These communities encourage residents to use compostable boxboard or newspaper to line their kitchen pails. In addition, some local governments encourage residents to use aseptic containers (e.g., gallon ice cream containers, paper milk cartons) to collect food scraps before placing them into the kitchen pail. This keeps food scraps contained and minimizes required cleaning.

Figure 3-3: Kitchen Pail (Source: Rehrig Pacific)

Figure 3-4: Kitchen Pail (Source: Norseman Environmental Products)

Curbside Collection Containers

Using carts represents the best management practice for collecting residential food scraps. It is important for food scraps to be containerized with a lid to minimize potential issues with odors, vectors, and other nuisances. Much like with automated recycling and refuse, there are many options for cart sizes, including the following.

- **12-gallon cart:** This size is used if only food scraps are collected in the container. These carts may work well in communities that use compostable paper or plastic bags for yard trimmings. The carts may be placed alongside yard trimmings and collected using a semi-automated collection vehicle.
- **32-to 95-gallon cart:** These sizes of carts are more suitable for communities that intend for residents to place yard trimmings and food scraps into one container. The appropriate size depends on the needs and preferences of the community; for instance, communities that generate large quantities of yard trimmings may wish to offer a 64 or 95-gallon container. It is important to note that food scraps can be heavy as compared to yard trimmings; because of this, local governments may wish to implement weight limits for the carts depending on size (much like in many solid waste ordinances). The weight limits would depend on the capabilities of the collection vehicle.

Many communities find that, because residents have different needs and space constraints, it is helpful to make different-sized carts available under a pay-as-you-throw rate structure. In other cases, local governments plan to provide residents with a "default" cart (e.g., 65-gallon), but send residents a post card that they can return requesting an alternative-sized cart (e.g. 32-gallon).

To Line or Not to Line

Lining in-kitchen food scrap containers as well as larger, outside organics carts with plastic liners can make food scrap composting seem much more palatable to residents and can reduce the frequency of cleaning containers. However, if plastic liners are used, food scraps must be de-bagged at the compost facility. Some communities allow biodegradable plastic liners, but they can look like regular plastics, causing confusion for residents and contamination for processing facilities. Further, they can be somewhat costly, and residents may be tempted to use less costly or "free" plastic bags available in the produce section at the grocery store. Another option is to allow residents to use biodegradable paper bags, newspaper or boxboard to line their containers. This method may not be as effective at preventing leakage into the container, but compared to plastic and biodegradable plastic, helps avoid contaminants at the processing site. The City of Burnaby, British Columbia includes step-by-step instructions on their web site for residents to create a liner out of newspaper. See these instructions at the following link:

http://www.city.burnaby.bc.ca/__shared/assets/Food_Scraps_brochure6338.pdf

3.4.3 Collection System Design

Below is a discussion of options for collection vehicles and frequency for communities that have three collection streams – refuse, recycling, and organics (including food scraps). In addition, this section provides a brief overview of a two stream (i.e. "wet/dry") collection system.

Typical Three Cart Collection System

Most communities in the United States and Canada that have residential food scraps collection have implemented a three-cart system – refuse, recycling, and organics. There are many options for a collection system that collects all three streams. Although food scraps must be collected weekly for health and safety purposes, especially in a warm climate like the H-GAC region, there is flexibility in collection frequency for recyclables.

In communities that have weekly organics collection, recyclables are typically collected either weekly or every other week. Both weekly and every other week are consistent with best management practices for collecting recyclables. Factors to consider when deciding on collection frequency of recyclables include the following:

- **Size of containers** – Large recycling containers (e.g. 90-gallons and above) are more easily collected every other week.
- **Cost** – Limiting collection frequency for recycling can reduce cost to the customer.

- **Customer education –** An every other week schedule for recyclables requires a commitment to customer education and communication. If the program is perceived as "too complicated," participation may be reduced.

Every Other Week Refuse

Some communities that have developed comprehensive organics collection programs (e.g., including most or all putrescibles) have been able to successfully reduce the frequency of curbside collection of refuse to every other week, offsetting some collection costs of the organics program. The City of Toronto is an example of a city with every other week refuse, as described in the text box below.

Reducing refuse collection frequency to every other week represents a drastic change from the status quo of how waste is managed. Therefore, before a local government implements every other week refuse collection, they must ensure the following.

- **High participation in food scraps recycling.** Residents must participate in food scrap recycling in order to set out refuse once per week. Once organic materials are removed from the refuse stream, what is left in the refuse is dry debris that is suitable for every other week collection. It is critical for local governments to ensure high participation in organics recycling before implementing every other week refuse. In some communities, with appropriate enforcement actions, may be necessary for every other week refuse to be feasible.
- **Ability to accept all organics.** If every other week refuse is implemented, the weekly organics program must have the capability to accept all residentially generated organic materials. This includes materials that may not be accepted at all composting facilities, such as meats, dairy, diapers and pet waste.
- **Pilot program success.** Local governments in the H-GAC region should conduct pilot programs before implementing every other week refuse. There are no current examples of local governments with every other week refuse in warmer climates. Therefore, communities in the H-GAC region should also be aware of any future efforts by other communities to reduce refuse collection frequency in warm areas in the United States.

Organics Collection in Toronto

The City of Toronto (Ontario, Canada) has a three-stream waste collection program in place. Residents receive weekly collection of "almost all" organics (including soiled paper, pet waste, diapers, all food scraps, yard trimmings, and sanitary products). The organics are collected in a split-body vehicle. The other side of the vehicle is used to collect, on alternative weeks, single-stream recyclables and rubbish for disposal. Therefore, trash and single-stream recyclables are collected every-other-week, while organics are collected on a weekly basis. Yard trimmings are collected separately, on a variable schedule depending on the season. Yard trimmings are delivered to a separate processing facility, and processed in a different fashion than the "green bin" organics.

Wet/Dry Collection Systems

Some communities in Canada and in California have taken a two-stream approach to organics management. In these two-stream systems, often called "wet/dry" systems, residents set out material in two streams. The wet stream is the organic fraction of the waste stream that includes food scraps, food soiled paper, yard trimmings, and other organics. The dry stream includes all remaining debris after the organic fraction of the waste stream is separated, including traditional recyclables (e.g., paper, plastic, metal cans) as well as materials traditionally disposed as refuse.

In a wet/dry collection system, the wet stream is transported to a composting facility. The dry stream is taken to a materials recovery facility that sorts recoverable material from material that cannot be recycled. The residuals from both the composting facility and the material recovery facility are disposed.

There are several advantages to a wet/dry system, including the following:

- No materials are directly disposed, as they are all sorted for recovery;
- Potential to achieve very high recycling rates; and
- Increased convenience to the resident that only has to sort materials into two streams.

However, there are also some significant disadvantages to a wet/dry program, including, but not limited to, the items listed below.

- Facilities to sort mixed municipal solid waste (dry stream) are limited. Specifically, R. W. Beck did not identify any similar sorting facilities in the H-GAC region.
- The public is accustomed to separating recyclables from other dry debris. Implementing wet/dry collection would require significant education and communication efforts.
- There are few communities that have implemented wet/dry systems, especially in warm climates. R. W. Beck identified two communities in the United States utilizing this collection system (Portola Valley, California and Woodside, California). [2]
- Processing costs are higher for composting as well as the material recovery facility.
- Recyclables and organics would be of lower quality than in traditional, three stream programs.

Because of these reasons, and because many communities in the H-GAC region have made significant investments in source-separated recycling programs, R. W. Beck does not recommend that H-GAC communities pursue wet/dry programs for organics management. Table 3-5 shows a summary of the collection scenarios to collect three material streams.

[2] Source: *"5-year Audit Program Assessment Revised Final Report,"* Alameda County Source Reduction and Recycling Board, January 2008.

Table 3-5
Collection Scenarios for Three Material Streams

Scenario	Refuse	Recycling	Organics *(Incl. Food Scraps)*
Weekly Refuse *Example: Alameda County, California (17 jurisdictions)*	Weekly	Weekly or Every Other Week	Weekly
Every Other Week Refuse *Example: City of Toronto, Ontario (Canada)*	Every Other Week	Weekly or Every Other Week	Weekly
	Alternating Every Other Week – Shared Vehicles		
Wet/Dry Program *Example: Woodside, California*	Managed as One “Dry” Stream Weekly/Every Other Week		Managed as “Wet” Stream Weekly

3.4.4 Collection Vehicles

This section discusses food scraps being integrated into existing residential yard trimmings programs. Adding food scraps to these programs typically does not require a change in vehicle types. A discussion of vehicles for yard trimmings collection can be found in Section 3.3.3.

3.5 Source Reduction

Source reduction methods are an important aspect of any municipal organics management program. Source reduction can reduce the amount of material that must be collected and processed, which reduces overall cost. The reduction of solid waste is higher on the waste hierarchy than recycling and composting.

The following describes two strategies for residential source reduction that can be incorporated into a municipal organics program on a voluntary or mandatory basis.

Grasscycling

Grasscycling involves the practice of leaving grass clippings on the lawn instead of collecting material after mowing. It simply involves removing the grass catcher from the lawnmower, and mowing when the grass is dry to prevent old clippings from clogging up the mower, and to keep blades sharp. These clippings rapidly decompose and provide numerous benefits such as:

- Limiting the number of trips collection and distribution trucks must make to haul materials, thus decreasing associated pollutants;
- Decreasing costs associated with the collection and processing of clippings;
- Eliminating the opportunity for grass clippings to uncontrollably release ammonia and possibly methane under anaerobic conditions prior to reaching the final disposal site;
- Increasing the quantity of nutrients that is returned back to the soil; and

- Reducing the need for fertilizer and land watering.

Backyard Composting

Backyard composting is promoted in many communities across the United States, and is generally considered to be a waste reduction (vs. recycling) activity, since it prevents organics from entering the municipal solid waste stream.

There are several backyard composting containers commercially available that make composting relatively easy (some allow for easy rotation of the contents of the compost bin), and instructions for backyard composting are easy to find. Alternatively, residents can construct their own simple, yet effective backyard composting bins at a low cost.

In general, backyard composting is ideal for:

- Yard trimmings;
- Vegetative kitchen scraps;
- Cow or horse manure;
- Dryer lint;
- Wood;
- Fireplace ash; and
- Paper.

It is recommended that backyard composters avoid the following materials. [3]

- Coal or charcoal ash – Might contain substances harmful to plants.
- Dairy products (e.g., butter, milk, sour cream, yogurt) and eggs – Create odor problems and attract pests such as rodents and flies.
- Diseased or insect-ridden plants – Diseases or insects might survive and be transferred back to other plants.
- Fats, grease, or oils – Create odors and attract pests such as rodents and flies.
- Meat or fish bones and scraps – Create odor problems and attract pests such as rodents and flies.
- Pet wastes (e.g., dog or cat feces, soiled cat litter) – Might contain parasites, bacteria, germs, pathogens, and viruses harmful to humans.
- Yard trimmings treated with chemical pesticides – Might kill beneficial composting organisms.

Large-scale composting facilities often include some of the materials that are backyard composters are cautioned to avoid, however large-scale composting operations have more technical expertise, monitor the compost, and often use technology to help ensure that potential issues are avoided.

[3] U.S. EPA, “Create Your Own Compost Pile” as accessed on August 5, 2010.

Section 4
NON-RESIDENTIAL COLLECTION OF ORGANICS

4.1 Overview

In approaching organics diversion, specifically collection and composting of food scraps, many communities have focused efforts on non-residential (i.e. commercial) generators. Larger generators allow local governments to source potentially large amounts of material while dealing with a small number of customers. In addition, communities can work closely with commercial customers to ensure that food scraps received are clean and free of contamination.

This section describes best management practices for collection of organic materials from commercial generators. R. W. Beck would note that there is currently limited infrastructure in the region for commercial food scraps composting. Nature's Way, in Conroe, Texas, is the only facility identified by R. W. Beck in the region that is able to accept food scraps from commercial generators. Therefore, in order for commercial organics recycling to grow in the region, additional processing capacity is needed, specifically in the southern portion of the region.

4.2 Materials

4.2.1 Types of Materials

As previously mentioned, this section primarily focuses on non-residential collection of organics. Non-residential organic materials can include the following:

- Food scraps;
- Non-recyclable paper (including compostable food service ware, bathroom paper towels, coffee filters and coffee cups, etc);
- Compostable plastics; and
- Yard trimmings.

Typically, non-residential organics are collected commingled (e.g. paper, compostable plastics, and food scraps in one container). Material may be bagged or loose, as discussed in Section 4.4.2. Yard trimmings may also be commingled with organics. However, oftentimes commercial entities will utilize landscape contractors. If this is the case, landscape contractors will typically be charged with managing yard trimmings generated from the landscaping activities. Therefore, yard trimmings may be managed separately, depending on the site.

4.2.2 Pre-Consumer and Post-Consumer

Commercial organics, specifically food scraps, are also defined as being pre-consumer or post-consumer. Pre-consumer food scraps include materials that are generated from kitchen preparation work or food product manufacturing. In other words, the material does not come into contact with the consumer before being collected for composting. Post-consumer food scraps consist of plate scrapings and other food that has come into contact with the consumer. For instance, in a restaurant, food scraps generated by chefs and other food preparers would be considered pre-consumer. Food scraps generated by plate scrapings at the dishwashing station would be considered post-consumer.

When developing a non-residential collection program, it is important for local governments to identify whether they are sourcing pre-or post-consumer food scraps. Post-consumer food scraps are much more likely to be contaminated with glass, plastic, and other non-compostable material that may have been commingled with the food when served. In addition, composting facilities may not be willing to accept post-consumer food scraps due to potential issues with contamination. Last, pre-consumer food scraps requires training of food service professionals, whereas post-consumer food scraps may require education and training of a much wider audience. Local governments and commercial entities may consider implementing a phased approach to food scrap recycling in which pre-consumer food scraps are targeted, with future planned expansion to post-consumer. This is the approach used by a Texas Instruments campus in Plano, Texas, as described on page 4-12.

4.3 Potential Generators

There are countless potential generators of commercial organic materials. Listed below are the types of generators that commonly participate in organics recycling in Texas and other areas of the United States.

- Colleges and universities with large student dining facilities
- Convention centers
- Farming and agriculture
- Food and beverage product manufacturing
- Grocery stores
- Hospitals with large dining facilities
- Hotels
- Office buildings and corporate campuses
- Prisons
- Restaurants
- Schools and school districts
- Sports arenas and stadiums

Before initiating a program, local governments should identify possible generators of commercial organics, including, but not limited to, the types of entities on this list.

4.4 Interior Collection

An important aspect of commercial organics collection is how the material is collected inside the facility at the point of generation. This Section describes the potential containers that may be used to conduct this collection.

4.4.1 Containers

Options

Several container options exist for the collection of organic material inside a commercial facility. These options are listed as follows.

- **One to five gallon buckets/pails.** These small, open containers can be utilized as interior collection containers for food scraps. They can be placed on the countertop during food prep for workers to place scraps. Although these containers have a limited capacity, the small size helps to prevent staff members from unintentionally overloading the container or liner, if applicable. A liner may not be necessary in all cases, as these containers can be easily cleaned in an on-site dishwasher or sink.

Figure 4-1: Small Pail for Food Scraps

Figure 4-2: Slim Jim Organics Container

- **Slim Jims.** Slim Jim containers are 23-gallon collection bins with a compact design. Slim Jims have a larger capacity than one to five gallon buckets, but are still small enough to prevent unintentional overloading by staff members. Furthermore, Slim Jim containers are available in wheeled designs for easy transfer of organics to exterior receptacles. Slim Jims are also short enough to easily fit underneath food preparation tables or stations.
- **Converted refuse containers.** When implementing an organics program, surplus refuse containers can be utilized to collect organics. With this in mind, a system of clear and concise labeling should be developed to help users unmistakably distinguish between organics and refuse containers.

- **Automated carts.** Systems which utilize automated carts can take advantage of the fact that these containers can be transported from the interior to the exterior without removing the liner or transferring the organic contents. The contracted waste hauler can then easily collect organic waste from the automatic cart. However, because these containers can be large, some ergonomic challenges and decreases in efficiency can be created if workers are not able to scrape food scraps from the countertops directly into the cart. In addition, some facilities may not be able to use carts due to interior space constraints.

Figure 4-3: Automated Cart for Interior Collection

Advantages and Disadvantages

Table 4-1 provides a summary of the different container options, including advantages and disadvantages.

Table 4-1
Comparison of Interior Collection Containers for Non-Residential Customers

Container	Advantages	Disadvantages
One to Five Gallon Bucket/Pail	▪ Easily transportable for personnel ▪ Can be placed on the counter for use by food prep personnel ▪ Can be washed in an on-site dishwasher or sink ▪ Smaller size prevents overloading of container with excess weight ▪ Differentiable from refuse containers	▪ Difficult to commingle bulky organics, such as plants, cardboard, or paper ▪ Not typically used for post-consumer food scraps ▪ May not be used as collection container for hauler
Slim Jim Container	▪ Size (23-gallon) is consistent with compostable liners ▪ Available with rollers to ease transport to outdoor receptacle ▪ Smaller size prevents overloading of container with excess weight ▪ Shorter height allows for food to be scraped off of food prep table	▪ Difficult to commingle bulky organics, such as plants, cardboard, or paper ▪ May not be used as collection container for hauler

Container	Advantages	Disadvantages
	▪ Differentiable from refuse containers	
Converted Refuse Container	▪ Similarity to refuse program makes organics diversion seem simple ▪ Larger size allows for commingling of bulky organics ▪ Low cost option, as surplus refuse containers will exist with implementation of organics program ▪ Available with rollers to ease transport to outdoor receptacle	▪ Potential confusion with refuse container increases potential for contamination ▪ Greater level of signage and employee communication is needed
Automated Cart	▪ Can utilize same container for interior and exterior collection ▪ Larger size allows for commingling of bulky organics ▪ Rollers to ease transport to outdoor receptacle	▪ Carts can be taller than food prep tables ▪ Carts can be too large for use by some generators ▪ Larger liners are needed for carts than for a typical interior container

Factors to Consider

There are many factors that should be considered when a selecting interior collection containers for commercial generators of organics. Some of the key factors that should be considered are as follows.

- **Point of generation.** It is important to focus interior collection efforts on those areas where organic materials are generated, such as kitchens, banquet rooms, landscaping areas and cafeterias. Bins should be suited to the point of generation. For instance, buckets or pails may be suitable for kitchen collection; however, larger containers may be needed for collection in cafeterias or at dishwashing stations.
- **Co-location of refuse and organics containers.** Organic collection bins should be placed next to waste and recycling bins whenever possible. This minimizes cross-contamination in all bins and, if designed correctly, minimizes waste disposal.
- **Cost.** Generators should consider re-purposing existing waste bins as organics bins. Paint, signage or lids may be used to distinguish them from waste bins.
- **Employee safety.** Smaller buckets or countertop bins can be used to capture food scraps from kitchen prep or bussing stations. These bins are easier to maneuver and provide better ergonomics for personnel handling food scraps.
- **Exterior collection needs.** Bins designed for indoor use are often not effective in outdoor environments. For instance, they are often not durable enough to withstand outdoor conditions, precipitation, or other problems.

4.4.2 Container Liners

When it comes to bag liners for collection containers, there are several options available for an organics collection program.

- **Bagless.** If no liner is used, bins must be cleaned regularly to minimize potential issues with odor and pests. This is the least expensive option but requires labor to maintain the bins. Some generators have an outdoor area with water connection where containers are rinsed each time they are emptied. In addition, small buckets may be cleaned in a dishwasher or sink.
- **Conventional plastic liner.** Once materials are collected in a plastic liner, the contents must be emptied in the organics dumpster or other collection container and the liner must be disposed separately in the waste dumpster. This option keeps containers clean and does not require purchasing changes, but can pose ergonomic challenges at the dumpster and may add labor. For instance, if dumpsters are located in separate areas, staff spend time taking liners from the organics to the waste dumpster.
- **Kraft paper bags.** These bags are typically used for collection of yard trimmings but can also be used to line food scrap collection containers. However, if Kraft bags are used, R. W. Beck recommends that the material holding time not exceed two days.
- **Compostable plastic liners.** This option involves some up-front work on purchasing decisions, but minimizes labor as the liner keeps the container clean and is tossed into the organics dumpster along with its contents. Performance is improving with these liners; however, they typically cannot hold the same weight as a conventional plastic liner. Generators should also confirm with the hauler and/or processor that compostable bags are acceptable at the composting facility.

Compostable plastic bags are optional for commercial food scrap collection. However, using compostable bags for collection drastically improves the cleanliness interior and exterior collection containers and prevents public health and nuisance issues from occurring as a result of the program. **If compostable plastic bags are acceptable to the composter, and a generator is able to afford the increased cost, compostable plastic bags are recommended for commercial organics collection.**

4.5 Exterior Collection

The following section describes best management practices for exterior collection of non-residential organics. Exterior collection includes the docking area, containers, vehicles, and collection frequency.

4.5.1 Docking Area Design Considerations

Area Requirements

The docking area refers to the outdoor area where collection containers – such as carts, front-load containers (e.g., dumpsters), and roll-offs are placed for collection by the collection vehicle. In order for an organics recycling program to be successful, there must be adequate space in the docking area for the type of container used for collection. Table 4-2 shows the area requirements associated with docking areas for carts, dumpsters, and roll-off containers.

Table 4-2
Area Requirements for Organics Docking Areas

Area Requirement	Cart (96 Gallon)	Front-Load (6 CY)	Roll-Off (20 CY)
Footprint	3 – 4 square feet	30 – 40 square feet	175 – 200 square feet
Vertical Clearance	15 – 25 feet	15 – 25 feet	25 – 30 feet
Vehicle Access	30 – 40 feet long, 10 – 15 feet wide	30 – 40 feet long, 15 – 20 feet wide	40 – 50 feet long, 15 – 20 feet wide

Design Considerations

In addition to meeting the area requirements, the following factors should be considered in the design and planning of an outdoor docking area.

- **Aesthetics** – Ideally, organics collection containers should be stored out of view of customers and neighbors. In addition, it is helpful to construct enclosures for containers as a visual barrier.
- **Accessibility** – The docking area should be accessible for the employees that will be required to handle material. Docking areas should be located as to minimize the distance from the point of generation to the point of collection.
- **Safety** – Safety features, such as ramps and mechanical lifts, should be used to minimize the risk of employee injury due to handling of heavy material.
- **Cleaning** – If necessary, the docking area should include access to water for frequent container cleaning.

Figure 4-4: Docking Area with Ramp and Vehicle Access

4.5.2 Containers

Options

Several container options exist for the collection of organic material on the exterior of a commercial facility. These options are listed as follows.

- **Automated carts.** Carts may be used for smaller generators of food scraps as well as generators that have limited docking space. As previously mentioned, carts may also be used for interior collection. In addition, carts can be advantageous because, if needed, they can be stored in refrigerated space until collection day to prevent degradation of material. It is important to ensure that automated carts do not exceed weight limits. Customers should consult their hauler to ensure that carts are an appropriate weight.

  If generators plan to collect primarily food scraps in their cart, it is recommended that the size not exceed 64 gallons, as the carts are not able to be maneuvered if they get too heavy. 32 or 64 gallon carts are recommended for food scrap collection. Larger carts may be used if for high quantities of compostable paper or other bulky organics.

Figure 4-5: Automated Cart for Organics Collection

- **Front-load containers.** Front-load containers, the typical container that is used to collect commercial refuse, may also be used for organics collection. Typical front-load containers for organics are one to four cubic yards. Bulky organics may be included due to greater volume. However, dumpsters must be frequently cleaned if designated for organics. In addition, some customers may have space constraints, especially if they already have designated containers for trash and recycling.

  Some haulers have utilized plastic front-load containers, as opposed to metal, for organics collection. Plastic dumpsters are beneficial because they do not corrode due to organic contents like metal containers. However, plastic containers may not be as durable as metal containers, and can be more easily damaged from repeated contact with concrete. Metal and plastic containers are suitable for organics collection and consistent with best management practices.

Figure 4-6: Front-Load Container for Organics Collection

- **Roll-offs.** Roll-off containers may be used for extremely large generators such as hotels, industrial food processors or manufacturers, large supermarkets, or other large generator of organics. Roll-offs for commercial organics must be covered. Roll-offs are beneficial to haulers because they do not need a full route to be able to provide the service. In addition, roll-off containers are more easily sealed and can be cleaned each time they are collected. However, roll-offs for food waste should not exceed 25 CY. Larger roll-offs are too heavy to be transported due to the weight of food scraps. If needed, compactors may be used.

Figure 4-7: Roll-Off Container for Organics

Advantages and Disadvantages

Table 4-3 provides a summary of the different container options.

Table 4-3
Comparison of Exterior Collection Containers for Non-Residential Customers

Container	Advantages	Disadvantages
Automated Cart (32 to 64 gallon)	▪ Used for interior and exterior collection ▪ Can be stored in refrigerated space ▪ Good for small generators or space-constrained customers ▪ May be cleaned by generator as needed, as opposed to hauler	▪ More difficult to include bulky organics ▪ Food scraps can exceed weight limits for automated arms or tippers; customers should consult haulers on weight limits
Front-Load (1 to 4 CY)	▪ Can accommodate bulky organics ▪ Once per week collection efficiency is achievable; can be collected up to seven times per week ▪ Consistent with typical refuse containers for commercial customers	▪ Employees may be required to lift material overhead to dispose in dumpster ▪ Some customers may not have space to accommodate additional container ▪ Must be removed for cleaning
Roll-Off (15 to 25 CY)	▪ Works well for large volume generators ▪ Haulers do not need a full route to provide service ▪ Container can be cleaned and/or replaced after each use ▪ Containers are easily sealable	▪ Not suitable for small generators ▪ Depending on volumes, container may be collected less frequently than once per week ▪ Roll-offs require a large footprint and adequate docking space

Factors to Consider

There are many factors that should be considered when a selecting exterior collection containers for commercial organics. Some of the key factors that should be considered are as follows.

- Containers of all types should be lockable to prevent vectors from being able to go inside of the container.
- Containers must be sealed. Many front-load containers have a plug in the bottom that can be removed. This plug should be in place for food scrap collection.
- Some customers choose to have smaller containers so that the container can be collected more frequently during the week. This option could potentially be more costly, but it is a more conservative option to prevent nuisance issues from occurring.
- Docking space may be the most important factor in determining which type of container to utilize. It is important to thoroughly assess docking space before procuring a service provider.

4.5.3 Frequency

Because of the putrescible nature of commercial organics, this material should typically be collected no less than one time per week. This level of collection frequency is especially important for the H-GAC region because of the warm climate.

Although once per week is the minimum recommended collection frequency, certain customers, based on location, preferences, or material generated, may prefer more frequent collection, especially in summer months. With commercial organics, it is better to have a smaller container collected more frequently than a larger container collected less frequently. For instance, a customer that generates six cubic yards of material per week would typically need a two cubic yard container collected three times per week instead of a three cubic yard container collected twice per week. Generators should weigh the cost of different service levels against the potential risk of having organics stored on site for a longer period of time.

Regardless of collection frequency, containers should be closely monitored by the generator to ensure that public health or nuisance issues do not occur as a result of the program.

4.5.4 Vehicles

Commercial organics collection can be accomplished with the same types of vehicles that are used for refuse collection: automated (or semi-automated) vehicles, front-load vehicles, or roll-off trucks. However, there are best management practices to be followed in terms of vehicle maintenance, as described below.

- Trucks should be cleaned after each collection day in order to prevent buildup of material on the packer blade.
- Seals on the door of the vehicle should be water tight to prevent leakage in transit.

- Organics vehicles should not be shared with refuse or recycling operations. If glass, plastic, or other non-compostables are collected with an organics vehicle, it can contaminate future loads, even if the materials are never commingled.

4.6 Cost Drivers

In many cases, service providers for commercial organics collection have created rate structures that provide incentive for customers to participate. Many companies aim to make organics collection less costly than equivalent refuse collection in order to offer customers a cost savings for participating in the program.

However, there are many factors that may cause organics collection to be more costly than comparable refuse collection, including the following:

- Organics containers may need to be more frequently cleaned than typically refuse containers.
- Composting facilities may represent a longer haul distance than a landfill or transfer station.
- Because organics collection in the H-GAC region is not fully developed, haulers may have lower collection efficiency due to excess capacity on-route.
- If plastic front-load containers are used, as opposed to metal containers, it can represent an additional cost.
- Customers may request for more frequent collection of material in order to prevent potential public health, odor, or pest issues.

Corporate Food Scraps Diversion

Texas Instruments Campus in Plano, Texas

The TI campus in Plano is approximately 937,000 square feet with between 800 and 900 employees on-site. The cafeteria serves breakfast and lunch to employees. Based on extensive diversion efforts for multiple material streams, the campus has achieved a diversion rate of 78 percent.

An increasingly important aspect of the campus diversion program is the diversion of food scraps from the campus cafeteria. TI focuses food scrap collection efforts on pre-consumer food scraps generated by meal preparation activities. All food scrap items, including produce, meats, fish, oils, and dairy, are collected as part of the program. TI is moving toward integrating post-consumer food scraps into the collection system. In anticipation of this transition, TI has converted all serviceware in the kitchen area to compostable paper and bioplastic products.

TI utilizes 96-gallon carts provided by the City of Plano for interior and exterior collection of food scraps. Empty carts are wheeled into the food prep area at locations convenient for kitchen staff. When full, kitchen staff wheel the carts down a ramp adjacent to the kitchen to the outdoor collection area. The City collects carts from this location five days per week.

TI utilizes biodegradable plastic bags to line collection containers. These bags represent a significant expense for the program, costing between $0.85 and $1.30 per bag, depending on the vendor and the quantity purchased.

TI fills an average of two carts per day of food scraps. At the beginning of the program, they filled an average of six carts per day. However, participation in the program enabled them to identify ways to reduce food waste generated and become more efficient in food preparation activities. TI staff estimate that this program results in about five percent waste diversion for the campus.

4.7 Other Keys for Success

Taking the time to design the proper organics collection infrastructure is critical to the success of any program. However, to ensure continual success of a program, several approaches can be utilized. The following sections describe these approaches, which are critical aspects of an effective organics collection program.

4.7.1 Program Manager

The program manager is the person on-site at the generator that oversees and "champions" an organics recycling program. Program manager responsibilities include monitoring organics collection activities, ensuring that employees and volunteers are well trained regarding program details, and tracking and reporting the results of the program to company leadership and staff. In R. W. Beck's experience, the most successful commercial organics diversion programs are those that have strong program managers in place to continually advocate for the program at all levels of the organization.

4.7.2 Waste Audit

Conducting a waste audit is an important step in the process of developing an organics program. The goal of the waste audit is to determine the amount of organic material generated to ensure that an adequate number and size of interior and exterior containers are provided for collecting material. The waste audit information is also used as a baseline to measure the program's success and areas for future improvements. Simple instructions for conducting a waste audit are as follows.

- **Set aside waste.** Custodial staff or collections contractors should be instructed to set aside waste from at least one day of regular business operations. This waste should be placed on an open tarp or tarps.
- **Measure the volume of waste.** The length, width and height of the pile should be recorded to determine the total volume of waste examined.
- **Note number of hours or days over which waste was collected.** This information allows the waste auditor to extrapolate waste amounts for a longer time period.
- **Open the bags of waste.** The bags of waste can be split open using a box cutter and can either be emptied on the tarp or examined within the bag. Examining waste within the bag allows for easier clean-up, but may be more difficult to visually inspect.
- **Photograph waste.** Multiple photographs of the waste should be taken and should specifically note any materials of particular note (e.g., significant quantities of food scraps and other organic materials).
- **Note all materials present.** Waste types should be listed discretely as well as categorized into a broad material type (i.e. paper, plastic, metal, organic).

- **Estimate composition by volume for each material present.** Beginning with the most commonly present material, estimate visually its percentage by volume.
- **Repeat this process for each noted material.** The total of these percentage estimates should sum to 100 percent.

4.7.3 Staff Education and Training

Employee support and participation are essential to the success of any organics collection program. Program managers should identify the "spark plug" employees at the outset of the program, and leverage their interest and energy to help shape the program and inspire their peers. Employee-led efforts can take many forms, such as competitions between departments or parties that reward the highest levels of participation. Program managers should also find ways for employees to have fun, to gain a sense of ownership over the organics program details, and recognize them for the program's success.

Staff members tend to respond better to the new program when managers demonstrate that the program is important to the institution. It can be useful to post information about the program for customers and others, such as vendors, to see. It is important to make sure that all staff members—from purchasing to food service to housekeeping to custodial to security—are aware of the new program and the cultural change expected.

Staff training which results in a sustainable change in organizational behavior with respect to materials handling is critical to program success. Thorough training should be completed before the program commences and should continue as new staff members are hired. Annual re-fresher training, similar to other annual compliance training sessions, can be very helpful. Adding language about waste and recyclable and organic materials management to written job descriptions can help to reinforce this training.

4.7.4 Management Support

Approaching institutional management early on in the planning process to solicit their buy-in and ideas for the program is a key for success. By demonstrating the financial, environmental, and social benefits of the program, the program managers can connect it to the institution's mission or other important organizational or strategic values. Program managers should also encourage institutional managers to participate in a kick-off or launch event with employees. It is also important to demonstrate the applicability of this activity if the institution is engaging in any Leadership in Energy and Environmental Design (LEED) programs.

4.7.5 Program Evaluation

Throughout the life of the organics collection program, the program staff members should continue to monitor and provide feedback on the quality of the organics collected. Once the program is well established, monitoring, quality control and periodic re-fresher or spot trainings as necessary, become the key aspects to maintaining program effectiveness. New habits take time to become second nature, so a long-term commitment will be necessary to ensure that the cultural change at the facility has occurred.

Suggested strategies for optimizing performance of the institution's organics program include the following:

- **Conducting facility walk-throughs.** This involves walking through the institution's facilities regularly to examine the program in action. The examination should include notes regarding activities that seem to be working well and those that need improvement. Further feedback can be attained by asking customers or guests what they think of the program.
- **Auditing containers**. Entails inspecting the inside and outside of the containers for odor or insect problems, spillage and leakage. The inspector should also take note of the condition of any applicable posters or stickers as well as whether correct materials are going into each bin. If contaminants are present, the inspector should also make note of what they are and, if possible, where they originate from.
- **Soliciting employee feedback**. This can be accomplished through a variety of approaches including conversations during routine walk-throughs, or even through the use of an "in-box" for comments, complains or suggestions. When directly inquiring employees, program managers should focus on where employees see success, what areas could be improved in the future, and what key challenges or obstacles are present in the program. Employees see the program from the inside, and often have a strong sense of seemingly minor ergonomic and logistical changes with respect to the handling of discarded materials that could improve worker productivity and sense of control. Leveraging this experience and utilizing this information can constructively and responsibly improve the organics collection program.

4.8 Resources

Following are resources related to non-residential organics collection.

- *"Organics Best Management Practices for Large Public Institutions,"* Houston-Galveston Area Council, August 2009,

  http://www.h-gac.com/community/waste/resources/default.aspx
- *"How to Conduct a Business Waste Audit,"* Houston-Galveston Area Council, http://www.h-gac.com/community/waste/resources/default.aspx
- *"Recycling Ordinances and Building Design Guidelines," North Central Texas Council of Governments, August 2009*

  http://www.nctcog.org/envir/SEELT/documents/Final_Report-Ordinances_Guidelines_August_2009.pdf

Section 5
DEVELOPING A PROCESSING SITE

5.1 Overview

Successful development of a composting site, whether by the public or private sector, can have a significant impact on the overall success of an organics program. The determination of an appropriate site location, and developing the site according to best management practices, enables a community or private company to avoid environmental, operational, and community relations issues that can occur.

This Section provides a comprehensive overview of regulatory, site development and design, and capital requirements to develop a composting site. This Manual is focused on windrow composting as the composting method; however, many of these requirements are applicable to any composting site, regardless of the composting method.

5.2 Regulatory Requirements

Following is an overview of the regulations that apply to composting facilities in Texas. The elements of regulation include statutes enacted by the Texas Legislature as well as specific rules addressing composting operations in the Texas Administrative Code. This section is meant to provide an overview of the regulations that must be considered when developing a composting site; this section is not meant to provide legal advice, counsel, or instruction on how to comply with relevant regulations.

5.2.1 Statutes

Statutes have been enacted by the Texas Legislature to regulate the general nuisance, pollution, and sanitation issues associated with the collection or stockpiling of waste. In addition, statutes grant the legal authority to local governmental entities to regulate businesses and to establish aesthetic standards. These statutes require that facilities operate according to certain guidelines, but do not provide many technical details or quantifiable regulations with which to judge compliance. The following Chapters are generally applicable to composting operations:

Health and Safety Code

- Chapter 341 – Minimum Standards of Sanitation and Health Protection Measures
- Chapter 343 – Abatement of Public Nuisances
- Chapter 365 – Litter

Local Government Code

- Chapter 215 – Municipal Regulation of Businesses and Occupations
- Chapter 234 – County Regulation of Businesses and Occupations

Water Code

- Chapter 26 – Water Quality Control

5.2.2 Rules

The Texas Commission on Environmental Quality (TCEQ) enforces rules delineated in the Texas Administrative Code (TAC). Specifically, TAC Chapter 30 Section 332 outlines the requirements for composting facilities. In addition, for exempt facilities, Sections 328.4 and 328.5 may apply.

Tiers of Regulation

The TCEQ has tiers of regulation that provide for various design and operational requirements depending on the type and amount of feedstock processed by a composting facility. Notwithstanding, all composting facilities must follow some basic requirements which denote limitations on storage as well as reporting and recordkeeping requirements. Specific regulatory requirements related to composting facilities are as follows.

- **Exempt Operations:** TCEQ requirements indicate that for facilities which only process source-separated yard trimmings, clean wood material, vegetative material, paper and manure, there is no need to provide a permit, registration or notification under the 30 TAC 332 composting requirements. However, these facilities must follow the requirements of an exempt recycling facility which denote the limitations on storage as well as the reporting and recordkeeping requirements.
- **Operations requiring notification:** Facilities that compost any source-separated meat, fish, dead animal carcasses, oils, greases or dairy materials must register a Notice of Intent to Operate a Compost Facility with the TCEQ 30 days prior to construction of the facility. Operational requirements for notification facilities include pathogen reduction by maintaining the temperature of the windrows at 55 degrees centigrade or higher for 15 days or longer with the required number of turnings.
- **Operations requiring registration:** Facilities that compost additional materials including, but not limited to, municipal sewage sludge must apply for a registration with the TCEQ. These facilities are also subject to more detailed location, operating, and reporting requirements than facilities requiring notification. Registration applications for these facilities include the submittal of a site operating plan and notification of the adjacent landowners. The registration applications must be certified by a Texas-registered professional engineer. Operational standards include the management of the 25-year, 24-hour rainfall event, access restrictions, the employment of a certified composting operator, and monitoring of the end-product based on compost testing requirements set forth in the rules.

- **Operations requiring a permit:** Facilities that compost mixed municipal solid waste (MSW) or grease trap waste must apply for a TCEQ permit for the composting facility. Permit applications for these facilities include the submittal of a site operating plan, drainage calculations, geologic information (based on soil borings), groundwater characterization, and notification of the adjacent landowners. The permit applications must be certified by a Texas-registered professional engineer. Operational standards include the management of the 25-year, 24-hour rainfall event, access restrictions, employment of a certified composting operator, and monitoring of the end-product based on compost testing requirements set forth in the rules. In addition, facilities requiring a permit must submit monthly and annual reports which detail the sampling and analysis of final product characteristics.

5.3 Site Considerations

This section describes site considerations such as buffer distance, site size, and infrastructure and utilities that must be accounted for when planning for a compost facility. Proper siting is a prerequisite to the establishment of a safe and effective compositing facility. Design requirements, and to some extent operations, are influenced by site conditions. Communities should take care in selecting a suitable site as a means of controlling design and construction costs and preventing operational problems over the life of the facility.

5.3.1 Location

Location is a key factor when beginning the planning process for a compost facility. Factors to be considered when selecting a compost site location include the following.

- **Accessibility** – It is important for the site to be convenient for retail and wholesale customers and sources of material.
- **Area –** Site must be large enough to contain a composting facility with the capacity to easily process projected volumes of material and to provide room for storage of the finished product.
- **Relationship between site and surrounding land uses** – Site should be adequately buffered from sensitive adjacent land uses such as residences, schools and parks.
- **Protection of surface and groundwater –** Site should be evaluated for its potential impacts on water. Of primary concern are proximity to wetlands, floodplains, surface water, and groundwater.

Accessibility

Accessibility of the composting location is important for the convenience of feedstock sources as well as end users and customers. Communities should assess the following aspects of any potential composting site:

- Impact of potential traffic on neighborhoods along the major delivery routes;

- Distance traveled to the site by residents and/or collection vehicles;
- Proximity to major thoroughfares and municipal collection routes;
- Location of utilities; and
- Availability of traffic signals and turn lanes.

Ideally, roadways servicing the composting facility would be paved, un-crowded thoroughfares through non-residential areas. However, local governments and private companies can alter operations to accommodate a site that is located among busier streets or within proximity to a high population area by scheduling feedstock deliveries during off-peak hours.

Area

It is critical that compost sites be adequately sized to allow for space to accept feedstock, process materials, store materials, and sell finished product. Space for maintenance, administrative offices, and other personnel should also be accounted for. Discussion of facility sizing is provided in Section 5.3.4.

Neighbors

One of the most important factors that must be considered when designing a composting facility is the impact on neighboring residents and businesses. It is common for compost facility neighbors to have concerns about odors and nuisances resulting from the site.

While it is ideal for compost facilities to be sited in a rural area with minimal neighbors, it may not be possible due to land availability. In addition, if compost facilities are too remotely located, it can impact the accessibility of the site, as described above.

The following list provides some strategies to consider when selecting a compost site location that will mitigate the impact of compost facilities on surrounding neighbors.

- **Use visual barriers.** It is true that oftentimes composting neighbors "smell with their eyes." Utilizing visual barriers, such as berms or landscaping, can not only improve the aesthetics of a site but can limit neighbors' potential negative perceptions. Site planning should incorporate buffer zones in keeping with surrounding areas. Fencing or landscaping can also be used to block direct view of compost operations.
- **Avoid sensitive neighbors.** While it may not be feasible to site a compost facility in a location with no neighbors, it is ideal to avoid siting a facility near areas that may be more sensitive to odors and nuisances. For instance, schools, residential areas, and public parks may be more sensitive to potential odors and nuisances than other industrial or agricultural operations.
- **Be aware of other odor-generating operations.** Siting a compost facility near other odor and nuisance generating operations can create situations in which neighbors perceive that a compost facility is generating issues that are attributable to other operations. Consider surrounding operations when selecting a compost

site and avoid siting near other operations that may create odors, dust, noise, or any other nuisances that may be attributed to the composting operation.

- **Use water to control dust.** Dust can be created on a compost site by vehicle traffic, tracking dirt onto roadways outside the facility, and handling compost materials that are too dry, including window turning. Controlling dust by watering roads and maintaining proper moisture levels within the compost will reduce this nuisance. In addition, some facilities have utilized crushed glass on interior roads and parking lots to reduce dust from traffic areas.
- **Mitigate noise.** Backup alarms on trucks and loaders and the operation of grinders, mulchers and windrow turners will have related nuisance noise. A community should establish standard working hours of operation for the compost facility, generally to coincide with the normal working day. Using muffling devices for machinery, enclosing some operations, providing distance between site and neighbors, and creating noise barriers will reduce the impact of noise on neighbors.
- **Consider site characteristics.** The facility planning process should include an evaluation of site topography and the direction and velocity of prevailing winds in relationship the site location. A facility should not be located upwind of a populated area unless controls are to be employed to limit dust, noise and odor problems that may develop, as discussed in Section 6.7.
- **Proactively communicate with neighbors.** An important part of a good neighbor strategy involves letting the public know the facility plans from the beginning. Plans should be descriptive and address potential problems and how they may be mitigated. Informing the public is a way to garner support for a project, determine the extent of opposition and identify possible changes that will allow the project to move forward in a positive atmosphere. In addition, compost facilities could consider providing neighbors with free product on an annual basis to facilitate a positive relationship.

Environmental Impacts

Environmental impacts are also an important consideration when siting a composting facility. Proper design and operation of a compost facility can control potential environmental impacts that may include air and water pollution, odor, noise, vectors, fires, and litter. Two important aspects of a site that must be considered are the soil structure and the surface and subsurface water sources.

The soil structure at the site should be evaluated by a geotechnical specialist to determine the potential for infiltration. If the site will have a considerable amount of impermeable pavement, the soil should be permeable enough to ensure that excess water can infiltrate the ground and does not pool at the surface (causing restricted vehicle access). However, if the soil is not found to be adequately permeable, specific drainage devices such as diversion channels and retention ponds should be utilized in the site design.

The location of the site as compared to surface and subsurface water sources must also be considered. Compost facilities should not be sited in a wetland, 100-year floodplain, or an area with shallow depth to groundwater. An acceptable buffer distance between the ground surface and the water table is approximately two to five feet.[1] This buffer distance aids in protecting the composting facility by lessening the chance that:

- The windrows will be washed away during periods of high precipitation;
- Pooling will occur, slowing the composting process; and
- Water reaches the water table without adequate filtering through the soil.

Buffer distances from water sources are recommended; however, a composting facility should be designed in such a way to avoid any issues associated with run off. R. W. Beck recommends utilizing water retention and storage ponds whenever possible.

5.3.2 Site Size

The site size for a municipal compost operation depends on the processing method (e.g., windrows, static pile) utilized at the facility as well as the type and quantity of feedstock. For an efficient operation, composting facilities should allocate space for all stages of the composting operation including pre-processing, processing and post-processing.

In addition, the following factors impact the size of a site that is needed for a compost facility:

- On-site structures, including scale-house, office buildings, or other structures;
- Equipment maneuvering and parking;
- Vehicular traffic patterns including queuing and parking;
- Feedstock storage;
- Curing and finished product storage;
- Drainage components such as diversion channels, holding ponds and infiltration areas;
- Buffer distances; and
- Future expansion areas.

Pre-Processing Area

A pre-processing area is needed for the following activities:

- **Delivery and storage of feedstocks:** The pre-processing area should include space for customers to deliver feedstocks and to store feedstocks that do not need to be immediately incorporated into the operation. In addition, for facilities that accept high nitrogen materials (e.g., food scraps, manure), the pre-processing area should have space for material to cover incoming loads with materials such as wood chips or finished compost.

[1] Source: Environmental Protection Agency, *Composting Yard Trimmings and Municipal Solid Waste,* May 1994

- **Volume reduction:** Chipping, grinding, and shredding operations to reduce feedstock particle size should be part of the pre-processing area.
- **Mixing:** Some composting facilities have mixing areas where materials are combined before constructing the windrows instead of mixing materials within the windrows.

The size of the pre-processing area depends on the type and quantity of materials processed as well as equipment that is used to process materials. In addition, if a facility is receiving a high volume of deliveries from large, commercial vehicles as well as a high number of deliveries from small landscapers and residents, there may be a need for two drop-off areas to avoid accidents.

Processing Area

The processing area includes the composting pad – where material is actively processed – and the curing area for finished product. The size of the composting pad and curing area are primarily dependent on the amount of material that the facility will receive as well as the expected processing time for a windrow.

One of the most important design considerations for the processing area is the ability to maneuver windrow turning equipment, front end loaders, water trucks, and other necessary equipment in the aisles between the windrows. This can be accomplished by planning aisles that are approximately 10 to 15 feet wide. However, different windrow turning equipment may have different design requirements. For instance, utilizing a straddle-type windrow turner enables windrows to be grouped in pairs five feet apart with 15 foot aisles between each pair. [2] Using a front end loader to turn windrows requires 15 foot aisles between each windrow. If a side-mounted windrow turner is used, the site should allow for 10 to 15 foot aisles. Communities should consult equipment specifications available from manufacturers of windrow turners during the design process of a composting pad.

Figure 5-1: Recommended Windrow Spacing of 10 to 15 Feet

[2] Source: Environmental Protection Agency, *Composting Yard Trimmings and Municipal Solid Waste*, May 1994

In addition to the composting pad, the processing area also includes a curing and temporary storage area. This area is utilized to store compost for the final phase of the composting process which allows the material to age and become more stable. The siting requirements associated with the curing and storage area are less sensitive than those required for the composting pad, as the curing material is much more mature than virgin compost and is not subject to as many runoff or groundwater contamination issues. However, the curing area should be upwind and upslope from the processing area to avoid potential contamination of the finished product.

In general, the curing and temporary storage area requires approximately one quarter of the area required for the composting pad, however this is subject to the length of time expected for compost to cure and whether there is any additional space needed for storage of finished product.

Post-Processing Area

The post-processing area includes infrastructure utilized to enforce quality control measures and for the storage of finished compost product. This infrastructure may include a blending operation, a bagging machine and storage for bulk compost. The post-processing area may also be combined with the curing area in some instances. In general, the area required for curing and storage can vary from 25 percent of the composting pad area to twice the pad area for compost with biosolids feedstock due to the length of time required for curing and stabilization.

Figure 5-2: Finished Compost Storage Bunkers

As a rough estimate, the approximate volume of material that will need to be accommodated in the storage stage can be calculated by multiplying the approximate daily volume of finished compost by the maximum number of days that the compost must be stored on-site. A general estimate of the daily volume of finished compost can be determined by multiplying the volume of daily feedstock by 50 percent.[3] However, total volume reduction of incoming feedstock during the compost process depends on the types of material accepted at the facility.

The space needed for storage areas can be determined by dividing the approximate volume of finished compost by the average pile height. Furthermore, when calculating the area requirements, it is important for local governments to also consider maneuvering area for equipment and vehicles.

5.3.3 Buffer Distance

Buffer distances are important to include in the design of a compost facility for environmental reasons as well as to improve relationships with neighbors. State and local regulations often specify requirements for minimum buffer zones or give an offset distance from property lines, utility easements, adjacent businesses or from surface water and other water sources. Section 5.2 of this Manual provides an understanding of applicable regulatory requirements for composting facilities in the H-GAC region. This section provides general guidelines on recommended buffer distances to minimize environmental and neighbor impacts.

Environmental Impacts

Runoff and leachate from a composting facility can have potential negative impacts on water sources. To protect water resources near the site, care must be taken to ensure a vertical as well as horizontal buffer zone. Recommended buffer distances include:

- Two to five foot vertical distance from land surface to groundwater or bedrock;
- 200 feet horizontal to a drinking water supply well; and
- 100 to 200 feet horizontal distance from surface water and wetlands.

Neighbor Impacts

The following buffer distances are recommended in order to minimize impacts on neighbors to a compost facility:

- 400-500 feet from residence, place of business, or other sensitive adjacent land use; and
- 50 feet from property line.

In addition, facilities sited in areas with a prevailing wind should extend the buffer zone in the same direction as the wind. This extension aids in minimizing the level of detectable airborne odors from the facility to neighbors downwind.

[3] Source: Dougherty, Mark, *"Composting for Municipalities,"* Natural Resource, Agriculture, and Engineering Service Cooperative Extension, November 1998

5.3.4 Overall Site Size and Layout

Municipal facilities in Texas typically have a processing area, including pre-processing, processing, and post-processing area of approximately five to ten acres for every 50 tons per day of material accepted. This variability is due to differences in site design and layout, operations, and land availability in a specific community. In addition to the processing areas, additional space for structures, buffer, and drainage infrastructure must be accounted for. The amount of space needed for these additional features varies widely from site to site.

Some important site layout considerations are listed as follows:

- It is ideal to have separation between customer/retail areas and processing areas where heavy machinery and equipment is operated. The public-facing areas of the site should be as non-industrial as possible.
- Windrows should generally be constructed parallel to the slope of the pad so that runoff flows between windrows and not through them. However, in areas with low precipitation, windrows may be oriented perpendicular to the slope to encourage rainwater collection and preserve windrow moisture.
- The site should be oriented according to the compost process to reduce excessive maneuvering of material throughout the site.

Figure 5-3 shows an example facility layout that is not site specific. Figure 5-4 shows an example facility layout and includes the composting pad, curing and storage areas, visual screens, a delivery loop for customers, and drainage components. This layout is site-specific (e.g., designed with a specific site in mind).

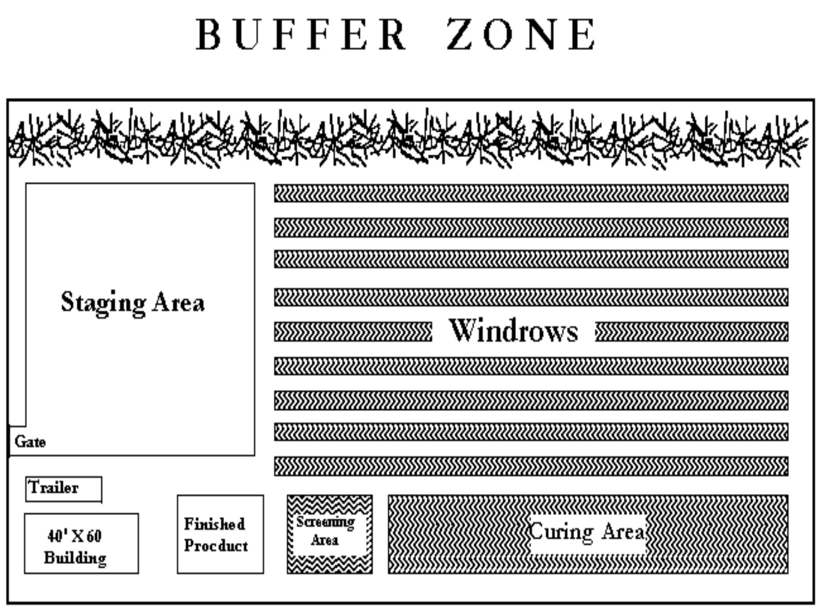

Figure 5-3: Example Composting Facility Layout (Generic)

Source: *Composting for Municipalities*, Natural Resource, Agriculture, and Engineering Extension Service

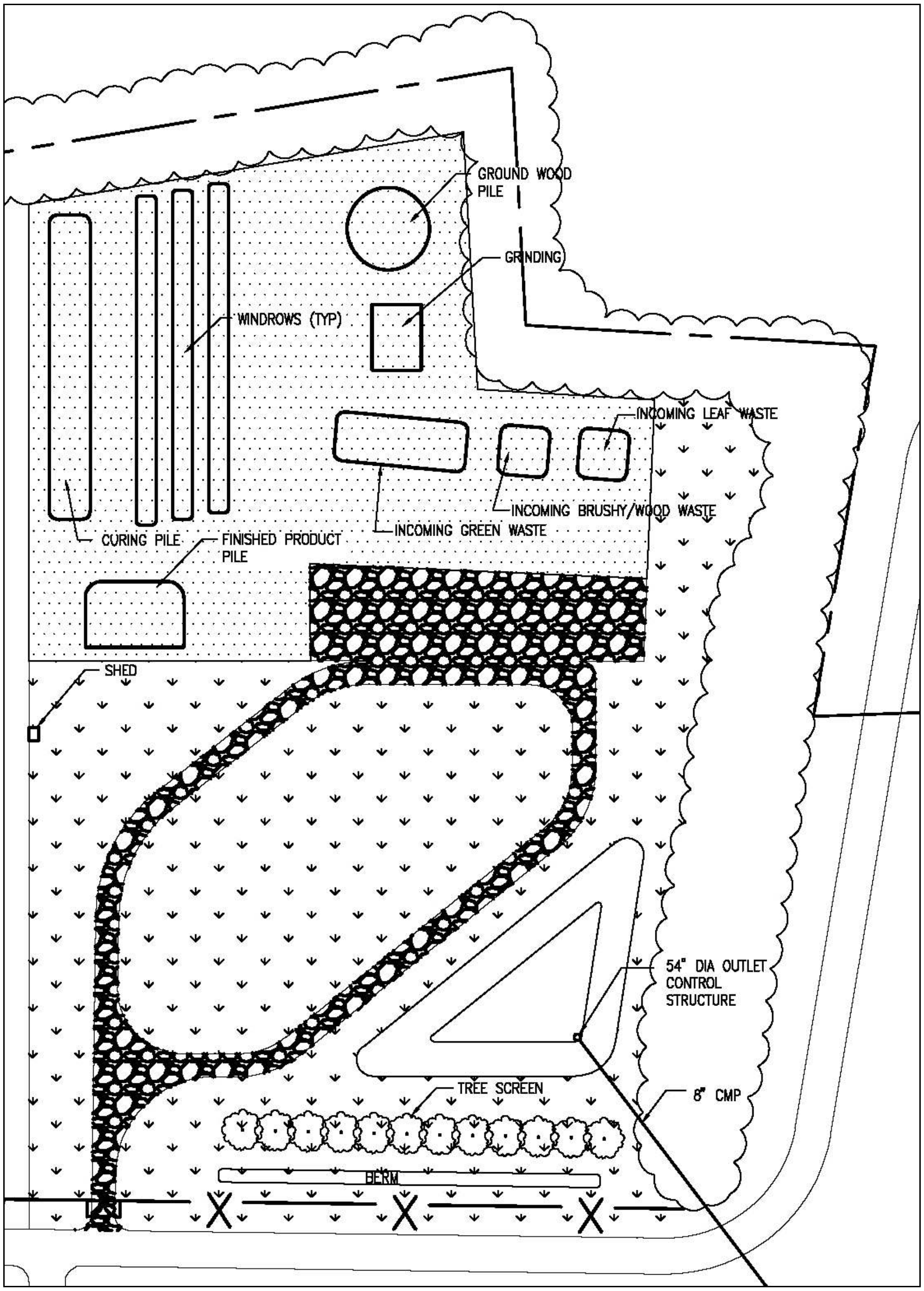

Figure 5-4: Example Composting Facility Layout (Site Specific)

5.4 Infrastructure and Utilities

This section describes the infrastructure and utility demands associated with the construction of a municipal composting facility and include the working pad, utilities, and site security.

5.4.1 Working Pad

The following describes options and factors to consider when selecting a material from which to construct the processing pad for a compost facility.

Options for Working Pad

Composting pads must withstand heavy vehicle traffic and regular scraping from front-end loaders and other composting equipment. Because of this, as well as other considerations mentioned above, some local governments choose to construct compost pads of durable materials such as compacted sand, lime-stabilized clay, asphalt or concrete rather than native soil surfaces. Some of these material options are shown in Table 5-1.

Table 5-1
Potential Materials for Processing Pad

Material	Pros	Cons
Compacted Native Soil Some soils drain well enough that they can be compacted and used as a pad without the addition of gravel or other materials to make it more stable. These soil types include silty sand with gravel or sandy clay with gravel.	▪ Low cost ▪ Widely used in Texas	▪ If soils not permeable enough, may be difficult to maneuver equipment during high precipitation
Sand and Gravel with Filter Fabric A combination of sand and gravel can make a good working surface. Topsoil is removed and the filter fabric is rolled out to cover the surface. Gravel or sand and gravel mix is then placed 12" to 18" on top of the fabric and compacted. The fabric is a key element of the pad; without the fabric, gravel will work its way into the soil and need to be replaced to keep a good working surface.	▪ Equipment will maneuver well on the working surface	▪ Bits of gravel and sand may be included in the final compost product ▪ More costly than compacted soil
Stabilized Soil Alternative to concrete that produces a hardened, nearly impervious pad. Soil may be stabilized with lime, Portland cement, asphalt, or fly ash.	▪ Produces a nearly impervious pad ▪ Sturdy enough to withstand equipment	▪ More costly than compacted soil
Compacted Clay Clayey soil can be layered and compacted to provide a low permeability pad.	▪ Low cost, depending on native soil type ▪ Precedent for use in Texas	▪ In areas of high precipitation, these pads may create difficulties in maneuvering.
Asphalt or Concrete Composting pads can be constructed out of asphalt or concrete, usually at sites where soils are highly permeable and/or where groundwater levels are too close to the surface.	▪ Concrete is best material for operations ▪ Produces impervious pad	▪ Highest cost ▪ Stormwater runoff must be managed ▪ Asphalt not durable in hot weather

Factors to Consider

In selecting a material for the composting pad, local governments should consider the following factors.

- **Longevity –** Materials like concrete and asphalt are long lasting, but may be require demolition if no longer desired.
- **Cost –** There is a trade-off between cost and durability of the composting pad. For instance, compacted native soil is the lowest cost option but may not be as durable as other options.
- **Materials to be processed –** For certain materials, such as biosolids, and in some states, food scraps, local or state regulations may require a concrete pad.
- **Equipment –** Certain types of equipment, such as windrow turners, may not be able to maneuver on certain types of compost pads.
- **Site drainage properties and hydraulic infrastructure –** With the increase of impermeable surfaces at the site, it may be necessary to increase hydraulic infrastructure at the site with the construction of holding ponds or of infiltration areas.
- **Slope –** Regardless of material type, composting pads should be constructed at a one to two percent slope.

5.4.2 Utilities

To support basic sanitary services, fire protection, pile moisture content and dust control, water is needed at a compost site. The volume of water needed for composting activities is dependent on the types of feedstock utilized in the process as well as the climate. Water sources at municipal composting sites can include run-off or rainwater collection basins, farm ponds or sub-surface wells.

Other utilities that may be needed at the site include sewer, telephone and electricity. The existence of sewer and telephone services will depend on site-specific infrastructure and the level of finish-out desired for the site. Electrical needs are universal to composting facilities and are generally needed for site lighting, offices, scale houses, storage buildings, machinery operation and maintenance. Furthermore, electricity may be necessary to operate some materials-handling equipment such as augers or conveyers. Windrow composting facilities may also use equipment powered by gasoline, diesel, or propane engines. If this is the case, some facilities may have on-site storage for these fuels.

5.4.3 Security

Site access for any composting facility should be controlled to avoid damage such as vandalism, arson, illegal dumping, or theft. Minimum security measures such as perimeter fencing and gated access roads are recommended. Other measures such as the use of a closed-loop security camera system may be necessary for facilities that have repeat trespassing issues. In addition, it is recommended that compost facilities have lighting to prevent trespassing during evening hours.

5.5 Capital Needs

This section provides an overview of the capital needs for a composting facility (other than site development costs). The summary includes equipment, scales, and other structures.

5.5.1 Equipment

This section describes composting equipment and their potential uses.

Tub Grinder

Tub grinders reduce the size of yard trimmings and other organic materials by moving material over a fixed floor containing hammer-mills. Tub grinders require regular maintenance and replacement of the hammers. Typical cost for a tub grinder can be between $300,000 to $750,000 depending on size.

Figure 5-5: Tub Grinder

Horizontal Grinder

More compost facilities are using horizontal grinders for preparation of feedstock. Grinders should be selected based on the volume of feedstock coming into the facility, the type of feedstock, and the preferred function. Handling organics, yard waste and brush are the main application of a horizontal grinder. Small tree debris, split logs and some wood debris can be mulched with a horizontal grinder. Easily changeable screens are also a benefit with these types of grinder providing a coarser faction if processing wood for mulch or finer faction for compost. Horizon grinders are generally lower horsepower so if large amounts of tree debris is being processed, a tub grinder may be a better selection. Horizontal grinders can cost between $350,000 and $400,000.

Figure 5-6: Horizontal Grinder

Excavator

An excavator can be used on a compost site to load feedstock into a grinder and to load trucks with finished compost in addition to any excavation project that may be necessary. An excavator working in tandem with a track mounted horizontal grinder works well preparing feedstock for compost. An excavator can be equipped with a bucket, a clam shell to grab and hold brush, or scissors to split large logs. The typical cost for an excavator is $150,000 to $300,000, depending on size.

Figure 5-7: Excavator

Trommel Screen

A trommel screen is a rotating screen that often includes a feed hopper and loading conveyor. The drum rotates and retains larger particles within the drum while fine particles fall through the holes or screen and onto a conveyor. The typical cost for a trommel screen is between $200,000 to $300,000.

Figure 5-8: Trommel Screen

Vibratory Screen

A vibrating screen employs a reciprocating or oscillating motion to improve separation. Wire mesh screens of different sizes are used to remove larger particles and obtain the desired size as fine as 1/8 inch. The vibration and slope of the screen works to move oversized material off the screen while the finer particles drop onto a conveyor. The typical cost for a vibratory screen is between $200,000 to $300,000.

Figure 5-9: Vibratory Screen

Windrow Turner

Windrow turners are available in a variety of sizes and designs. Pictured is a self-propelled windrow turner. This type of turner allows windrows to be spaced approximately five feet apart and may be 10 to 20 feet wide and as tall as 10 feet. The typical cost of a windrow turner depends on style and size, but the range can be between $250,000 to $350,000.

Figure 5-10: Self-Propelled Windrow Turner

Other windrow turner options include:

- **Towable turners:** Windrow height may be three to eight feet tall, nine to 18 feet wide, depending on single or double pass. Spacing between windrows is generally six to eight feet.
- **Attachment turners:** This type of turner attaches to a loader or tractor and can be as small as a skid-loader attachment. Windrows can be extended (continuous) stack and height is generally three to five feet.
- **Elevated-face turners:** Can be towable or self propelled. This type of turner with an optional conveyor and can be used in extended stack windows and heights of six to eight feet.

Front-End Loader

A front-end loader is a very versatile piece of equipment at a compost facility. The loader is used throughout the process to move incoming feedstock, load grinders, build windrows, turn windrows and move cured and finished compost. Loaders should be selected based on the size of the site and volume of compost. Too small of a loader will result in greater time to move volumes of material. Too large a machine on a small site may be difficult to maneuver and will incur extra fuel cost. A small front-end loader is generally equipped with a three to four cubic yard (CY) bucket, a mid-size. The typical cost of a front-end loader depends on size and features, but the range can be between $200,000 to $300,000.

Figure 5-11: Front-End Loader

Mixers

One way to mix organic waste or food scraps is to unload a truck or produce and other material onto a bed of wood chips and then scoop it up and add it to a windrow. The blending is then accomplished with the first turning of the windrow. Numerous sites are premixing food scraps, often with corrugated and soiled paper before adding it to a windrow. Horizontal and vertical mixers can be advantageous in size reduction and blending of material in the pre-compost phase. The typical cost for a mixing machine is $70,000 to $250,000, depending on size and features.

5.5.2 Scale

Many larger composting facilities utilize a truck weigh scale to track the weight of feedstock coming into the facility as well as the weight of finished compost leaving the site. The use of a scale and scale house aids in reducing wait time upon entering and exiting the site, as weights can be quickly and accurately recorded. Further streamlining can also be completed for operations which utilize multiple similar vehicles, as tare weights can be stored in the system.

It is important to note that if a composting facility is co-located at a landfill, transfer station, or materials recovery facility (MRF), it is possible that the scale and scale house infrastructure may already exist and could potentially be utilized for both operations.

Furthermore, while scales provide an accurate measure of the material entering and exiting the facility, they represent a considerable expense. For a less expensive accounting method, facilities can alternatively choose to keep track of material by estimating the volume of each load as it is delivered to the facility. Facilities that do not utilize scales typically charge tipping fees based on cubic yards of material delivered.

5.5.3 Structures

A composting facility may require the following structures:

- Maintenance facility;
- Site storage building;
- Administrative building or trailer; and
- General personnel facilities.

At a minimum, sites should have access to electricity, heating, ventilating, and air conditioning (HVAC), bathroom facilities, and potable water. Furthermore, all facilities should either be wired for telephones or have a radio for emergency situations. For larger (greater than 50 tons per day capacity) composting facilities, personnel facilities may also include an office, shower, locker room and lunch room, as appropriate.

City of Austin's Hornsby Bend Composting Facility

The City of Austin (City) operates Hornsby Bend, a 1,200 acre multi-use environmental campus, which houses the Hornsby Bend Biosolids Management Facility, the South Austin Regional Wastewater Treatment Plant (WWTP), a bird and wildlife sanctuary, and acres of biologically diverse land and native Texas habitat. The Hornsby Bend Biosolids Management Facility includes the biosolids composting site which composts biosolids from both of the City's WWTP facilities into a product called Dillo Dirt.

The City of Austin's Solid Waste Department (SWD) provides yard trimmings collection service to residential customers once per week. This yard trimmings collection includes grass clippings, leaves, and small branches less than five feet long and three inches in diameter. These materials are ground using a tub grinder once accepted at the facility. Once ground, this material is combined with biosolids and formed into windrows.

After the windrows are formed, the compost operator ensures that sufficient temperatures are reached in order to virtually eliminate pathogens and other contaminates such as weed seeds. According to United States Environmental Protection Agency (EPA) standards, this can be accomplished if the windrow reaches a temperature of 55 degrees Celsius and sustains this temperature for at least 15 consecutive days.

The City does not sell any of its approximately 40,000 CY of finished Dillo Dirt compost product directly to the general public. Instead, the City contracts with wholesale vendors to sell finished product. These vendors purchase bulk Dillo Dirt at a rate of $12 per CY and sell Dillo Dirt to the public at approximately $30 to $40 per CY.

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Section 6
OPERATING A PROCESSING FACILITY

6.1 Overview

This section provides a comprehensive overview of best management practices for operating a windrow-composting site. Although this section focuses on windrow composting, it also includes an introduction to basic composting concepts as well as a summary of other potential composting technologies.

This section is meant to provide an introduction to the best management practices for composting in the H-GAC region. For communities that are interested in pursuing the development of a composting site as part of their overall organics management efforts, R. W. Beck recommends consulting the additional resources provided at the end of this Section.

6.2 Basic Concepts

Composting is the microbial decomposition of discarded organic materials under controlled conditions. The end product, compost, is used as an organic soil amendment. It promotes microbiological activity in soils necessary for plant growth, disease resistance, water retention and filtration, and erosion prevention.

Decomposition, as it occurs in nature, is the result of microbial activity. Composting is a process that speeds up natural decomposition by developing controlled conditions for microorganisms to thrive and decompose materials more quickly.

Anaerobic and aerobic microorganisms are both present in the decomposition process. However, anaerobic microorganisms create unpleasant byproducts, such as methane gas and odor. Therefore, the objective of a composter is to create favorable conditions for aerobic microorganisms to dominate the decomposition process.

The level of biological activity that occurs in composting is based on the following factors:

- Air;
- Moisture;
- Particle size; and
- Nutrient levels (e.g., carbon and nitrogen).

6.2.1 Air

The microorganisms active in composting require oxygen to break down material. Compost piles should contain enough spaces within the pile for air to move freely.

The oxygen concentration of the air within a compost pile should be between five and 15 percent. If the oxygen concentration is too low, then anaerobic conditions will occur. If the oxygen concentration is too high, then the pile will dry out and biological activity will slow. The addition of bulking material is a practice used by composters to introduce oxygen into a compost pile, as described in Section 6.4.1.

6.2.2 Moisture

Microorganisms active in the composting process also need water to break down material. Striking a balance between too much moisture and too little moisture is key, as too much moisture in a composting pile can disrupt the flow of oxygen in the pile, producing odorous anaerobic conditions. On the other hand, too little moisture causes microbes to dry out and become dormant.

The target moisture content for a compost pile is between 45 and 55 percent. To ensure that a compost is appropriately moistened, many composters use the "squeeze test." In this test, composters grasp a handful of compost and squeeze. If the compost drips after being squeezed, then the moisture content is too high. If the material retains its shape after squeezing without releasing excess water and dampens the composter's hand, then the moisture content of the compost is within an acceptable range. The feel of compost with the target moisture content should be that of a sponge that has been wrung out.

6.2.3 Particle Size

The particle size of compost also affects the ability of the microorganisms to decompose material. Smaller particle sizes creates more surface area for the microorganisms to break down, which enhances microbial activity. However, particle size should not be too small. Too small of particle sizes will increase the density of the pile, decreasing airflow and creating the potential for anaerobic conditions. The target particle size for a compost pile is between ½ inch to 2 inches in diameter.

6.2.4 Nutrient Levels

Carbon and nitrogen are the two main nutrients that fuel the microorganisms in the decomposition process. The target C:N ratio for compost is of 30:1 (by weight). If the C:N ratio is too high, microbial activity will slow. If the C:N ratio is too low, decomposition will initially occur quickly, but anaerobic conditions could occur.

Composters should calculate the C:N ratio of their compost recipes by using the formula shown below. In addition, a common rule of thumb is 50 percent high nitrogen and 50 percent high carbon by weight. This weight ratio can typically be achieved by mixing a three to one ratio of carbon to nitrogen material by volume.

The C:N ratio of a compost recipe can be determined by the following formula.

(Percent of Feedstock A* C:N Ratio of Feedstock A) + (Percent of Feedstock B* C:N Ratio of Feedstock B) = Blended C:N Ratio

The table below shows the C:N ratio of common compost feedstocks. The On Farm Composting Handbook, a resource developed by the Natural Resource, Agricultural, and Engineering Service Cooperative Extension (NRAES), contains a complete and detailed list of over 50 compost feedstocks.

Table 6-1
Carbon to Nitrogen Ratio of Common Feedstocks

Feedstock	C:N Ratio
Biosolids	6: 1 (activated sludge) to 16:1 (digested sludge)
Food Scraps	14:1 – 16:1
Grass Clippings	9:1 – 25:1
Hay	15:1 – 32:1
Leaves	40:1 – 80:1
Manure	19:1 – 30:1
Tree Trimmings	451:1 – 819:1
Wood Chips	16:1

Source: *On Farm Composting Handbook,* Natural Resource, Agricultural, and Engineering Service Cooperative Extension.

6.2.5 Summary

As discussed in this section, recommended conditions for composting are summarized in Table 6-2.

Table 6-2
Recommended Composting Conditions

Parameter	Target Range
Oxygen Concentration	5%-15%
Moisture Content	45% - 55%
Particle Size (inches)	½ inch – 2 inches
Nutrient Levels (C:N)	30:1

6.3 Composting Methods and Technologies

Although the science of composting is the same regardless of the technology used, there are several available composting technologies, including the following:

- Static pile composting;
- Aerated static piles;
- Windrow composting; and
- In-vessel systems.

Although there are various technologies available, as listed above, this section focuses on windrow composting. However, many of the principles discussed in this section would also apply to other composting methods.

Technology affects the rate of decomposition, space required for the facility, equipment and personnel needed

6.3.1 Static Pile Composting

Open pile composting involves the collection of organic materials into open piles or stacks. Once piles are formed, the material heats from the inside causing air inside to rise, pulling cooler air inward from the sides and bottom. This natural air movement causes the pile to aerate without constant turning. In general, because of pile compaction, larger piles are more difficult to aerate successfully.

The primary advantage of static pile composting is that, since piles are turned infrequently (two to four times per year), less equipment and personnel are needed. However, static pile composting is more time intensive than windrow composting, as it can take one to two years to produce finished compost.

In addition, if piles are constructed to be too large, the pile temperature can get too high, creating a potential fire hazard for the facility. Once temperatures inside of the pile reach 190 degrees Fahrenheit, the heat acts as a catalyst for chemical reactions that generate even more heat and at a faster rate. When the pile shifts because of volume reduction and fresh air (oxygen) comes into contact with the super-heated material, spontaneous combustion occurs and causes fire in the pile.

Figure 6-1: Static Pile Composting Facility (Nature's Way, Conroe, TX)

6.3.2 Aerated Static Piles

Aerated static piles is a variation on static pile composting in which the composter uses passive or forced aeration to increase the flow of air into the static pile. In both methods, open-ended perforated pipe is placed under the compost pile. Similar to open-pile designs, passive aeration of the gasses within the compost occurs naturally as the warm gas at the center of the pile rises and is replaced with cooler air. This process occurs more efficiently with passively-aerated static piles, as the open-ended perforated pipe at the base of the pile provides a preferential pathway for replacement gasses. Forced aeration utilizes these same principles and also introduces a blower to supply air from the bottom of the composting pile.

It is important to note that aerated static piles are not typically turned during active composting; because of this, wood chips and brush are added to the pile to maintain pile structure.

Aerated static pile composting has similar advantages and disadvantages to static pile composting. However, aerated static piles produce finished compost more quickly than static pile, as the process can be completed in three to six months.

6.3.3 Windrow Composting

Windrow composting is the most common technology utilized in Texas for municipal composting. Windrow composting involves forming long piles that are turned on a regular schedule. The size, shape and spacing of each windrow is directed by the type of equipment utilized to turn each pile. For smaller operations, front-end loaders are utilized to turn piles, while larger operations typically utilize specialized windrow turners. Windrow aeration is primarily accomplished through natural air movement, similar to static piles. Air is also introduced into the pile during periodic turning.

Figure 6-2: Windrow Composting Facility (City of Little Rock Municipal Compost Facility)

Windrow composting has several advantages over other technologies. First of all, windrows are turned at regular intervals to increase porosity within the pile and release excess heat, water vapor and other gases. By increasing the porosity with turning, windrow composting is able to achieve more efficient passive air exchange, which decreases the amount of time needed to produce finished compost. Windrow composting facilities are able to produce finished compost in four to six months. Also, by exchanging the material at the base with the material at the top, the compost product becomes more uniform.

The disadvantages of the windrow technology are the higher capital requirements than other technologies, such as static pile technology. For instance, more specialized equipment, such as windrow turners, are typically needed to accomplish the turning. In addition, windrow facilities typically require an improved composting pad to enable turning equipment to easily maneuver through the windrows.

6.3.4 In-vessel Systems

In-vessel composting systems are high technology systems in which composting is conducted in a completely closed system. In these systems, the active composting process is contained in either a vessel, building or other container. Because of this, these systems offer the highest level of control of biological activity, airflow, agitation, moisture levels, and particle size within the system. Many in-vessel systems utilize forced aeration technology and mechanical turning to expedite the composting process and keep operating costs minimal.

In-vessel composting is the most costly and capital-intensive composting technology. However, it can provide advantages in certain applications. For instance, in-vessel can be an effective technology to process odorous material, such as food scraps and biosolids. Because most in-vessel systems are operated as closed systems, odors can be collected more easily for treatment in biofilters.

Figure 6-3: Example of In-Vessel Composter

In addition, in-vessel technology is more suitable for urban areas than open composting technologies, because of the fact that they are enclosed. Also, facilities can have smaller sites due to higher material processing rates.

It is also possible to create an anaerobic, in-vessel system and then collect the methane produced. This technology is often referred to as an anaerobic digester. However, the composted material coming out is not a good quality compost, as it contains alcohols, which can damage plants. Residual material from an anaerobic digestion process may be re-composted with high carbon material in aerobic conditions to create a quality compost product.

6.4 Compost Process

This section describes the process of converting raw feedstocks into marketable compost.

6.4.1 Feedstock Preparation

Following are the required steps to prepare raw feedstock prior to composting.

Step 1: Sorting

Incoming material should be screened for contaminants before grinding or shredding. This process will help to ensure high quality of the finished compost. Compost facilities should consider charging a fee to customers for excessive time spent removing contaminants.

In addition, a compost facility may consider storage of incoming material as opposed to immediate processing. High-carbon material, such as brush and yard trimmings, is suitable for storage. Piles of raw feedstocks should not exceed 12 feet in order to prevent on-site fires.

In addition to storage of unprocessed feedstocks, facilities that commonly accept high nitrogen feedstocks, such as biosolids or food scraps, should have access to ground high carbon material, such as wood chips or ground yard trimmings, to immediately cover or mix with these feedstocks upon being accepted at the facility.

Step 2: Size Reduction

The next step in the compost process is reducing the particle size of bulkier material. Suitable materials for size reduction include brush, yard trimmings, tree stumps, scrap wood, and paper products. The optimal particle size is discussed in Section 6.2.5.

The purpose of size reduction, in addition to increasing the surface area of material in the pile, is to achieve the optimal pile porosity. Bulking agents such as ground woody material help to keep the density of the compost pile to a reasonable level, so as not to encourage anaerobic conditions. Furthermore, bulking agents help to increase pile stability by providing structure to the pile during active composting.

Step 3: Mixing and Pile Formation

The final step in feedstock preparation involves the mixing of feedstocks to create the optimal compost recipe. In windrow composting, initial mixing and pile formation can be done in separate steps if specialized mixing equipment is used. However, mixing is typically achieved in the process of constructing and turning the pile.

One approach to constructing a windrow is the *layering method*. Front-end loaders will layer the feedstocks in the appropriate ratios – usually three buckets of carbon material to one of nitrogen material. Another approach is the *horseshoe method*, which works particularly well for high nitrogen materials. In this method, the composter makes a horseshoe shape out of high carbon material, such as yard trimmings. The high nitrogen material is unloaded inside of the horseshoe. A front-end loader is used to close the ends of the horseshoe so as to cover the high nitrogen material and create one windrow.

During pile formation, the composter must evaluate the moisture and nitrogen content of the feedstocks. Water or high nitrogen feedstocks may be added to achieve optimal ratios. Specifically at yard trimmings only compost operations, the composter is deficient in nitrogen and water. By the time municipal yard trimmings ground and mixed, they are typically very dry. Using high nitrogen materials such as food or biosolids eliminates these two issues.

6.4.2 Active Composting

The active composting state is the period in which the materials are encouraged to decompose. Microbes transform the windrow into compost and release carbon dioxide and heat. When certain temperatures are reached, any pathogens, weed seeds and insect eggs are eliminated.

Step 4: Turn Windrows

To conform to the United States Environmental Protection Agency's (EPA) class A pathogen requirements, a composting temperature of at least 55 degrees Celsius (approximately 130 degrees Fahrenheit) must be maintained for at least 15 days during active composting for a windrow facility. Also, a minimum of five turnings are required during this active composting period. This standard for windrow composting is known as the Process to Further Reduce Pathogens (PFRP). These regulations ensure that temperatures in the active composting stage are high enough to effectively destroy weed seeds and inactivate heat-resistant primary pathogens. The turning of windrows also ensures that all of the material within the pile has been decomposed evenly and been exposed to high temperatures, not just the material in the center of the pile.

Step 5: Monitor Conditions

During the active composting phase, one of the most important activities is to monitor the conditions of the compost. The following aspects of the compost should be closely monitored and corrected if found to be outside of the target range.

Porosity

Suitable porosity levels in a composting pile are necessary to ensure the flow of air throughout the pile. As discussed previously, bulking agents may be added during feedstock preparation to increase the porosity in the pile. However, these bulking agents decompose as the pile matures, and become unable to increase structural integrity of the pile. Thus, during the active composting process, periodic turning becomes crucial to maintain porosity and incorporate oxygen.

The pile may become anaerobic quickly if there is not enough airflow. Not only will the operator be able to tell by the odor, but also by the quicker cooling. Anaerobic decomposition is slower and does not generate the same amount of heat as aerobic composting. Therefore, the piles will not get as hot or stay hot for as long.

Moisture Content

As previously mentioned, pile moisture is crucial for encouraging microbial activity and should be kept between 45 percent to 55 percent. Because the decomposition process produces a considerable amount of heat, moisture must be monitored continuously to ensure that evaporation has reduced the moisture of the pile.

If a pile becomes too dry, it may be moistened with water or liquid feedstocks. If a pile is too wet, it should be turned to release excess moisture.

Temperature

The temperature of a composting pile increases during the active composting process due to the enhanced microbial activity during decomposition. Generally, many operators strive to operate the composting systems between 130 and 140 degrees Fahrenheit. Daily temperature readings are critical to ensure that the pile does not heat above the desired range. Temperature readings also play a major role in determining a schedule for turning the compost piles. In general, a compost pile should be turned if it meets one of the following conditions:

- The pile temperature reaches over 165 degrees Fahrenheit;
- The temperature drops suddenly, for no apparent reason; or
- The temperature changes greater than 20 degrees Fahrenheit from a one foot depth to a three foot depth of the pile.

Windrow temperatures should be taken daily with a long (four foot) thermometer that can reach deep into the pile. To take readings in a windrow, probe toward the bottom of the pile and the mid-level every 15 feet. Note any extreme variations in different areas of the windrow.

6.4.3 Screening

Screening the compost helps to rid the product of any oversized particles (such as contaminants or other clumps of material) which were not completely decomposed during the composting process. The particles that are screened off (minus the contaminants) can be used as feedstock for a future compost batch. The fine particles are cured to make finished compost.

To meet the requirements of end users, inert materials such as glass, rocks, and plastics should be removed from the compost through a screening process. Generally, operators utilize a ¼ to ½ inch screen for compost depending on the type of feedstock used initially. Types of screens typically used at composting facilities include:

- Trommel screens;
- Shaker screens; and
- Vibratory screens.

Trommel screens and vibratory screens are the most commonly used screen types at composting facilities.

6.4.4 Curing

In the curing stage, the compost is left in windrows or static piles to mature and stabilize. Many operators choose to relocate curing material to a designated area away from the active composting area to preserve space for younger windrows.

As compost completes the curing stage, the mature product has the necessary forms of plant nutrients, has low levels of phytotoxic volatile organic acids, and does not consume extraneous oxygen. A mature compost is a dark brown color (not black), smell like a rich, healthy soil, and no longer has recognizable components.

In the curing pile, the remaining excess carbon is processed by the microbes. This is also a time when beneficial fungal hyphae begin to grow as well as actinomycetes, which are both important for the conversion of nutrients and minerals into a form that plants can absorb.

6.4.5 Storing Compost

Storing compost does not require heavy oversight, as long as the compost has been properly cured and does not have a high rate of microbial activity. The size of storage piles is typically determined by the size of the loader, conveyors or other materials handling equipment available at the facility. To control dust during storage, operators should ensure that pile moisture stays around 35 percent. Furthermore, although cured, the temperature of each storage pile should be monitored to ensure that the pile is stored safely and is not susceptible to combustion.

If storing compost during a long period of time, the composter may consider covering the material. This will protect it from excess wind, rain running through it and leaching nutrients, and from weed seeds transported through the air.

6.5 Staffing Needs

Because of the labor-intensive nature of the composting process, multiple staff members will be required to operate the facility. Table 6-3 gives a summary of typical staffing requirements for a composting facility. It should be noted that the quantity of each staffing position necessary to operate a composting facility is dependent on the throughput of the facility, the types of feedstocks accepted, as well as the types of equipment used at a facility.

Table 6-3
Composting Facility Staffing Needs

Job Classification	Description
Facility Manager	Provides oversight for the facility staff, acts as liaison with governing entity
Foreman	Oversees daily operations of the facility
Heavy Equipment Operator	Operates loaders, screeners, windrow turners and other site equipment
Sales Staff	Markets compost product through direct interaction with customers
Maintenance/Laborers	Performs general site maintenance activities, including inspection of incoming material

6.6 Health and Safety

As with any industrial operation, it is important to ensure the health and safety of operations personnel. The following details important procedures to protect the health and safety of compost operations staff.

6.6.1 Equipment Safety

Many safety issues at a composting operation relate to the heavy equipment required to manage the facility. To potentially help avoid many problems, managers should utilize the following best management practices:

- Provide proper training and clearly communicate how to correctly operate and service each piece of equipment used at the facility;
- Keep a current log of all maintenance activities as well as manufacturer-provided operational instructions;
- Discourage employees from rushing when handling and processing materials;
- Equip all non-stationary equipment with backup alarms, fire extinguishers and radios;
- Require personnel to maintain an adequate distance from operating machinery, such as grinders and windrow turners;
- Provide frequent and thorough safety training; and
- Enforce universal safety measures such as the use of seat belts while operating machinery and wearing safety glasses, hard hats, earplugs, and appropriate footwear.

6.6.2 Operator Health

Composting facilities also create the potential for non-equipment related health issues to occur. In order to protect the health and safety of all personnel, composters should utilize the following best management practices:

- Provide filter masks for all employees in dusty areas;
- Provide drainage facilities in work areas to remove ponded water and leachate that may contain pathogens or vectors or cause employees to slip and fall; and
- Require normal sanitary measures, such as washing hands before touching food or eyes and workers should promptly treat and disinfect cuts and abrasions. [1]

6.7 Nuisance Control

For composting facilities, the proper management of nuisances is imperative to maintain environmental health and to operate the facility in accordance with best management practices. Furthermore, a facility that has minimized nuisances preserves a positive standing amongst neighbors and throughout the community.

Typical nuisances that can be experienced at a composting facility include:

- Dust;
- Odor;
- Runoff and leachate;
- Noise;
- Litter; and
- Vectors.

Proper operations of the site, as discussed in Section 6.6.1 through Section 6.6.6 can help to minimize the effects of these nuisances. In addition, the following best management practices will minimize nuisances experienced at a composting facility.

6.7.1 Dust

A compost facility can produce dust from many sources including unpaved roads, receiving areas, and grinding operations. Improper dust management can lead to health concerns for facility employees. Furthermore, dust can also increase the risk for fires, as it acts as an insulator on machinery and can overheat engines.

Specific dust-control methods include the following:

- Utilize a water truck to dampen heavy traffic areas such as the loading and receiving areas as needed;

[1] Sanitary methods become even more critical if unprocessed biosolids are being handled. Unprocessed biosolids can contain disease-causing organisms, and anyone in regular contact with this material is at a greater risk of contracting infections.

- Apply crushed glass to interior roads as a dust suppressant;
- Construct the receiving, mixing, storage and bagging areas inside a structure with a ventilation system, or create "walls" with vegetative material to filter dust;
- Pave any on-site roads and keep these roads free from compost or feedstock which can dry and create dusty conditions; and
- Dust fixtures such as structural beams, light fixtures and other surfaces.

6.7.2 Odor

Another potential nuisance that can be caused by composting is odor. Although many odors that are produced during the composting process are harmless to human health, they can be troubling to neighbors. To ensure that nearby residents are not impacted by odors, the best defense is to leave a large buffer distance between the composting area and the property boundary. Where this is not possible, other forms of odor control may be implemented, such as the following:

- Implement frequent turning of windrows to prevent anaerobic conditions from occurring;
- Install a wind sock on the facility to indicate when the wind might be blowing in the "wrong" direction, and time turning of windrows accordingly;
- Use misters with fragrance; [2]
- Ensure that the site has proper drainage with no areas of ponding water;
- Do not allow unscheduled deliveries of high nitrogen materials; and
- Immediately add high carbon materials such as paper products, leaves, wood chips, or yard trimmings to high nitrogen feedstocks.

6.7.3 Runoff and Leachate

Control of contaminated runoff and leachate from a composting pad can be accomplished through the use of effective site design, proper operation, and continuous maintenance. Because compost piles act as sponges and absorb more moisture than they release, contaminated runoff is more of a concern at composting facilities than leachate. Efforts should focus on minimizing the runoff entering and exiting the site through the use of environmentally protective measures. The degree to which this runoff needs to be managed varies considerably based on the feedstock type, site grading, area weather, and facility size.

For runoff entering the site, ditches and berms can divert clean water and minimize the amount of runoff that needs to be managed within the site boundary. However, several measures can be implemented to control runoff that has entered the facility. If excess moisture is a concern for facility operators, the windrows should be constructed parallel to the slope so that any precipitation that falls within the site can freely flow

[2] This strategy has been used at facilities with some success; however, neighbors may be wary of chemicals being sprayed into the air.

between the windrows instead of through the windrow mass. However, if the compost facility is sited in an area with a tendency to become too dry, windrows should be oriented perpendicular to the slope so that precipitation is encouraged to flow through the windrow mass. More finished (i.e. mature) windrows should be placed uphill from less mature windrows.

Runoff from composting facilities is chemically similar to a low-strength municipal wastewater and can be treated using the following methods:

- Land application at the facility, which allows organic compounds to be absorbed into the soil;
- Vegetative filter strips, which allows runoff to filter through vegetation; and
- Recirculation, which involves pumping runoff back through the windrows to allow for some absorption of organic materials. [3]

6.7.4 Noise

Although a compost facility does not generate noise in excess of what a typical industrial facility might produce, composting operations may sometimes wish to employ certain noise reduction methods. Noises from a composting facility can be disruptive to neighbors and can even be damaging to workers at high volumes. Sources for noises at a composting facility include:

- On-site vehicles' engine exhaust systems, back-up beepers and horns;
- High-impact equipment;
- Fans;
- Motors and gears; and
- Amplified bells, alarms and public address systems.

The effects of these noises can be mitigated using several approaches. Buffers constructed from berms, trees or horizontal distance from neighboring landowners can effectively lessen the effects of site noises. In some cases, it may be necessary to install sound walls along the perimeter of the site for increased control of noise pollution. On a larger scale, composting facilities can potentially be sited in a more industrial zone rather than residential to minimize the noise control systems required.

6.7.5 Litter

Litter at a composting facility can be generally found concentrated at entrance and exit points, receiving areas, and truck washing areas. Furthermore, windblown litter from throughout the composting process, primarily plastic bags and shreds of paper, can sometimes be found throughout the facility property. Operators should collect litter as soon as it is identified to maintain a clean and orderly site. Litter can be reduced by employing the following strategies:

[3] As discussed in Section 5, retention ponds are recommended for composting facilities. The collected water comes in handy for recirculation and watering dry loads.

- Install litter-control fencing around problem areas or around the perimeter of the site;
- Manually gather litter around the site frequently;
- Install shields around conveyors and conveyor loading points;
- Impose a tipping fee surcharge for uncovered loads (to reduce littering along approach roads); and
- Clean roads leading to the facility on a regular basis, whether or not litter on these roads is caused by the composting operation.

6.7.6 Vectors

A vector is an animal or insect such as raccoons, rats, birds, flies and mosquitoes that carry pathogens from one area to another. For public health and safety, the presence of vectors should be monitored and controlled. To control vectors, operators should implement the following best management practices:

- Keep all receiving areas clean;
- Minimize the time that raw feedstock is stored on-site;
- Immediately cover putrescible organics with a carbon layer to prevent flies, rodents and birds;
- Consistently turn windrows to expedite the compost process;
- Construct houses for swallows, bats or martins to control the mosquito population;
- Utilize rodent traps as needed;
- Minimize ponded water on the site, as these areas tend to attract mosquitoes and other insects; and
- Utilize commercial pest control services, as needed.

6.8 Materials Marketing

Marketing finished compost material has become increasingly important, especially with the expanding number of composting facilities in the United States. Even if a local government plans to offer material at no or little cost to residents, it is critical to identify end markets for the products to ensure the ability to move material as it is produced.

R. W. Beck would caution local governments against offering compost material at no cost to residents due to the following reasons:

- Offering material at no cost may send the message that compost has no value;
- It may have adverse impacts on private composters; and
- It limits a local government’s ability to recover the costs associated with compost operations.

6.8.1 Marketplace Specifications

Market specifications are a key driver of determining the product quality that can be produced and sold in a specific geographic location. Because most compost end-users are interested in the compost product's effects on vegetative health, characteristics such as compost stability, maturity, organic content, pH, water-holding capacity and bulk density are of great concern.

6.8.2 Product Documentation

Effective product documentation can be a useful tool for marketing end product and consistent documentation provides customers with a sense of trust in the compost. For bagged compost, this documentation can take the form of printed labels or stickers. For bulk compost, an informational flier or data sheet can be provided upon purchase. This documentation serves several purposes including:

- Informing consumers of the general benefits of compost;
- Advising consumers on the proper use of specific compost products;
- Educating consumers on the potential cautions associated with using a specific compost product;
- Notifying users of the ingredients of a product, including the type of feedstock utilized; and
- Complying with certain product labeling requirements and legislation.

One such labeling standard is the United States Composting Council (USCC) Seal of Testing Assurance (STA) program. The USCC created this program in 2000 to standardize the method by which compost was labeled and marketed. Composting operators are now allowed to label their product as STA-approved product if they meet the following requirements:

- Regular sampling and testing of compost based on annual production volumes;
- Testing for the existence of pathogens, heavy metals, pesticides and inert materials to assure public health and safety standards are met;
- The use of approved laboratories, which have demonstrated that they are able to perform the specific testing methods in the program rules;
- Certification that the compost facility is in compliance with local, state and federal regulations; and
- Analysis of the compost product for pH, soluble salts, nutrient content, moisture content, organic matter content, maturity, stability and particle size.

Because of the quality of product that is ensured by these requirements, many end users choose to exclusively purchase STA-approved compost product. Thus, to ensure that their product has sufficient marketability, many compost operators participate in this program. Participants in the program are allowed to place an STA program logo on their product as long as they are compliant with the program rules. This logo helps to reinforce the program's slogan, "If it isn't STA compost, then what is it?"

6.8.3 Marketing Strategies

Compost can be marketed to several consumer markets including homeowners, landscape professionals and wholesale distributors. Many compost facilities choose to distribute product directly to commercial retailers, while others choose to market to homeowners.

A composting product is most marketable among all consumers if the compost meets applicable regulatory standards and achieves a high degree of consistency between batches. This degree of consistency can only be achieved through proper management of both the feedstock quality and the compost process.

According to the USCC, the most common issue with compost quality is the lack of maturity and stability. As a general rule, the longer that compost remains in the active and curing stages, the more stable and marketable the end product will be. Table 6-4 shows the physical, chemical and biological characteristics of quality compost.

Table 6-4
Compost Quality Characteristics[4]

Quality	Characteristic
Physical	Dark color, uniform particle size, pleasant earthy scent, absence of inerts, moisture content less than 50 percent, near-neutral pH.
Chemical	Available nutrients (nitrogen, phosphorus, and potassium), relatively high level of organic matter, minimum levels of heavy metals, organic pollutants, pesticides and herbicides, low soluble salt content
Biological	Sufficient maturity and stability, absence of pathogenic organisms, absence of weed seeds.

6.8.4 Market Value

The market value for compost depends on the quality of the product, the product availability and the targeted consumer market. Typically, the price for compost made from high carbon feedstocks is less than that of compost that includes high nitrogen material. However, lower grade compost can be utilized in a variety of applications including daily landfill cover and highway subgrade material. The Texas Department of Transportation (TxDOT) is a major consumer of low-grade compost for its roadway projects and should be considered as a potential end-user for finished product throughout the state.

Another important end user for finished compost product is the municipality itself. Local governments are typically a major outlet for compost produced within the community, as this product is used directly in various public works applications. This department should be encouraged to write product specifications that promote compost usage.

[4] Source: National Composting Program, 1994.

6.9 Resources

Local governments seeking to implement a composting program are highly encouraged to consult the following resources.

Publications

- *"Composting for Municipalities: Planning and Design Considerations,"* Natural Resources, Agricultural, and Engineering Service (NRAES), November 1998
- *"On Farm Composting Handbook,"* NRAES, June 1992
- *"Composting Yard Trimmings and Municipal Solid Waste,"* Environmental Protection Agency, May 1994
- *Biocycle* Magazine

Organizations and Programs

- United States Composting Council (USCC), http://compostingcouncil.org/
- USCC Seal of Testing Assurance (STA) program, http://compostingcouncil.org/programs/sta/
- State of Texas Alliance for Recycling (STAR) Compost Advisory Council, including annual Compost Camp training event, http://www.compostadvisorycouncil.com
- Solid Waste Association of North America, *"Managing Compost Programs"* training course and manual, http://swana.org/
- Texas Department of Transportation, http://www.txdot.gov/

7.1 Overview

This section describes many non-operational roles that may be performed by municipalities with regard to organics management. Oftentimes, local governments must do more than provide service, but they must also procure service providers, make policy decisions, work with various stakeholders, and perform many other functions in order to ensure a successful organics diversion program. This section provides recommendations for local governments that seek to do the following in support of their organics diversion programs:

- Develop public-private partnerships;
- Achieve political acceptance;
- Develop ordinances; and
- Pursue funding for composting.

7.2 Develop Public-Private Partnerships

Local governments in the H-GAC region have historically relied on the private sector to provide much of the regional waste disposal and recyclables processing infrastructure. In addition, many communities in the region also utilize private service providers to provide hauling service. Many communities in the region may also pursue a public-private partnership to provide their organics management program.

7.2.1 Keys for Success

The following list includes keys to success for a public-private partnership for organics management service.[1]

- **Structure long-term service agreements.** R. W. Beck recommends that contracts with haulers and processors be from five to seven years in length. If the processor has assurance of receiving material over a period of time, they can continue to make investments in the facility and program and have greater financial viability. In addition, if haulers have longer contract terms, they can recover the capital cost of equipment (e.g., vehicles, carts) over a longer period of time. Since renewal terms are not guaranteed, contractors will likely depreciate these capital costs

[1] For additional information, refer to the Recycling Contract Negotiations Guidebook developed by R. W. Beck for the North Central Texas Council of Governments in May 2009, http://www.nctcog.org/envir/SEELT/documents/Recycling_Contract_Negotiation_Guidebook.pdf

exclusively over the initial contract term. Therefore, longer contract terms can result in lower cost to the customer.

- **Actively work with the private sector.** Even prior to conducting a procurement process, engage with the private sector to gather information about what services are able to be provided and what the limitations or challenges are for a particular service. For instance, if distance to the processing facility is a barrier to organics processing, then a local government may be able to entice a private company to develop a facility as part of the procurement process. Frequent and quality discussions with the private sector are beneficial for the local government as well as the private companies involved.
- **Consider separating disposal and processing contracts.** When landfill-tipping fees are bundled as part of the overall rate for a particular service, the impact of diverting materials from the waste stream may not pass through to the local government. Local governments should consider developing separate disposal agreements in order to fully understand the cost of disposal. In addition, developing a separate processing contract may result in a better rate than the private sector is able to achieve because municipal contracts are generally longer term than private contracts.
- **Account for storm debris.** In the H-GAC region, it is critical for municipal hauling, disposal, and processing contracts to define whether the private company will be responsible for handling storm debris. If storm debris is specifically defined in the contract, it minimizes confusion when the municipality is responding to a disaster.
- **Ensure that operations are performed according to best management practices.** Municipal service agreements should include performance requirements for private companies to perform service for the community according to best management practices. For hauling operations, this would include utilizing the correct type of vehicles and containers, limiting set outs, and providing the appropriate collection frequency. For processing, typical contract provisions may include end product standards for compost material, a requirement to operate the facility according to the site-operating plan, and maintaining a site free of nuisances to the public.
- **Dedicate efforts to public education.** Many municipal service contracts include provisions requiring the contractor to contribute to public education and outreach. However, the most successful diversion programs are the ones in which the community itself, in partnership with the private company, dedicates adequate time and resources to public education. Local governments should consider contractually obligating itself to providing a certain dollar amount annually to public education for diversion programs. This ensures that the local government has adequate funds for this activity, especially in years in which there is a budget deficit.

7.2.2 Overcoming Industry Opposition

In some instances, local governments within the H-GAC region have experienced private industry opposition to organics efforts, specifically the development of municipally owned and operated processing infrastructure. Public-sector projects can be perceived as directly competing with private companies. Also, projects may be prohibited from grant funding if it is perceived that the project creates a competitive advantage over similar private sector efforts (see Section 7.5 for further information on grant funding).

In order to overcome industry opposition, as well as to demonstrate in a grant application that a project does not create a competitive advantage over private industry, local governments should consider the following strategies.

- **Conduct a procurement for services.** Before pursuing a municipal operation to provide service, local governments can conduct either a Request for Information (RFI) or a Request for Proposals (RFP) to gauge if private service providers are able to provide service in the area. If no service providers are able to provide service, it can be useful information to include in a grant application.
- **Engage in discussions with private operators.** Local governments that are interested in developing infrastructure for organics should initiate discussions with the private sector regarding what services are available and what obstacles exist to providing service in the area. Discussions may be formal, such as a roundtable, or informal, such as casual meetings in person or over the phone.
- **Demonstrate geographic barriers to companies providing service.** In many instances, the biggest barrier to utilizing existing processing facilities is hauling distance. If local governments are not located in a reasonable haul distance to an existing facility, include the specific distance in the grant application and provide an estimate of hauling costs and potential emissions that would be incurred by hauling material to the existing facility.
- **Explore and document alternatives.** In grant applications, communities should document alternative options for material if the grant is not awarded. For instance, if there are no service providers in the area willing to haul to a composting facility, will the material be landfilled? Does the City have the financial resources to pursue the project without the grant funding?

7.3 Achieve Political Acceptance

Achieving political acceptance from local government management and elected officials is a critical aspect of program development. Following are recommended strategies to gain political acceptance for organics diversion programs.

- Communicate with elected officials and management during the planning stages and provide frequent updates as to the status of program planning. Seeking feedback early in the process can be beneficial for building buy-in for the program.

- Gather feedback from the public using focus groups, public meetings, or statistically valid customer surveys. Concrete feedback from customers can be extremely persuasive to elected officials. R. W. Beck recommends conducting statistically-valid surveys when data is needed on the needs, preferences, and opinions of an entire community, as opposed to active members of the community.
- Provide benchmarking data from other communities, including costs, service levels, diversion data, and disposal cost savings. Success stories from other communities, particularly those that are similar in size and geographic area, can clearly communicate the benefit of organics programs.
- Conduct financial analysis to illustrate the potential financial benefits or cost to the community. If possible, show the cost differences between different scenarios that are being considered.

7.4 Develop Ordinances

Local governments may choose to implement ordinances to supplement and support organics diversion programs. This section provides a description of the types of organics ordinances that may be implemented.

This section is based on the *Recycling Ordinances and Building Design Guidelines* developed by R. W. Beck for the North Central Texas Council of Governments.[2] Local governments are encouraged to refer to this document for additional detail on organics ordinances. The document contains the following information for each ordinance:

- Inclusion criteria;
- Minimum requirements;
- Enforcement mechanisms;
- Penalties;
- Case examples; and
- Sample ordinance language.

The following provides a brief description of ordinances that can be put into place to support organics diversion.

7.4.1 Mandatory Program Development for Generators

Mandatory program development ordinances require that generators develop programs for organics diversion. For example, the City of San Francisco mandates that all generators develop organics diversion systems, including provision of labeled containers, for use by employees or occupants. Generators must also continually educate employees and occupants on how to properly source separate materials for composting.

[2] This document may be found at the following link: http://www.nctcog.org/envir/SEELT/studies.asp

7.4.2 Mandatory Recycling Rate

Some communities choose to require generators to demonstrate that they have achieved a specific recycling rate. These ordinances incent organics diversion if they are set at such a level that it is difficult to achieve the mandated rate without diverting organics. Mandatory recycling rates are more common on the West Coast, particularly in California.

7.4.3 Disposal Bans

Disposal ban ordinances prohibit public institutions and other commercial establishments from disposing designated materials. In addition, these ordinances can prohibit disposal facilities in the community, such as landfills and transfer stations, to accept prohibited materials for disposal. Disposal ban ordinances are commonly enacted in conjunction with a mandatory recycling ordinance.

Communities also have the option to enact disposal bans via a contract with a solid waste service provider. For example, the City of Arlington, Texas requires that its residential solid waste hauler not collect grass clippings from residential customers. This "Don't Bag It" program is not included in the City's code of ordinances.

Disposal bans for organics are commonly enacted on a statewide basis. The State of Arkansas, for example, prohibits the disposal of brush and yard trimmings in any landfill. Local governments are required to develop programs to divert this material. R. W. Beck has identified 24 states that have some form of a statewide landfill ban on organics.

Organics disposal bans have recently come under some scrutiny by landfill operators because of the development of landfill gas to energy (LFGTE) systems at many landfills across the country. Because organic material generates much of the methane produced from landfills, some believe that LFGTE and composting/organics bans are mutually exclusive approaches to solid waste management. Recent efforts to repeal a statewide organics ban in the State of Florida highlight this issue.[3]

Anticipating the emergence of this issue, the U.S. Composting Council released a joint policy statement with the Solid Waste Association of North America (SWANA) in May 2006. This policy statement states that both composting and LFGTE serve an appropriate place in integrated solid waste management. According to the statement,

> *"Composting is an organic recycling strategy, while the purpose of a bioreactor landfill is to reduce the long term care requirements for disposal of those organic wastes that are not being recycled, or are already present in existing landfills."* [4]

[3] Source: *"Florida Governor Vetoes Repeal Of Yard Trimmings Disposal Ban,"* Biocycle Magazine, June 2010

[4] Source: "*Joint Statement on Composting and Bioreactor Landfills,"* The Solid Waste Association of North America (SWANA) and U.S. Composting Council (USCC), May 2006.

Local governments may be required to examine the role of both LFGTE and composting/organics bans in their communities.

7.4.4 Mandatory Hauler-Provided Recycling Service

Local governments can require haulers to provide recycling services to public institutions and other commercial customers. This type of ordinance places the burden of compliance on the hauler rather than the generator of organic material. This type of ordinance typically requires haulers to do the following:

- Provide organics collection containers;
- Collect organic material with a specific frequency;
- Notify the participating customer of the program and its requirements; and
- Provide reports to local governments regarding the quantities of material collected.

It is important to note that this type of ordinance should only be enacted in a local government that has the infrastructure in place (e.g., processing facility) to divert organic material. The City of San Francisco's mandatory composting ordinance also includes requirements for solid waste collection service providers.

7.5 Pursue Funding for Composting

Local governments can choose to pursue financial and other benefits from composting. The benefits discussed in this section are grant funding, the TCEQ compost rebate program, and carbon credits.

Grant Funding

H-GAC administers the Solid Waste Grants Program in which it distributes grant funds made available through the TCEQ. However, these grant funds are only distributed to local governments or to public or private entities that partner with local governments for a particular program. Also, according to state law (Section 361.014 (b) TX Health & Safety Code), a project or service funded under this program must promote cooperation between public and private entities, and the grant funded project or service may not be otherwise readily available or create a competitive advantage over a private industry that provides recycling or solid waste services. **It is the responsibility of the grant applicant to demonstrate that the project does not create a competitive advantage. In order to demonstrate that a project does not create a competitive advantage over the private sector, local governments can utilize the strategies discussed in Section 7.2.**

TCEQ Rebate Program

Funding opportunities also exist for organics processors. For example, as provided by the Texas Health and Safety Code,[5] the operator of a public or privately owned MSW

[5] Source: Chapter 361, Section 361.0135 and Title 30 Texas Administrative Code, Chapter 330, Section 330.677

facility may be eligible for a rebate of up to 20 percent of the solid waste fees collected by the facility. To be eligible for the rebate, the operator of the facility must submit a composting plan to the TCEQ and receive written approval of the plan.[6] It is important to note that this rebate only applies to composting facilities owned by entities that have permitted MSW facilities (e.g., landfills, transfer stations) and not to independent compost companies. However, MSW facilities may choose to partner with independent compost companies in order to receive the rebate.

Carbon Credits

The Climate Action Reserve (CAR) is a carbon-offset registry. CAR registers carbon-offset projects of all types, including organic waste digestion and organic waste composting. The Organic Waste Digestion Project Protocol was adopted in October 2009 and the Organic Waste Composting Project Protocol was adopted on June 30, 2010.[7]

Currently, only food waste and food soiled paper composting is eligible for registry by CAR under the Organic Waste Composting Project Protocol. National data indicate that approximately 64 percent of yard trimmings generated are diverted from disposal. Because of this data, CAR determined that yard trimmings composting would not represent additional carbon reductions, since yard trimmings composting is consistent with the status quo.

For additional information about carbon credits for composting, refer to the CAR website at www.climateactionreserve.org.

[6] Source: Title 30 Texas Administrative Code, Chapter 330, Section 330.677

[7] Source: http://www.climateactionreserve.org/how/protocols/adopted/organic-waste-composting/current/

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Section 8
RECOMMENDATIONS FOR REGIONAL IMPLEMENTATION

There are many public and private entities that need to participate in order to implement organics diversion within the H-GAC region. Below are recommendations for regional government (e.g., H-GAC), local governments, and commercial generators in the region.

8.1 Regional Government

The primary means for H-GAC to influence organics diversion is to distribute TCEQ grant funding to projects and studies through the Solid Waste Grants Program. In light of this, R. W. Beck has identified recommended priority areas for grant funding based on the findings of this report. R. W. Beck would recommend that H-GAC place grant funding priority on projects that address the following issues:

- Public-private partnerships for organics diversion programs.
- Equipment and materials to develop municipal organics processing programs. Local governments that have a lack of processing facilities in their area may develop their own facilities to meet the needs of municipal programs.
- Provide public education. H-GAC can prioritize grants that provide education regarding home composting, benefits of organics diversion, uses and benefits of mulch and compost, and other organics-related issues.

R. W. Beck recognizes that there is some opposition in the region regarding local governments providing municipally-operated processing services. The current Solid Waste Grants Program requires that local governments demonstrate that their grant funding request would not create a competitive advantage over a private processor of organics. However, the grant program is unclear as to what kind of information would be needed to demonstrate that a project would not create a competitive advantage. To address this issue, R. W. Beck recommends that H-GAC create a working group (that may be a subcommittee of the Solid Waste Advisory Committee) to develop reasonable guidelines for local governments to follow when seeking a grant for organics processing. Private industry service providers should be actively involved in determining reasonable guidelines.

In addition to distributing grant funds, H-GAC, as the regional association of local governments, has an opportunity to take a lead role in supporting organics diversion on behalf of the region. More specifically, H-GAC could undertake the following:

- Organize stakeholder discussion forums, roundtables, and other networking events that enhance communication between generators, haulers, processors, and end users of organics. These programs help foster understanding of the needs and concerns of all stakeholders in the marketplace and develop cooperative efforts to increase diversion.

- Explore opportunities to work with state, regional, and national industry and trade associations in sponsoring activities of mutual benefit. Such activities can include educational workshops or conferences.
- Continue to provide outreach and technical assistance activities for local governments in the region on organics diversion.
- Include vendors of compostable food service items within the H-GAC Buy cooperative purchasing program. If these products are offered, it will be important to communicate the need for these materials to be composted.
- Consider providing relevant education on organic waste reduction, such as education regarding resource efficient landscaping for commercial buildings.

8.2 Local Government

Local governments that have an interest in expanding organics diversion within their jurisdiction can participate in regional efforts in cooperation with H-GAC as well as establish programs of their own. Potential roles for local government include:

- Set local goals, policies, and regulations regarding organics diversion. Local goals and policies will drive diversion efforts. It is very difficult to gain support for organics diversion without high-level direction on why it is important for a particular local government.
- Evaluate the adequacy or success of your residential yard trimmings program, if there is a program in place. If there is no program in place, initiate discussions with management and elected officials as to the benefits of yard trimmings recycling.
- Identify area needs for hauling and processing service. Communicate with service providers about the need for these services within the service area.
- In areas that lack processing capacity, consider conducting a procurement for a private company to build a composting facility on local government property. Commit to providing material to the facility for a certain price for a seven to 15 year contract. Having the assurance of material for a longer period of time will provide greater incentive for a private company to develop infrastructure.
- Regionalize organics programs by cooperating with other communities to provide education, and even infrastructure. Sharing capital costs can make organics programs more financially feasible and ensure a lower cost per ton (due to greater throughput from multiple communities).
- Consider unbundling your community’s solid waste disposal contract. Paying for these costs directly, instead of bundling them as part of the residential solid waste fee, can demonstrate the direct benefit of diverting a large material stream like commercial organics.

- Reach out to commercial generators within the local government's jurisdictional area to provide education and awareness about the benefits of organics diversion.
- Consider an exclusive franchise for commercial hauling. If awarding the right to provide refuse hauling service for an entire community, local governments have the ability to require that haulers offer services such as commercial recycling and commercial organics collection.
- For municipal organics diversion programs, consider entering into medium to long term contracts with processors of organics (e.g., three to seven years). Extended contract terms will enable processors to invest in their facilities and ensure long-term financial viability.

8.3 Commercial Generators

Below are recommendations for commercial generators of organic materials to overcome some of the challenges associated with commercial organics diversion.

- Evaluate waste reduction opportunities such as reducing food packaging, evaluating food preparation practices and purchases, grasscycling, resource efficient landscaping, and other opportunities. Organics waste reduction can make a significant impact when barriers prohibit the development of organics collection and diversion programs.
- Talk to waste haulers and other service providers about the feasibility of providing organics collection service and the costs associated with those services. When there are hesitations about providing service, consider a pilot program to evaluate the feasibility of a large-scale system.
- Engage with local governments in the region for opportunities to partner to develop organics diversion programs.
- Assess the potential cost reductions associated with organics diversion, including reduced waste hauling fees, food purchases, and soil amendment costs. Communicate with stakeholders about the cost saving opportunities associated with organics diversion.
- Engage all stakeholders (e.g., management, staff, custodians, kitchen staff) from the planning stages of a project to solicit their feedback on program development. It is important to maintain stakeholder engagement on an ongoing basis to get feedback on program performance.
- Communicate with local processing facilities about the interest in organics diversion. Processing facilities may consider expanding service (e.g., accepting food scraps) if they knew there was demand for service.

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A.1 Overview

In 1993, The State of Arkansas enacted legislation prohibiting yard waste from being disposed in landfills. Because of this regulation, the City of Little Rock (City) developed a program for the collection and diversion of yard waste through a composting operation.

A.2 Residential Collection

The City collects leaves, grass, and bundled brush from residents one time per week using rear-loading collection vehicles. Residents place material in plastic bags or customer-provided garbage cans for collection. The City also has three knuckle boom trucks that are used to collect large brush piles from residents on a call-in basis. City staff brings the residential yard waste material to the mulching and composting area of the City's disposal facility as shown in Figure A-1.

Figure A-1: Residential Yard Trimmings Feedstock Arriving at Compost Facility

The City's curbside collection program generated approximately 90 percent of the incoming material to the compost site over the last several years. Landscaping and tree trimming firms may bring in additional yard waste and brush. Other clean wood debris, such as pallets may be delivered to the landfill by vendors or haulers.

A.3 Composting Operation

At the compost site, the material is ground and screened to remove contaminants, such as shredded plastic bags. City staff has marketed the ground yard waste as mulch, compost, and boiler fuel. In the past, the City has also used the ground yard waste as alternative daily cover. However, the City has minimized its use of this material for alternative cover because of its poor compaction properties. The City generates revenue from the sale of material as mulch, compost, and boiler fuel.

A.3.1 Site Size and Features

The City's composting operation is co-located with the City's landfill at 10803 Ironton Cut-Off Road, Little Rock, Arkansas. The designated composting area, excluding the City's disposal facility, is approximately 20 acres.

- **Pad:** The composting pad at the facility is constructed from asphalt.
- **Security features**: The site is an integrated waste management facility, which includes the City of Little Rock solid waste hauling, demolition debris (Class 4) landfill, MSW (Class 1) landfill and composting operations in addition to the scale house and solid waste department office. The site is fenced and access to the facility is through a gated entrance.
- **Water access**: The facility is served by city water supply. In addition, there are two stormwater collection/detention ponds near the compost site.
- **Retail area**: A majority of the compost produced by the City of Little Rock is used in city landscape projects. Compost is available for purchase by area residents and landscape businesses. In addition to compost the City also produces wood chips and wood boiler fuel. A majority of the wood chips produced are used by the City's Parks Department; some wood chip material is available to residential and small business for purchase when there is excess material. The City does have a few industrial customers that purchase wood boiler fuel.

A.3.2 Operating Hours

The operating hours for the City's composting facility are as follows:

- Monday through Friday from 4:00 pm to 7:00 pm; and
- Saturdays from 7:00 a.m. to 12:00 p.m. (seasonally).

A.3.3 Feedstock

Over the last several years, the facility has handled 22,000 to 24,000 tons of yard waste annually.

Contamination

Residents often place yard waste in plastic bags for collection by the City's curbside collection operation. Currently, the plastic bags are shredded as material is sent through the grinder. The ground material is then moved to windrows and the plastic is screened out once the compost has matured. However, small plastic pieces passing the 3/8-inch screen opening during the final screening process still may contaminate the compost, resulting in a lower quality final product.

Plastic bags are considered contamination and their removal therefore represents an additional cost to the City.

A.3.4 Equipment

Table A-1 lists the equipment used in the compost operation. In addition to the equipment listed in Table A-1, the City has a semi-truck used to move some of the stationary equipment around the site.

Table A-1
Equipment Used in Compost Operation

Equip. No	Year	Make	Description
01H012	2001	Morbark	Grinder
01H014	2001	Morbark	Trommel screen
01N121	2001	Case	Front end loader
05H016	2005	Wildcat	Windrow turner
08H019	2008	Metso	Vibratory screen
86N036	1986	Case	Front end loader
93N093	1993	Case	Front end loader

A.3.5 Staffing

The City employs four full-time employees as part of the composting operation, including three equipment operators and a supervisor. Additionally, some landfill staff may assist with operations at the compost site from time to time. Compost operators are generally kept busy with site operations on a full-time basis. If one of the staff is absent due to illness or vacation, the operation works short-handed or the supervisor helps out in an operator role. The compost operation supervisor and the landfill supervisor will cover each other’s duties during vacation or other absences.

A.3.6 Compost Process

Feedstock and Grinding

Yard waste delivered to the site is separated into general yard waste feedstock and oversized material, such as tree trunks or pallets, which are ground for mulch. The facility uses a tracked excavator equipped with shears to split tree trunks that allow the facility to handle large tree trunks for grinding into valuable mulch. Tree stumps and root balls are transported to the Class 4 landfill for disposal. The Morbark 7600 Wood Hog grinder is currently used for the grinding operation.

Once ground, the materials are then shaped into a windrow formation using a wheeled loader as shown in Figure A-2.

Figure A-2: Windrow formation at the City of Little Rock Composting Facility

Turning Compost Windrows

The compost operation currently uses a Wildcat SPB716 self-propelled windrow turner. This unit has the capability of turning a windrow seven feet in height by 16 feet wide. If windrows are constructed to this height and width and spaced with approximately 8 feet between each windrows, approximately 35 windrows could be constructed at one time. However, additional spacing is left by skipping a windrow or two for easier equipment access and fire lanes. Generally, the maximum number of windrows on the site at any one time is likely to be 28 to 30. Windrows are turned one to two times per week at this operation. Composting is usually completed in approximately 90 days by the City operation.

Managing Moisture Content

The City has had some issues with exceptionally moist compost during the final screening process at the facility, caking and clogging the screens. In order to prevent this issue, the City turns the windrows more frequently as the compost nears its maturity, prior to screening.

Screening

The landfill replaced one trommel screen with a vibratory screen. Discussions with staff indicate that this has improved the efficiency of its operation. According to staff, the vibratory screen appears to screen the compost better, resulting in final compost with less contaminants. A trommel screen is still onsite and used in the operation, but with less frequency.

A.3.7 End Markets

The City sells compost and mulch to residents, landscapers, and commercial business and has industrial customers for the boiler fuel. Sales for these products average between $50,000 and $60,000 per year. In 2007, the average sales price per ton for the material was as follows:

- Compost - $14.67
- Mulch - $17.07
- Boiler Fuel - $1.75
- Weighted Average - $8.38

As shown above, the average price per ton for compost is lower than mulch even though compost is considered a premium. This is because a majority of mulch is sold to residents at $25 per ton. By contrast, more compost is sold to commercial customers in bulk for $12 to $14 per ton.

A.4 Key Findings for the H-GAC Region

Based on the case study of the municipal composting operation for the City of Little Rock, Arkansas, R. W. Beck identified the following key findings that are applicable to the H-GAC region:

- Boiler fuel is a potential end market for lower-quality compost or mulch product.
- When plastic bags are permitted for curbside collection of yard trimmings, considerable contamination can occur in the final compost product.
- Co-location of composting facilities with other solid waste or recycling facilities allows for sharing of staff during peak times as well as other equipment, such as a scale for weighing of loads.

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Appendix B
ALAMEDA COUNTY SOLID WASTE MANAGEMENT AUTHORITY CASE STUDY (Stopwaste.org)

B.1 Overview

The Alameda County Waste Management Authority (of Alameda County, California), otherwise known as Stopwaste.org (Stopwaste) is a public sector entity developed in 1976 by a Joint Exercise of Powers Agreement.[1] The Agreement was developed between Alameda County, 14 local governments, and two sanitary districts.

Stopwaste is responsible for the development and implementation of the Solid Waste Management Plan that outlines how the region will meet the state-mandated diversion goal of 50 percent.[2] In addition to the 50 percent state mandate, the Authority adopted a local goal to meet a 75 percent diversion rate by 2010 while pursuing greater diversion into the future.

Stopwaste is promoting diversion of organics, specifically food waste and other compostable materials, as a key part of its efforts to achieve 75 percent diversion. This section describes its efforts to divert residential and commercial food scraps from the waste stream.

As an agency, Stopwaste does not have authority to direct any jurisdiction on what programs it should put in place for waste or recycling. However, Stopwaste assesses a fee on tons disposed within Alameda County to fund its operations. A portion of this funding is redistributed to jurisdictions on an annual basis. In order to be eligible for funding, communities must comply with a minimum level of diversion programs. Because of this available funding, jurisdictions have an incentive to implement diversion programs in a uniform manner.

B.2 Waste Characterization

Based on the results of a waste characterization study conducted in 2000, Stopwaste found that compostable materials, including food scraps, plant debris, and contaminated paper, comprised approximately 27 percent of the waste stream. Of the 40 material categories measured by the study, these four materials were the four largest in the composition of the waste stream. Because of this reason, Stopwaste decided to focus on diversion of organics as a strategic regional initiative in order to achieve the local goal of 75 diversion.

[1] Source: www.stopwaste.org; A Joint Exercise of Powers Agreement allows two or more public authorities to operate collectively.

[2] Assembly Bill 939 (AB 939) passed in 1989 required all communities in California to achieve a 50 percent landfill diversion rate by the year 2000.

B.3 Economics of Organics Diversion

B.3.1 Pay as You Throw Service Rates

Most of the Stopwaste jurisdictions have implemented pay as you throw (PAYT) service rates for residential collection. The rate structures in place in each community vary in their progressiveness (i.e. cost difference between the largest and smallest container). Following is a summary of the range of cost for each refuse container size for the 17 jurisdictions.[3] These rates are inclusive of all residential services received.

- 30-35 gallon refuse container: $10.92 to $30.55 per month
- 60-64 gallon refuse container: $21.84 to $61.07 per month
- 90-96 gallon refuse container: $32.76 to $91.60 per month

B.3.2 Local Landfill Tipping Fees

The Stopwaste *5-Year Audit Program Assessment Final Report* identifies 16 landfills and transfer stations used by entities in the region (both within and outside of Alameda County).[4] According to this document, the average transfer station-tipping fee for municipal solid waste (MSW) was approximately $74.00 per ton (ranging from $60.00 to $90.00 per ton). The average landfill-tipping fee for MSW was approximately $35.00 per ton (ranging from $22.00 to $53.00 per ton).

B.4 Residential Collection

Weekly yard waste collection is one of the programs required by Stopwaste in order for jurisdictions to be eligible to receive funding; therefore, all jurisdictions within Alameda County have curbside collection of yard waste. The elements of this program include the following:

- Weekly collection
- Cart-based (size varies)
- Residents may use compostable bags or an additional cart for extra material

In 2001, Stopwaste began the process of coordinating with its member jurisdictions to integrate food scraps into the existing residential yard waste programs. Stopwaste provided $8.00 to $10.00 per household to municipalities that volunteered to participate. This funding was used as initial funding for program implementation costs.

In exchange for the implementation funding provided by Stopwaste, jurisdictions implementing food scrap recycling programs agreed to be consistent with the following:

[3] Source: Alameda County Source Reduction and Recycling Board, "*5-Year Audit Program Assessment Revised Final Report*," January 2008

[4] Ibid.

- Accept all food scraps, including produce, meats, breads, and dairy, and residential yard waste. Excluded from the programs are diapers, grease, and palm fronds.
- Cities would arrange with service providers to have material collected and composted.
- Collection would be conducted weekly using the residential yard waste carts.
- Jurisdictions would purchase kitchen pails (approximately one to two gallons) for distribution to all residents. Implementation funding could be used for these kitchen pails.
- Jurisdictions would utilize consistent messaging, terminology, and educational materials with the regional (Countywide) program.

Once jurisdictions have implemented residential foods scrap recycling, Stopwaste provides ongoing support in the form of cart auditing, troubleshooting, and regional marketing, as discussed in Section 1.6. At the time that this Manual was written, 15 jurisdictions in Alameda County had implemented residential food scrap recycling. The last community to implement the program was in 2009.

The funding for the residential Organics Technical Assistance program varies considerably from year to year. For instance, in FY 2009-2010, the annual budget was $279,000. In FY 2010-2011, the planned budget is approximately $1,000,000 due to a the implementation of new regional marketing initiatives.

B.5 Commercial Collection

This section describes multiple efforts on the part of Stopwaste to facilitate commercial food scrap diversion in its jurisdictions.

B.5.1 Stopwaste Business Partnership

Stopwaste runs a voluntary recycling technical assistance program, Stopwaste Business Partnership that targets medium to large-sized businesses. As part of this program, Stopwaste conducts on-site environmental assessments for local businesses that includes an evaluation of waste and recyclables management. Stopwaste then provides each business with a recommendations report. For certain businesses, recommendations may include food scrap recycling. Stopwaste, in partnership with local haulers, provides technical assistance for implementation of food scrap recycling. The annual budget for the Stopwaste Business Partnership program is approximately $1.2 million; however, this program covers a broad range of issues beyond organics recycling.

B.5.2 Commercial Food Scrap Outreach

Private haulers compete throughout Alameda County for collection of commercial food scraps; Stopwaste jurisdictions do not have exclusive franchise agreements for food scrap collection because this material is defined as a recyclable commodity.

Stopwaste works with each of its jurisdictions in targeting large generators of commercial food scraps. Each jurisdiction is responsible for ensuring that there are service providers available to provide collection service.

In cooperation with local haulers and staff from the jurisdictions, Stopwaste staff provides technical support to large generators that wish to divert food scraps. Technical support can include developing educational materials, conducting staff training, and designing the interior and exterior collection areas.

B.6 Regional Marketing Campaign

One of the primary roles of Stopwaste in the regional residential food scrap recycling program is the management of a regional marketing campaign. The jurisdictions provide residents with the needed information on *how* to participate and Stopwaste focuses on marketing and advertisement that persuades residents on *why* they should participate. The following section describes key elements of the Stopwaste marketing campaign, “Make it Second Nature.”

B.6.1 Successful Messaging

The key message of the regional food scrap recycling campaign for Stopwaste is “Make it Second Nature.” This message is meant to communicate the following:

- Food scrap recycling is just as common and as “everyday” recycling of bottles and cans. This message is effective for the California audience that is accustomed to recycling bottles, cans, paper, and other traditional recyclables.
- Food scrap recycling is connected to the nature cycle. Because of the high amount of agriculture in the area, Stopwaste is able to make the connection of food scrap recycling and the food that is consumed on a daily basis.

Figure B-1 below is a sample educational piece that educates Alameda County residents on the cycle of food scrap recycling.

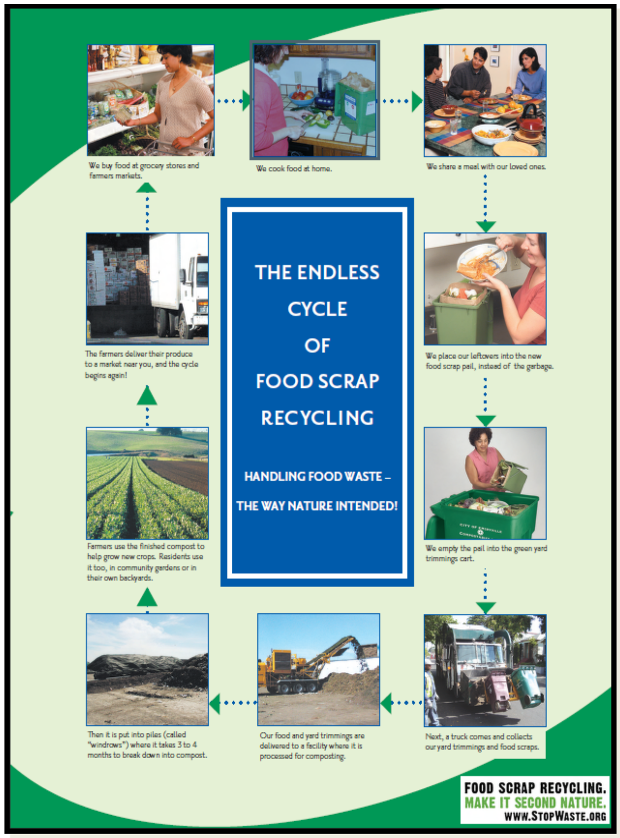

Figure B-1: Sample Nature Cycle Educational Piece

B.6.2 Consistent Elements

A key benefit of a regional marketing campaign is the consistent messaging and program operational requirements across all communities. For instance, all of Stopwaste's food scrap recycling education features the green organics cart. In addition, all communities that participate in the program must have a green cart for food scraps and yard waste. In addition, the term "food scrap recycling" is used to describe the program. This terminology was chosen for the following reasons.

- Other communities have chosen to describe their residential food scrap programs as "composting." However, Stopwaste actively promotes backyard composting and did not want to create customer confusion.
- The word "scrap" was used instead of "waste" to reinforce the concept that food scraps are a recyclable resource and not a waste product.

The green cart and the use of the term "food scrap recycling" are two common elements in the "Make it Second Nature" marketing campaign. The following figure is an example of a billboard that utilizes these two elements.

Figure B-2: Sample Billboard with Common Educational Elements

B.6.3 Overcoming Common Obstacles

The regional marketing campaign seeks to overcome some common obstacles that may prevent residents from participating in food scrap recycling. The following table shows the most common obstacles to participation in food scrap recycling and the strategies that Stopwaste used in its marketing campaign to overcome these obstacles.

Table B-1
Strategies to Overcome Obstacles

Obstacle	Strategies
The “ick” factor A common objection to participating in food scrap recycling is the fact that it is perceived as unsanitary. Residents also express concerns about odors and pests resulting from their source separation of food scraps.	▪ Stopwaste ensured that all images of food scraps used in marketing materials were generally sanitized and clean in appearance. ▪ Marketing materials provide tips on how to keep food scrap separation sanitary. For instance, you may freeze food scraps until collection day to prevent degradation of materials. In addition, residents are encouraged to use aseptic containers (e.g., ice cream container, milk carton) to collect food scraps before placing them in the cart.
It’s too complicated Some residents perceive food scrap recycling as being too difficult.	▪ All marketing and educational materials emphasize easy one, two, three steps to participate in the program. ▪ All food scraps are accepted. The specific materials that are not accepted are diapers, palm fronds, and grease.
Confusion about paper products Most residents are able to easily understand composting of food scraps, but they have difficulty understanding integration of paper products.	▪ Stopwaste developed context-based marketing by distributing pizza boxes, coffee sleeves, and take out containers to local vendors that had food scrap recycling information printed on the side. ▪ The “Make it Second Nature” promotional materials specifically highlight coffee sleeves and pizza boxes as being accepted in the program.

B.7 Key Findings for the H-GAC Region

Based on the case study of Stopwaste.Org of Alameda County, California, R. W. Beck identified the following key findings that are applicable to the H-GAC region:

- In order to successfully divert residential food scraps, it is important for a community to have a mature and proven green waste program in place.
- It is important to develop strategic thinking on why organics diversion is an important regional initiative. Conducting a waste characterization can be valuable in demonstrating to elected officials and policy makers the importance of diverting organics from the landfill.
- When developing organics diversion efforts, especially for food scraps, it is critical to ensure that the appropriate partners are in place. Having users of compost, haulers of material, and composters of material is critical to the success of a program.
- Prioritizing grant funding for communities that have certain programs in place can be an effective incentive to advance diversion efforts.

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C.1 Overview

The City of Denton (City) operates a composting facility located on a campus adjacent to the City of Denton Landfill (Landfill) facility and the City's Pecan Creek Water Reclamation Plant (WRP). This composting facility has been in operation since 1994 and is primarily utilized as an alternative approach for biosolids management with the use of sludge from the WRP as a primary feedstock. Other feedstocks are collected through diversion from the adjacent Landfill and through the City's residential brush and yard trimmings collection program.

C.2 Residential Collection

The City of Denton's Solid Waste Department (SWD) currently provides brush collection services to residential customers once per week. Brush collection includes the collection of lawn trimmings, leaves, tree limbs, and other similar organic materials.

The SWD currently operates two routes dedicated to brush collection, plus a knuckle-boom truck for collecting larger brush piles. During the peak brush season, which is approximately March to September, the SWD may operate an additional brush truck. The knuckle-boom truck drives the same quadrant in which the brush routes are assigned on a given day.

Residents are allowed to place up to eight cubic yards at the curb for no additional charge. Residents are instructed to cut larger brush items into four-foot or smaller sections for collection. Residents are asked to bag yard waste and cut brush into lengths of four feet or less. The SWD conducts annual bag distribution events to provide residents with clear plastic bags that are intended for disposal of yard waste.

Yard waste and brush piles less than six cubic yards are collected by the manual collection crews using rear-load collection vehicles. The vehicles are used interchangeably with those used for manual residential refuse collection. In addition, the SWD has two knuckle-boom trucks, a frontline and back-up unit. Brush collection crews are instructed to call in brush piles that exceed six cubic yards so that the knuckle-boom truck can collect the larger brush piles.

C.3 Composting Operation

From this feedstock, several varieties of compost, mulch, and soil blends are created and sold to the general public. The name, description and pricing structure of these end products are discussed in Section C.3.7.

C.3.1 Site Size and Features

The City's composting operation is adjacent to the City's WRP and Landfill at 1100 Mayhill Road, Denton, Texas. The designated composting area, excluding the City's water reclamation plant, is approximately 12 acres.

- **Pad:** The composting pad at the facility is constructed from concrete.
- **Security features:** The site is equipped with an eight-foot chain link fence and an automated entry gate that is kept closed during non-working hours. Operators from the WRP are on duty 24 hours per day and include the compost facility in their regular inspection routes.
- **Water access:** The compost facility utilizes a tractor-mounted water tank and sprayer unit to control moisture levels in the windrows. Additionally, moisture is added during the screening process to minimize any windblown litter.
- **Retail area:** The public retail area is located near the entrance gate to the WRP site and is far from the compost operations area. For the safety of the general public, all transactions occur with the customers in their own vehicle. Customers drive to a window where they place an order for a specific product, and facility staff communicates via two-way radios to complete the order.

C.3.2 Operating Hours

The City operates the composting facility five days per week. The retail portion of the facility is open during the following times:

- Year-round on Wednesdays and Saturdays from 7:00 am to 3:00 pm; and
- From March 1st through November 1st, Tuesday, Thursday and Friday from 7:00 am to 11:00 am.

C.3.3 Feedstock

Feedstock Sources

As previously discussed, three feedstock types are collected for use at the composting facility:

- Sludge from the adjacent WRP;
- Brush and yard trimmings from the City's residential collection program; and
- Clean lumber diverted from the Landfill.

Contamination

Residents place yard waste in clear plastic bags for the City's curbside collection operation. Because the composting operation cannot accept plastic bags, the yard waste collection crews must manually rip open each yard waste bag and dump the contents into the rear-load truck. The empty plastic bags are then set aside and ultimately disposed in the landfill. The crew members check for contamination, which may include refuse or other non-compostable material, before tearing open the bags. Contaminated bags of yard waste are left at the curb. Refuse collection crews also do a cursory check of yard waste bags, looking for contamination. If contamination exists, they will dispose of the bags as refuse.

C.3.4 Equipment

The equipment utilized for daily operation of the composting facility includes the following:

- Large wheel loader with a 4 and 12 CY bucket;
- Small wheel loader with a 1 CY bucket;
- Scarab windrow turner;
- Trommel screen with 3/8" screens;
- Small grinder;
- Tractor-mounted water tank and sprayer unit; and
- Equipment/maintenance truck.

C.3.5 Staffing

Currently, the City employs three full-time employees and one part-time employee at the composting facility. Staff from the WRP is also utilized during the weekends to record the temperatures of the active composting windrows. Of the staff exclusively assigned to the composting facility, two employees operate the heavy equipment, one operates the light equipment and one acts as an unskilled laborer. Responsibilities are as follows:

- **The heavy equipment operators** handle construction, turning and removal of the windrows, recording temperatures, maintenance, screening, loading large bulk customers and adding water to the windrows.
- **The light equipment operator** handles loading the majority of public purchases, oversees debagging of yard trimmings from the residential collection routes, and monitors any other incoming brush or yard trimmings.
- **The unskilled laborer** handles debagging of residential yard trimmings, cleaning, and other daily maintenance tasks.

C.3.6 Compost Process

Feedstock and Grinding

Loads from the City's brush and yard trimmings collection arrive at the composting facility once per week. Loads of brush and clean lumber from the landfill are also delivered to the composting facility on as needed. When received, these materials are debagged (if necessary) and stockpiled onsite until needed. Composting staff inspects these materials for contaminants and to ensure that treated wood is disposed at the landfill.

Brush and yard trimmings are ground using a tub grinder until the material is roughly two to three inches in diameter. This operation is contracted to a third-party service provider. This chipped material is then combined with the biosolids to form the windrows. In general, a 4:1 ratio of chipped brush and yard trimmings to biosolids is used. However, in summer months, a ratio as small as 3:1 can be used to maintain moisture content in the windrow, as a greater amount of water is evaporated in the heat.

Windrow Formation

Windrows are formed using a layering process as shown in the following steps:

- The wheel loader is used to spread a layer of the chipped brush and yard trimmings as a base for the windrow.
- The empty loader bucket is used to slice a divot into the top of the chipped brush and yard trimmings layer. This divot should be large enough to receive approximately ¼ of the volume of the existing layer of chipped brush and yard trimmings.
- The appropriate amount of biosolids are added to the divot.
- A small amount of sawdust and finished compost is added over the biosolids layer. Sawdust increases the finished volume of the compost, but must be used sparingly to avoid lowering the quality of the product. The finished compost is used to seed composting microbes into the windrow and expedite the initial composting stage.

After these layers are formed, the windrow turner makes a minimum of two passes through the windrow to ensure that the materials are fully integrated and to initiate the active composting stage.

Active Composting and Curing

Once formed, the windrows begin the active composting stage. During this stage, the temperature is continuously monitored to ensure that sufficient levels are reached to kill pathogens and weed seeds. As needed, the windrows are turned with the windrow turner to ensure that the windrows compost evenly. After approximately 15 consecutive days with temperatures reaching greater than 55 degrees Celsius, windrows are dismantled and reformed into large curing piles for approximately three months. During this time, the compost stabilizes and temperatures hover around 45 degrees Celsius.

Screening

After the material has been cured, the compost is processed through the screener with 3/8” screens. During this process, moisture is added at the fine exit of the conveyer to minimize the production of dust or windblown debris. The fine material that passes through the 3/8” screen is moistened further and then formed into windrows for post-processing.

C.3.7 End Markets

In 2008, bulk and bagged compost sales totaled approximately $450,000. The price structure and description for each of the end products sold at the facility is summarized in Table C-1.

Table C-1
Denton Compost Facility End Products

End Product	Description	Price (per CY)
Dyno Dirt	Biosolids compost for use on lawns, flowerbeds or for applications around trees.	$25.00
Dyno Soil	Mixture of 50 percent biosolids compost and 50 percent sandy soil blend for use in raised beds, potted plants, soil enrichment, and yearly lawn applications.	$30.00
Dyno Landscape Mulch	Composted mulch product made from 80 percent wood chips and 20 percent Dyno Dirt for use around trees, flowers and shrubs.	$27.50
Dyno Lite	Compost made exclusively from yard trimmings and brush feedstock, which is suitable for use in vegetable gardens and small potted houseplants.	$30.00
Dyno Double Grind Mulch	Wood mulch, which has been ground twice, and helps retain moisture and conserve water.	$17.50
Dyno Deco-Colored Mulch	Colored wood mulch, which helps to add aesthetic appeal to outdoor spaces, will function as an agent to retain moisture and conserve water.	$30.00

The City also provides incentives for customers that purchase compost in large quantities. If a customer buys 10 CY or more, a 20 percent discount is applied. If a customer buys 100 CY or more, a 40 percent discount is applied.

C.3.8 Annual Budget

The annual operating budget for the Denton composting facility is approximately $1,000,000. This budget does not include capital expenses to construct the facility.

C.4 Key Findings for H-GAC Region

Based on the case study of the organics collection and processing program in the City of Denton, Texas, R. W. Beck identified the following key findings that are applicable to the H-GAC region:

- Local government solid waste divisions may partner with wastewater utilities for a mutually beneficial composting program.
- Utilizing plastic bags for curbside collection of yard trimmings is not recommended.
- Higher quantities of high-nitrogen materials may be required in compost during summer months in order to provide adequate moisture.

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D.1 Overview

The City of McAllen (City) has operated a composting facility since 2003. The City's facility was the first city-operated composting site in the Rio Grande Valley region of Texas. Currently, the facility produces approximately 16,000 tons of compost and mulch per year and accepts approximately 20 tons of food waste per day.

D.2 Residential Collection

The City's solid waste collections department collects leaves, grass, and bundled brush from residents one time per month using a grapple truck. Residents place brush material loose at the curb and use paper bags for leaves and grass. City staff brings the residential yard waste material directly to the composting facility.

D.3 Commercial Collection

Through the "Save the Greens" program, the City also collects food waste from several commercial customers within the City limits on Mondays, Wednesdays and Fridays. An example food scrap collection bin and its contents are shown in Figure D-1 and Figure D-2.

Figure D-1: Food Scrap Collection Container

Figure D-2: Contents of Food Scrap Collection Container

These commercial customers include grocery stores, large super-centers, and industrial food processors. The City utilizes a front-load container mover to collect containers from commercial customers. When collecting food scraps, City staff use the container mover to transport an empty container to the site (this vehicle is partially shown in

Figure D-3). Staff then unload the empty bin at the site and load the full bin onto the container mover vehicle. This full bin is taken and dumped directly into the windrows at the composting facility.

City staff has expressed that this method of collection is effective for the collection of a few containers, but lacks the potential for expansion. With this in mind, the City has made progress toward incorporating the “Save the Greens” program as part of the City’s commercial collections department in the hopes that a more conventional collection system can be established in the future.

In addition, the City has several commercial customers who choose to self-haul food waste to the composting facility at no charge.

D.4 Composting Operation

The composting operation opened in 2003 and began accepting food waste as part of the “Save the Greens” program in 2007. Through this program, the City is able to process produce, including fruits and vegetables. The facility produces two types of compost:

- Regular compost, which is mainly composed of brush and is only screened once; and
- Premium compost, which includes food residuals and is screened twice.

The premium compost is considered to be a superior product because of the high level of organic material present in the mix. The City generates revenue from the sale of both types of compost as well as from several mulch products as summarized in Table D-1.

D.4.1 Site Size and Features

The current composting facility is approximately 60 acres and is located at 4101 Idela Avenue, McAllen, Texas. The facility is located in close proximity to the City’s wastewater treatment plant in a moderately populated area.

Several advantages exist at the current site and include:

- Sufficient site size for current operations;
- Potential to expand current facility; and
- Proximity to major thoroughfares.

Several disadvantages also exist at the current site and include:

- Proximity to residential areas; and
- Issues related to drainage problems during periods of heavy precipitation.

With these advantages and disadvantages in mind, the City has made the decision to relocate the compost facility to a more rural area further away from residential areas. The future location of the composting facility is smaller than the current location at approximately 25 acres. However, the City also owns approximately 200 acres surrounding the new location, providing the potential for expansion, if necessary, as well as a generous buffer area. In addition, the City is not currently using all 60 acres for composting at the current site, and much of the current site is being used for storage of uncomposted yard trimmings material.

The following are additional characteristics of the current site.

- **Pad:** The composting pad at the current facility is constructed from compacted native soil. The City is evaluating whether to construct a concrete pad at the future facility to increase durability and improve site drainage during heavy rainfall.
- **Security features:** The site is surrounded by a chain link fence with barbed wire, and also has a security alarm, night lighting, and locks for specific pieces of heavy equipment.
- **Water access:** Water trucks, a mobile sprinkler system and fire hydrants are present on the site.
- **Retail area:** The site has a limited retail area where customers may purchase bulk compost or bagged product. Bagged compost and mulch may also be purchased from the City's Material Recovery Facility (MRF).
- **Neighbor relations:** To maintain good relationships with the neighbors surrounding the current site, the composting facility provides compost and mulch for their homes free of charge. This practice also helps to increase security by minimizing the amount of trespassing at the site.

D.4.2 Operating Hours

The City operates the composting facility Monday through Friday from 7:30 am to 4:00 pm.

D.4.3 Feedstock

The City composting facility processed approximately 20,000 tons of residential brush and yard waste feedstock and approximately 2,200 tons of food waste feedstock from commercial customers in 2009. Additional brush and yard waste feed stock is generated from hurricanes and other weather events and provide the facility with a considerable backlog of mulch for use in the composting process.

Contamination

The City does not allow plastic bags to be used for collection of food scraps. However, some plastic contamination can occur. To prevent contamination from affecting the final product, the City does not shred food waste material prior to composting. Food scraps are unloaded directly into a windrow and covered with brush. The food scraps break down during the compost process and also when they are turned with the windrow turner. When the finished compost is screened, any residual plastic bags are still generally in large pieces and are able to be screened out more easily.

D.4.4 Compost Process

Feedstock Preparation

Incoming brush and yard trimmings is ground and stored in piles until it can be utilized to build windrows. As mentioned previously, the City has access to a large volume of ground brush from hurricanes and other weather events.

As brush and yard trimmings are accepted at the site, compost staff separate large stumps from the material for separate processing. The materials are ground using a tub grinder from an outside contractor. The City has chosen to contract with an outside company for tub grinding services, as they have determined that this is the most cost effective option for grinding.

When a load of food waste is accepted at the composting facility, employees unload material directly from the container to a trenched windrow. A wheel loader is used to create a trench in the windrow.

Figure D-3: Addition of Food Scraps to Windrow

City staff then use the wheel loader to close the trench in the windrow to ensure that all food scraps are covered with a layer of yard trimmings.

Figure D-4: Covering Exposed Food Scraps with Yard Trimmings

Windrows are currently constructed to be no more than 12 feet in height to minimize the potential for fires. Individual windrows are approximately 30 to 40 feet wide and are spaced approximately 10 to 20 feet apart to allow the windrow turner to easily pass between the rows.

Turning Windrows

In general, the windrows are turned once or twice per week depending on the temperature of the windrow. The windrows complete the active composting stage in approximately six to eight weeks. The City checks each windrow once per day to ensure that temperatures are controlled. When the windrows have a higher temperature, the City increases the turning frequency and can complete the active composting stage in as few as four weeks.

Compost Moisture

The City has cited moisture content as a distinct challenge for their composting facility due to the climate in McAllen which is known for high year-round temperatures, as well as the lack of access to water at the site location. The incorporation of moisture into the windrows is accomplished in two ways:

- An on-site mobile sprinkler system, which allows the City to water compost piles over an extended period of time; and
- A water truck for extensive moisture needs.

When applicable, the City also relies on the moisture present in its food feedstock to maintain windrow moisture. As an example, the City has previously accepted orange juice as a feedstock for compost and therefore needed less additional water for the active composting process.

In general, the City chooses to incorporate food waste feedstock with wood feedstock as an initial step and assess the moisture needs of the compost in a successive step. Under this configuration, the City can adequately utilize the moisture inherent in the food waste prior to supplementing moisture with water.

Screening

All compost is screened at least once after the active composting stage is complete to remove any plastic or debris from the mixture prior to curing. Regular compost is screened once, as without the addition of food waste, the likelihood of contamination from plastic is diminished and any successive screenings do not increase the value of the finished compost product. In contrast, the premium compost must be screened twice to ensure that all plastic and debris has been removed.

Curing

After screening, the compost is allowed to cure for approximately one month to produce the finished product which is sold to landscapers, residents and commercial customers.

D.4.5 End Markets

The City sells compost and mulch to residents and landscapers for external projects and utilizes a portion for internal projects such as road embankment landscaping, park improvements and City facility landscaping projects.

The City participates in the United States Composting Council's Seal of Testing Assurance (STA) program. This program, which started in 2000, involves analyzing regular samples of the compost to verify that the compost meets standards for pH, soluble salts, nutrient content (nitrogen, calcium, magnesium, etc.), moisture content, organic matter content, maturity, stability, particle size, pathogens, and trace metals. With this certification, the City is allowed to use the STA program logo as a promotional seal when marketing their product to the community.

The pricing structure for the compost sales is summarized in Table D-1.

Table D-1
Current Compost and Mulch Pricing

Item	Cost[1]
Mesquite Wood Chips (1.5 ft^3 bag)	$3.98
Mulch (2 ft^3bag)	$2.15
Christmas Tree Mulch (2 ft^3 bag)	$2.50
Compost (1 ft^3 bag)	$1.75
Premium Compost (1 ft^3 bag)	$2.15
Compost (1 CY)	$16.00
Premium Compost (1 CY)	$20.00
Mulch (1 CY)	$12.00
Tree Stump Mulch (1 CY	$13.00

1 Cost does not include applicable taxes.

In 2005, the City generated approximately $40,000 in revenue from the sale of compost. In 2009, this revenue increased considerably to approximately $200,000. Furthermore, this revenue does not account for the cost savings associated with diverting a considerable tonnage from the landfill.

As previously mentioned, bulk and bagged compost may be purchased from the limited retail area at the composting facility as well as at the City's MRF. In the future, the City is hopeful that they can work with a retailer within the City to provide a more convenient retail outlet. Other material sold at the facility includes mulch from mesquite and Christmas trees.

D.4.6 Equipment

Table D-2 lists the equipment used in the compost operation. In addition to the equipment listed in Table D-2, the City has a roll-off truck used to transport large loads of finished material to the customer's facility.

Table D-2
Equipment Used in Compost Operation

Make & Model	Description
Doosan Mega 200V	Wheel Loader
Doosan Mega 200V	Wheel Loader
SCARAB	Windrow Turner
McClosky Brothers 621RE	Trommel Screen
GMC International	Water Truck
Bandit 1290H	Chipper
Rotochopper 250	Bagging machine
Kubota	Tractor
Freightliner	Roll-Off Truck
Ford F 250	Pick-Up Truck
Ford F 250	Pick-Up Truck

As previously discussed, the City has chosen to contract with an outside company for tub grinding services, and thus do not own a tub grinder at this facility.

D.4.7 Staffing

The City employs seven full-time staff to operate the composting facility, including two heavy equipment operators, two maintenance workers, one administrative clerk, one crew leader, and one manager. The staffing level at the composting facility is generally sufficient for daily operations. However, City staff has noted that an additional one or two heavy-equipment operators could be justified for the operation.

D.4.8 Operating Budget

The budgeted operational costs associated with the City of McAllen composting facility for FY 2009-2010 are summarized in Table D-3.

Table D-3
Annual Operating Costs

Item	Annual Cost
Operating Costs [1]	$66,800
Labor and Benefits	$290,200
Vehicle and Equipment Maintenance	$45,400
Contracted Services and Capital Cost	$334,600
Total Annual Cost	$737,000

1. Includes supplies, uniforms, tools, janitorial and other miscellaneous expenses.

Several pieces of equipment, including the bagging machine and chipper, as well as the site fencing were funded through grants awarded by the Texas Commission on

Environmental Quality through the local Lower Rio Grande Valley Development Council.

D.5 Key Findings for H-GAC Region

Based on the case study of the organics collection and processing program in the City of McAllen, Texas, R. W. Beck identified the following key findings that are applicable to the H-GAC region:

- McAllen is able to compost a considerable amount of commercial food scraps with a limited hauling operation. They rely on customers to self-haul material for processing.
- Food scrap composting is feasible in a hot climate with periods of heavy rains.
- When in an urban location, visual barriers are key in promoting good relationships with neighbors and limiting complaints of nuisances.
- Municipal programs that begin primarily as yard trimmings operations can grow over time to accept a wider variety of materials.
- Contracting for tub grinding of yard trimmings is a cost-effective alternative to purchasing a tub grinder.