City of Dallas

Local Solid Waste Management Plan 2011 - 2060

February 2013

This plan was funded through a solid waste management grant provided by the Texas Commission on Environmental Quality through the North Central Texas Council of Governments. This funding does not necessarily indicate endorsement of the plan's findings and recommendations.

Prepared by:
HDR Engineering, Inc.
17111 Preston Road
Suite 200
Dallas, Texas 75248

Prepared for:
City of Dallas
Sanitation Services Department
3112 Canton Street, Suite 200
Dallas, Texas 75226

In Association With :
CP&Y, Inc.
Risa Weinberger & Associates, Inc.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

VOLUME I: LOCAL SOLID WASTE MANAGEMENT PLAN
adopted under provisions of Texas
Health & Safety Code Ann.
Chapter 363 (Vernon)

Name of Local Government: City of Dallas
Sanitation Services
3112 Canton Street, Suite 200
Dallas, Texas 75226

The contents of local solid waste management plans are specified in and shall conform to the requirements of the Texas Health & Safety Code §363.064; the plans provide the general structure to implement a local program.

This plan is adopted subject to the rules and orders of the Commission and laws of the State of Texas and it replaces any previously approved plan. Nothing in this plan exempts the City of Dallas from compliance with other applicable rules and regulations of the Texas Commission on Environmental Quality. This plan is valid until canceled, amended, or revoked by the Commission.

Pursuant to Title 30 Texas Administrative Code §330.647(a), this plan is adopted by reference into Chapter 330, Subchapter O.

ADOPTED in accordance with Title 30 Texas Administrative Code Chapter 330.

ADOPTION DATE:

____
For the Commission

VOLUME I: LOCAL SOLID WASTE MANAGEMENT PLAN

SECTION I – NAME AND DESCRIPTION OF LOCAL GOVERNMENT

A. This Local Plan pertains to the City of Dallas, Texas (hereafter called City).

SECTION II – LOCAL PLAN

A. Local Goals

(1) Goal #1: Transition to a more sustainable material management system regarding waste and recyclable materials generated within the City.

Objective #1A: 40% diversion by 2020
Objective #1B: 60% diversion by 2030
Objective #1C: Maximize diversion by 2040

B. Waste Minimization, Waste Reuse, Recycling & Education

(1) The City operates a number of diversion programs to reduce the volume of materials requiring landfill disposal including:

- Collection of residential recyclable items
- Big Blue Recycling Drop-off sites
- Brush collection
- Electronics recycling
- Landfill diversion targeting metals, concrete, asphalt, sawdust, clean soil and brush

(2) The City will achieve a greater degree of waste minimization and waste recycling and reuse in three steps.

- Increasing the diversion associated with voluntary programs by:
  - Providing separate collection of organics
  - Bulk item reuse
  - Social marketing campaigns
  - Providing Technical assistance
  - Development of ordinances or incentive programs

- Implementing mandatory requirements for source separation.

- Processing the remaining solid waste to recover reusable materials prior to landfilling.

(3) Household hazardous waste from the City of Dallas is managed by the Dallas Area Household Hazardous Waste Network under a cooperative agreement with a number of municipalities.

(4) The City has established the following Recycling or diversion rate goals:

- 40% by 2020
- 60% by 2030
- Maximize diversion by 2040

(5) The City has adopted the "Don't Bag It" program for lawn clippings and creates mulch from brush and other yard wastes. The creation of a compost operation, to possibly include food scraps, is recommended.

(6) The City received the 2011 Green City Award from *Waste & Recycling News* for having the most effective recycling education program for a large city in the U.S. These educational efforts will be continued.

C. Municipal Solid Waste Facilities – The City of Dallas will:

(1) Continually assess the need for new waste disposal capacity;

(2) Assess methods to optimize the available disposal capacity;

(3) Cooperate with neighboring municipalities that need disposal capacity;

(4) Maintain transfer station capacity to consolidate waste and recyclable loads to reduce the effects of traffic and air quality impacts.

(5) Develop other infrastructure, as needed, to implement this Local plan.

Resolutions

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF DALLAS:

Section 1. That the City Manager is authorized to approve the Local Solid Waste Management Plan prepared under an agreement with the North Central Texas Council of Governments for the planning period 2011 – 2060. This plan describes the City's current Solid Waste Management System and outlines activities that can be taken to decrease the amount of discards that must be managed through sanitary landfilling and to transition to a more comprehensive approach to the management of the City's resources.

Section 2. That the City Controller is authorized to disburse funds as authorized under project BDZ1103.

Section 3. That this resolution shall take effect immediately from and after its passage in accordance with the provisions of the Charter of the City of Dallas and it is accordingly so resolved.

This page is intentionally left blank.

Table of Contents

Executive Summary

Why this Plan?

In spring 2011, the City of Dallas (City) began a planning process to identify the policies, programs, and infrastructure that will be needed to manage the discarded materials (municipal solid waste and recyclable materials) generated in the City over the next 50 years. The Local Solid Waste Management Plan (Plan) is the beginning of a long-term systematic effort to:

- Strive for sustainability by considering the entire life-cycle of products, processes, and systems;
- Demonstrate that the goals of economic growth, environmental stewardship and fiscal responsibility are inextricably linked;
- Reduce the volume and toxicity of discarded materials and maximize diversion from disposal; and,
- Spur economic growth by recovering valuable raw materials and clean energy from discarded materials.

Where is the City now?

The City operates a number of diversion programs to reduce the volume of discarded materials requiring landfill disposal. These include:

- Residential Recycling Collection – weekly collection provided to single-family residences using wheeled carts;
- Big Blue Recycling Drop-Off Sites – targeting multifamily residences and available to all generators;
- Brush Collection – monthly collection available to all residents;
- Electronics Recycling – drop-off program available to all residents;
- Pilot Recycling Programs – targeting multifamily residences and hotels; and,
- Landfill Diversion Programs – targeting metals, concrete, asphalt, sawdust, clean soil and brush.

What are the City's goals?

The City is now poised to transition its system from one focused on collection and disposal to one based on resource management. The City's goal is to strive for a more sustainable materials management system. To measure its progress toward this goal, the City has established the following objectives and timeframes.

The policies, programs and infrastructure described in this Plan will help the City to reach its waste reduction rates of:

- 40 percent diversion by 2020;
- 60 percent diversion by 2030; and,
- Zero Waste by 2040.

Once the City has reached its landfill diversion goals, it will continue to maintain its collection system, diversion programs and processing facilities through the 50-year planning period. In planning and implementing its new policies, programs and infrastructure, the City will monitor its successes and seek out new opportunities for innovation and advancement in policy and technology development.

What is Zero Waste?

Zero Waste is a philosophy and design framework that promotes not only reuse, recycling, and conservation programs, but also, and more importantly, emphasizes sustainability by considering the entire life-cycle of products, processes, and systems.

This comprehensive systems-approach promotes waste prevention by:

- Having products and packaging designed for the environment;
- Reducing the materials used in products and packaging;
- Using less toxic, more benign materials in production and manufacturing;
- Providing longer product lives by developing more lasting products; and,
- Having products that are repairable and easily disassembled at the end of their useful life.

"Zero Waste" does not mean 100% recycling. We may always have some residual materials that need to be landfilled. Communities striving for Zero Waste (such as Austin, Los Angeles and San Jose) have set goals of 80 to 90 percent diversion from landfills. The initiatives identified in this Plan are estimated to increase the citywide diversion rate to approximately 84 percent over the 50-year planning period. Product redesign and manufacturer responsibility will help communities reduce the amount of residual materials that can't be reused, recycled or composted. The City will strive for Zero Waste and take an active role in supporting statewide and national initiatives, such as those developed by the Texas Product Stewardship Council, to create a more sustainable materials management system.

Who participated in the development of this Plan?

The Plan was prepared by the City of Dallas Sanitation Services Department with input from:

- **Solid Waste Advisory Committee (SWAC)** – formed to assist the City in the development of the Plan. Members of SWAC include representatives from public agencies, private sector service providers, and community groups;
- **Community members** – self-identified as stakeholders in the planning process, who participated in the City's public workshops held on July 14th, 2011 and January 26, 2013;
- **HDR Engineering;**
- **CP&Y, Inc.;** and,
- **Risa Weinberger & Associates, Inc.**

What does the Plan do?

This Plan describes the policies and programs that could be implemented to achieve the City's goal of Zero Waste by 2040, with the interim steps of 40 percent diversion by 2020 and 60 percent by 2030.

To understand the effectiveness of the policies, programs and technologies identified by the stakeholders, the City estimated the diversion potential of the following key initiatives.

1. Encourage commercial haulers to provide recycling services to all of their customers—targeting multifamily and commercial generators.
2. Consider requirements for mandatory separation of recyclables and compostables from trash—targeting all generator sectors.
3. Develop a construction and demolition debris (C&D) ordinance and provide C&D technical assistance -- targeting roll-off and self-haul generators.
4. Advocate for extended producer responsibility at the state level and work with local retailers to increase take-back programs—targeting all generator sectors.
5. Provide separate collection for organics—targeting all generators.
6. Provide bulk item reuse and recycling—targeting all generators.
7. Undertake a social marketing[1] campaign—targeting all generator sectors.
8. Provide commercial technical assistance—targeting multifamily and commercial generators.
9. Develop a Resource Recovery Park at the landfill—targeting self-haul generators.
10. Develop a mixed materials processing facility to separate recyclables and compostables from trash—targeting all material streams.

What do we generate?

"Generation" is the sum of tons diverted (recyclable materials) plus tons disposed (municipal solid waste), and is used to determine the diversion rate.

Generation = Disposal + Diversion

In 2010, it is estimated that over 2.2 million tons of materials were generated within the City that were either diverted or disposed. Over 2.0 million tons were disposed in landfills and 192,000 tons were diverted from disposal through the City's current recycling programs (134,000 tons from Dallas' single-family single-stream recycling and the brush and bulky item collection programs). The 134,000 tons diverted from the single-family collection program represents almost 30% of the waste generated by single-family residents.

[1] Social marketing campaigns involve the systematic application of marketing alongside other techniques and tools to achieve specific social behavioral goals. McKenzie-Mohr, D. (2000). Fostering sustainable behavior through community-based social marketing. American Psychologist, 55(5), 531-537.

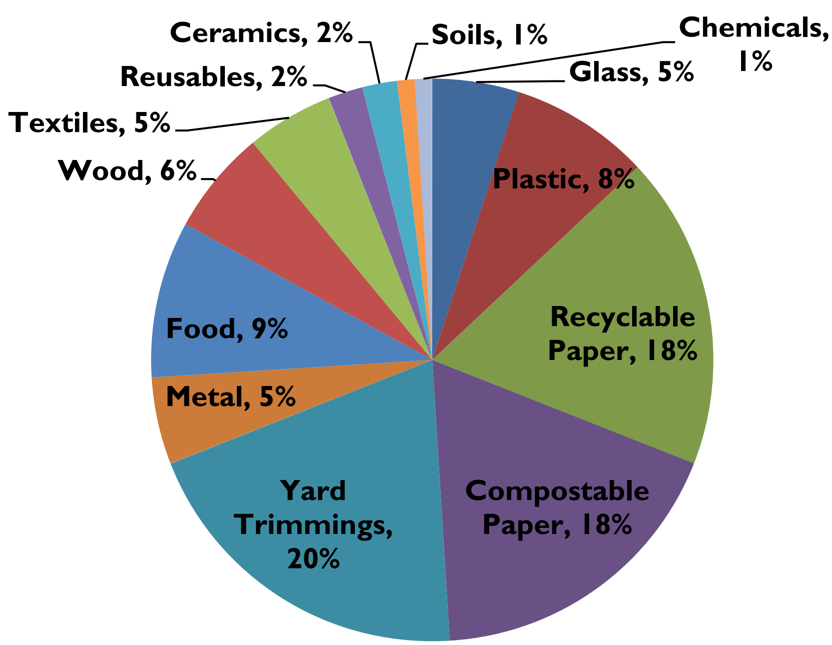
What is waste?

"Waste" consists of discarded materials most of which can be reused, recycled or composted.

To assist in the development of this Plan, a diversion model was created to evaluate the effects of the key initiatives on disposal and diversion throughout the City. The projected generation, diversion and disposal data for 2011 were used for the baseline tons and include estimates by generator type (single-family, multifamily, and commercial). The 2011 projections were extrapolated from the 2010 estimates based on anticipated population growth. This allows for a review of diversion increases based on new initiatives while maintaining the City's existing level of diversion.

The Plan uses the following estimated waste characterization percentages published by North Central Texas Council of Governments (NCTCOG) in 2002 using data from the Texas Natural Resource Conservation Commission Strategic Plan 2001-2005. [2] The "other" material category was divided into additional types (textiles, reusables, ceramics, soils and chemicals). The "paper" material category was further divided into "recyclable paper" and "compostable paper."[3]

Figure ES.1 Estimated Composition of Discarded Materials



---

[2] The Texas Natural Resource Conservation Commission (TNRCC) was the predecessor agency to the Texas Commission on Environmental Quality (TCEQ) which is the lead environmental agency within the State of Texas.

[3] In accordance with Texas Health and Safety Code (TH&SC) 363.064(a)(1), all local solid waste management plans must address sludge. In fiscal year 2010, only 5,451 tons of sludges were disposed at the landfill from the City's wastewater treatment plants. This minor quantity represents less than 1% of the waste delivered to the landfill during that time. Since the City has ample disposal capacity for these wastes, they are not considered in this Plan.

Source: *TNRCC Strategic Plan 2001-2005* with adjustments made by dividing the "other" category into textiles, reusables, ceramics, soils and chemicals and dividing the "paper" category into recyclable paper and compostable paper.

Diversion Projections

To estimate the diversion potential of the key initiatives identified in this Plan, the project team developed a diversion model. Based on the assumptions and calculations included in the diversion model (discussed in Appendix A, Task 4A), implementing the key initiatives will increase the citywide diversion rate to 84 percent.

Table ES.1 Diversion Estimates by Generator

	Single-family	Multifamily	Commercial	Total
Diversion (tons)	575,000	539,000	1,307,000	2,421,000
Disposal (tons)	92,000	123,000	257,000	472,000
Total Generation	667,000	662,000	1,564,000	2,893,000
Diversion rate	86%	81%	84%	84%

Note: Figures may not sum due to rounding.
Single-family diversion estimates include the current single-family diversion rate of approximately 30%.

The diversion rates are presented as a snapshot in time assuming full implementation of all programs. In reality, policies and programs will be developed over time through additional research, testing, and pilot programs before the programs are fully implemented. Several policies will require new ordinances and regulations which will require City Council action and time to implement. Based on this analysis, the City can increase its diversion rate to at least 84 percent, a very high rate of diversion, by implementing the policies and programs described in this Plan.

Phasing Recommendations

The Plan includes a phased approach where increased outreach and technical assistance would be provided prior to mandatory requirements. The diversion results are based on the following three scenarios that build upon each other:

- **Increase voluntary programs** — City to provide separate collection for organics (for purpose of composting), bulk item reuse and recycling, social marketing campaign, commercial technical assistance, encourage commercial haulers to provide recycling services to all of their customers, develop a construction and demolition debris (C&D) ordinance or incentive program and provide C&D technical assistance, develop Resource Recovery Facility(ies) within the City, and work with local retailers to increase take-back programs for hard-to-recycle items and advocate for extended producer responsibility at the state level;
- **Implement mandatory requirements** — develop mandatory source-separation practices and reporting; and,
- **Process residual waste** — process all solid waste to recover reusable materials prior to landfilling.

Table ES.2 Diversion Estimates by Scenario[1]

	Baseline (existing programs)[2] 2011	Increasing voluntary programs 2020	Adding mandatory requirements 2030	Add residual waste processing[3] 2040
Diversion (tons)	160,000	1,011,000	1,856,000	2,421,000
Disposal (tons)	2,172,000	1,493,000	841,000	472,000
Total Generation	**2,333,000**	**2,390,000**	**2,504,000**	**2,872,000**
Diversion rate	7%	40%	69%	84%

[1]Assumptions by program and material type are included in Appendix A.
[2]Baseline diversion estimates include the current single-family diversion tons only. Baseline disposal tons for 2011 are based on the estimated generation within the City less the projected single-family diversion estimate. Some of the disposal ton estimate may not be currently disposed.
[3]"Residual waste processing" means separating recyclable and compostable materials from solid waste at a mixed waste material recovery facility prior to landfilling.

Greenhouse Gas Reduction Potential

The key initiatives described in the Plan can significantly reduce the City's greenhouse gas emissions. Based on the estimated diversion rates at full implementations of programs, the following table presents the greenhouse gas emissions reduction potential of the scenarios using the United States Environmental Protection Agency (U.S. EPA)"WAste Reduction Model" (WARM) factors to estimate greenhouse gas emissions reduction based on material types and amounts diverted.

Table ES.3 Greenhouse Gas Reduction Estimates by Generator

	Single-family	**Multifamily**	**Commercial**	**Total**
$MTCO_2E$[1]	(523,000)	(749,000)	(1,783,000)	(3,056,000)
Equivalent number of cars removed from the road	96,000	137,000	327,000	560,000

[1]Metric Tons of Carbon Dioxide Equivalent

The U.S. EPA created WARM to help solid waste planners and organizations track and voluntarily report greenhouse gas emissions reductions from several different waste management practices.

WARM calculates and totals greenhouse gas emissions of baseline and alternative waste management practices—source reduction, recycling, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent ($MTCO_2E$), and energy units (million British Thermal Unit (BTU)) across a wide range of material types commonly found in municipal solid waste.

What else does the Plan cover?

The Plan is organized as follows:

Section I Plan Overview – Provides the planning context for the Plan, the purpose and objectives and describes the planning process undertaken by the City.

Section II Area Analysis

Chapter II.1 Area Description – Describes the City's physical infrastructure and its natural, demographic, and economic characteristics.

Chapter II.2 Current Solid Waste Management System – Describes the existing waste prevention, recycling, and composting programs and the facilities that are used to manage materials generated in the city.

Chapter II.3 System Evaluation and Needs Assessment – Evaluates both the current and planned solid waste management system activities, programs, and facilities.

Chapter II.4 Analysis of Alternatives – Provides the results of the analysis of the diversion potential and greenhouse gas reduction potential of the policies, programs and technologies.

Section III Area Recommendations

Chapter III.1 Goals, Objectives and Priorities – Describes how the policies, programs and technologies work to achieve the goals and objectives of the City.

Chapter III.2 Action Plan – Includes the tasks necessary to undertake the Local Solid Waste Management Plan, including the action steps, and an implementation schedule.

Appendix A: Technical Memoranda

Task 1: Solid Waste System Overview

Task 2: Waste Generation Projections and Landfill Capacity Scenarios

Task 3: Transfer Operations

Task 4a: Diversion Program Options

Task 4b: Organics Diversion Options

Task 5a: Technology Options for Municipal Solid Waste

Task 5b: Technology Options for Source Separated Organics

Appendix B: NCTCOG Closed Landfill Inventory

Appendix C: Model Ordinances and Contracts

Appendix D: Acronyms and Definitions

This page is intentionally left blank.

I.1 Section I Plan Overview

This section provides the planning context for the Local Solid Waste Management Plan (Plan), the purpose and objectives, and describes the planning process undertaken by the City of Dallas (City).

The City provides for the collection, processing and disposal of municipal solid waste and recyclable materials generated by the City's residents and businesses (single-family and multifamily residential and commercial. In order to more effectively provide these services in the future, the City has initiated a planning process to determine the future of the City's solid waste management for the next 50 years.

I.1.A Authority

The Comprehensive Municipal Solid Waste Management, Resource Recovery, and Conservation Act (Act), codified as Chapter (§)363, Texas Health and Safety Code (THSC), provided for each of the 24 regional planning councils (COGs) to develop Regional Solid Waste Management Plans (RSWMPs) for their respective regions. The Act further provides that local governments develop local solid waste management plans (Plans) that conform to the adopted RSWMP covering the area in the local government's jurisdiction. Local governmental entities are encouraged to develop solid waste management plans, as provided for in Title 30 Texas Administrative Code (30 TAC) Chapter 330 (MSW Rules), 30 TAC §330.631 through §330.649 (Subchapter O). Subchapter O contains the minimum plan content requirements and procedures that must be followed to develop adoptable local solid waste management plans.

The City of Dallas has received solid waste grant money from the Texas Commission on Environmental Quality (TCEQ) through the North Central Texas Council of Governments (NCTCOG) for the development of this Local Solid Waste Management Plan (Plan); (Grant Project # 11-04-G02). The City has combined the grant funds with their own funds to fully develop this Plan. This Plan is consistent with the *SEE Less Trash Regional Solid Waste Management Plan* adopted by the NCTCOG executive board on June 27, 2002.

I.1.B Purpose

The purpose of the Plan is to identify current and future needs, evaluate program and technical options for meeting these needs, and to define a course of action for future waste generated in the City. The City has developed this Plan in order to outline, over the next 50 years, the transition of the City waste stream from "trash" to "valued resources." The Plan provides a framework for expansion of the City environmental infrastructure, policies, and programs for the long term benefit of the community while garnering benefit from the re-use of resources.

I.1.C Objectives

The Sanitation Department has the primary responsibility for implementing this Plan. The Department's vision, mission statement, values and objectives are provided below.

Vision

To be the national leader in the transformation from a traditional integrated municipal solid waste management system to sustainable resource recovery.

Mission

To benefit our community and environment while garnering benefit from our waste resources by providing excellent customer services that promote waste reduction, resource recovery, and support to the City of Dallas sustainability efforts.

Department Values

- We deliver quality services through sustainable and innovative best practices.
- We are fiscally, socially, and environmentally responsible to our citizens.
- We are ethical and transparent within all our actions.
- We foster a safe and healthy work environment through employee/staff development, appreciation, recognition, and respect.

Department Objectives

- To meet community needs by providing excellent customer service and proactive education and outreach.
- To be fiscally responsible to our citizens.
- To provide optimal resource recovery while reducing the City's carbon footprint.
- To educate, empower and hold staff accountable to provide affordable quality services.

Determination of Plan Vision and Goals

City staff developed the following vision statement for the Plan which was reviewed by the stakeholders at the public workshop.

The City of Dallas will:

- Strive for sustainability by considering the entire life-cycle of products, processes, and systems;
- Demonstrate that the goals of economic growth, environmental stewardship and fiscal responsibility are inextricably linked;
- Reduce the volume of discarded materials and maximize diversion from disposal; and,
- Spur economic growth by recovering valuable raw materials and clean energy from discarded materials.

To realize this vision, the following goals were established for the Plan.

- 40 percent diversion by 2020;
- 60 percent diversion by 2030; and,
- Zero Waste by 2040.

Zero Waste is a philosophy and design framework that promotes not only reuse, recycling, and conservation programs, but also, and more importantly, emphasizes sustainability by considering the entire life-cycle of products, processes, and systems. It is important to understand that every community will have some residual amount of materials that must be disposed despite efforts at diversion.

I.2 Planning Process

The following sections provide a description of the planning process and justification for the underlying assumptions inherent in the Plan.

I.2.A Planning Units

The Plan is focused on the City of Dallas within the context of the regional and sub-regional plans. The geographic unit consists of the physical City limits. The Plan does not include analysis of neighboring municipalities or the City extra-territorial jurisdiction (ETJ). However; pursuant to 30 TAC §330.635(b)(3), this local Plan shall not prohibit, in fact or by effect, importation or exportation of waste from one political jurisdiction to another.

As a home-rule city, the City is authorized under the Texas Constitution to regulate the disposal of waste in its locality. The Texas Legislature has also explicitly authorized municipalities to regulate waste management: cities are permitted to "adopt rules for regulating solid waste collection, handling, transportation, storage, processing, and disposal," Tex. Health & Safety Code §363.111(a), and to operate a "solid waste management system," id. §363.117. This Plan does not limit the City's power in those regards, and also should not be construed to prohibit, in fact or by effect, any importation or exportation of waste from one political jurisdiction to another.

I.2.B Planning Period

The planning time period is 50 years, through 2060. This period allows for the discussion of long-term goals while still providing short term action items and strategies. Development methodology of this 50-Year Solid Waste Management Plan is similar to a typical 10 to 20-year plan. However, the focus and the output are slightly different. A 20-year plan can show desired future conditions (forms and functions) and include a strategy for achieving plan implementation. In order to comply with the applicable TCEQ regulations, short-term implementation strategies are presented for the first years of the plan; however, it is important to develop a plan that is flexible and that will not preclude different options and potential incorporation of new technologies that may develop over time. This 50-year plan encompasses the four planning periods, including: current; short-range (1-5 years); intermediate (6-10 years); and long-range (11-20 years). However, this Plan also includes much broader ideas that focus on longer-term issues and goals, and the strategies to address the issues and achieve the goals in the 20-50 year time period.

I.2.C Process Description

Advisory Committee

Pursuant to the Texas Administrative Code (30 TAC §330.639), an advisory committee was formed to provide input, review, and comment during development of the Plan. The advisory committee is comprised of members who represent a broad range of interests, including public officials, private operators, citizen groups, and interested individuals.

Public Participation

The planning process engaged the stakeholder community (including residential and commercial generators, community groups, non-profit and private sector service providers, and City and state representatives) in the solid waste planning process. Representatives from various stakeholder groups were included in the membership of SWAC to provide input, review and comment during development of the Plan. Two community/SWAC meetings were held during the planning process:

- **May 26, 2011: SWAC workshop to kick off the solid waste planning process** – to inform potential stakeholders about the planning process and to gather input on new initiatives to be considered for implementation. This meeting included a presentation of the City's current solid waste system, waste generation projections, and landfill capacity scenarios; and,

- **July 14, 2011: Community/SWAC workshop presenting the draft plan** - to present the findings from the technical memoranda addressing transfer operations, diversion options, organics processing, and technology options. This meeting provided an opportunity for stakeholders to review draft elements of the Local Solid Waste Management Plan and to provide input on the City's goals and objectives for the Plan.

- **January 2013: Stakeholder Meetings and Public Seminar** – to ensure that the public outreach process was as inclusive as possible, the City conducted a series of stakeholder meetings in early January and hosted a citywide public seminar on January 26, 2013. The purpose of the meetings was to obtain input on the timelines for implementing the Local Solid Waste Management Plan.

Coordination with Regional Planning Efforts

The Local Solid Waste Management Plan is designed to supplement and update the findings in the following regional planning efforts:

- *SEE Less Trash Regional Solid Waste Management Plan* adopted by the NCTCOG executive board of the NCTCOG on June 27, 2002; and,
- *Metroplex Area Sub-Regional Solid Waste Study* circa 2003 by Reed, Stowe & Yanke, a division of R. W. Beck.

These plans addressed the City's solid waste system in the context of regional and subregional planning. This Plan specifically addresses the City's local needs over the planning period.

Data Sources

The City reviewed the following data sources in developing the analysis for the Plan:

- **Evaluation of Waste Transfer Station Operations-2005** - evaluated operations of the three City of Dallas transfer stations;
- **Analysis of Brush & Bulky Collection Operations-2010** - recommended cost effective alternative to the existing brush and bulky collection system and evaluated whether the City could increase the amount of clean green waste;
- **Regional Recycling Rate Benchmarking Study-2007** - provided recycling rates for Dallas and surrounding cities in the Metroplex;
- **Chapter 18-Municipal Solid Waste-City Ordinances** - Defined acceptable containers, regulations for the collection and disposal of solid waste in the City, charges for collection and disposal, collection and disposal of illegally dumped solid wastes, and penalties for violations;
- **City of Dallas FY 2010 MSW Annual Reports to TCEQ for McCommas Bluff Landfill and City Transfer Stations** – provided annual tonnage at each facility and remaining site life at the landfill;
- **City of Dallas Sanitation Department Monthly Reports for diversion, transfer and disposal operations** – provided tonnage amounts for various programs and City facilities;
- **City of Dallas Website-Sanitation Services** - provided data on frequently asked questions about solid waste operations; and,
- **Metroplex Area Sub-Regional Solid Waste Study-2003** – provided date on waste generation estimates and regional landfill capacity.

Phasing Recommendations

The Plan includes a phased approach where increased outreach and technical assistance would be provided prior to mandatory requirements. The Analysis of Alternatives included in Section II presents the diversion results based on the following three scenarios that build upon each other:

- **Increase voluntary programs**—provide separate collection for organics for composting, bulk item reuse and recycling, social marketing campaign, commercial technical assistance, encourage commercial haulers to provide recycling services to all of their customers, develop a construction and demolition debris (C&D) ordinance and provide C&D technical assistance, develop Resource Recovery Facility(ies) within the City, and work with local retailers to increase take-back programs for hard-to-recycle items and advocate for extended producer responsibility at the state level;
- **Implement mandatory requirements**—develop mandatory source-separation practices and reporting; and,
- **Process residual waste**—process all municipal solid waste to recover reusable materials prior to landfilling.

Table I.1 Diversion Estimates by Scenario[1]

	Baseline (existing programs)[2] 2011	Increasing voluntary programs 2020	Adding mandatory requirements 2030	Add residual waste processing[3] 2040
Diversion (tons)	160,000	1,011,000	1,856,000	2,421,000
Disposal (tons)	2,172,000	1,493,000	841,000	472,000
Diversion rate	7%	40%	69%	84%

[1]Assumptions by program and material type are included in Appendix A.

[2]Baseline diversion estimates include the current single-family diversion tons only. Baseline disposal tons for 2011 are based on the estimated generation within the City less the projected single-family diversion estimate. Some of the disposal ton estimate may not be currently disposed.

[3]"Residual waste processing" means separating recyclable and compostable materials from solid waste at a mixed waste material recovery facility prior to landfilling.

Plan Adoption and Implementation

The Plan was developed in spring and summer 2011 and submitted for review to the NCTCOG and to the TCEQ in August 2011. The Action Plan, included in Section III, provides the implementation schedule for the Plan.

Plan Updates

The Plan is designed to be a living document with annual updates, program assessments every five years, and detailed implementation steps to be undertaken by City staff.

Since the Plan was developed and submitted for review in August 2011 the following events regarding solid waste in the City have occurred:

The Dallas City Council adopted a Resource Flow Control Ordinance on September 28, 2011 to regulate the flow of solid waste in the City to City-supervised waste facilities to, among other stated purposes, ensure the safe and proper handling of solid waste in the City and provide for environmentally sound, cost efficient solid waste management.

Metrics for Tracking Achievement of Goals

To track diversion and disposal tons by new initiative, the City will monitor performance from:

- City programs – where tons are tracked directly; and,
- Service provider reports – pursuant to the new ordinance requirements or franchise agreements.

For some policies and programs, the City will have to rely on diversion and disposal estimates. The direct effect of these policies and programs serve to enhance the City and private sector programs, but cannot be quantified separately.

Timeframes for Updating the Plan

The policies, programs and infrastructure identified in the Plan are slated for implementation in the short-term (2020) or in the medium term (2030). Most of the new infrastructure will be developed within those time horizons as well. The Plan also includes monitoring of new technology for future development (by 2040). The City will track performance by program annually and will conduct a plan update every five years, beginning in 2016. The City will closely monitor the development of state and regional plans and will incorporate regional plans and programs into the City's Plan during the five-year updates.

Section II Area Analysis

II.1 Area Description

This section describes the City's physical infrastructure and its natural, demographic, and economic characteristics.

II.1.A Physical Infrastructure and Natural Characteristics

The City of Dallas (City) is the county seat of Dallas County. Portions of the City extend into neighboring Collin, Denton, Kaufman, and Rockwall counties. According to the United States Census Bureau, the City has a total area of 385 square miles. Dallas makes up one-fifth of the much larger urbanized area known as the Dallas–Fort Worth Metroplex, in which an estimated one-quarter of all Texans live. Dallas and its surrounding areas are mostly flat; with the City at elevations ranging from 450 – 550 feet. The Trinity River including the West Fork and the Elm Fork, is the major waterway through the City. Its path (Elm Fork) through Dallas is parallel to Interstate 35E. The West Fork enters the City from the west and approximately parallels Interstate 30. The West Fork combines with the Elm Fork near downtown Dallas into the main stem of the Trinity and flows south alongside downtown, past south Dallas and the Pleasant Grove area, where the river is parallel to Interstate 45 until it exits the City and heads southeast.

Figure II.1 presents a map of the City of Dallas and surrounding municipalities. Figure II.2 shows the location of Dallas within the North Central Texas Council of Governments (NCTCOG) planning region.

Figure II.1: City of Dallas and Surrounding Municipalities

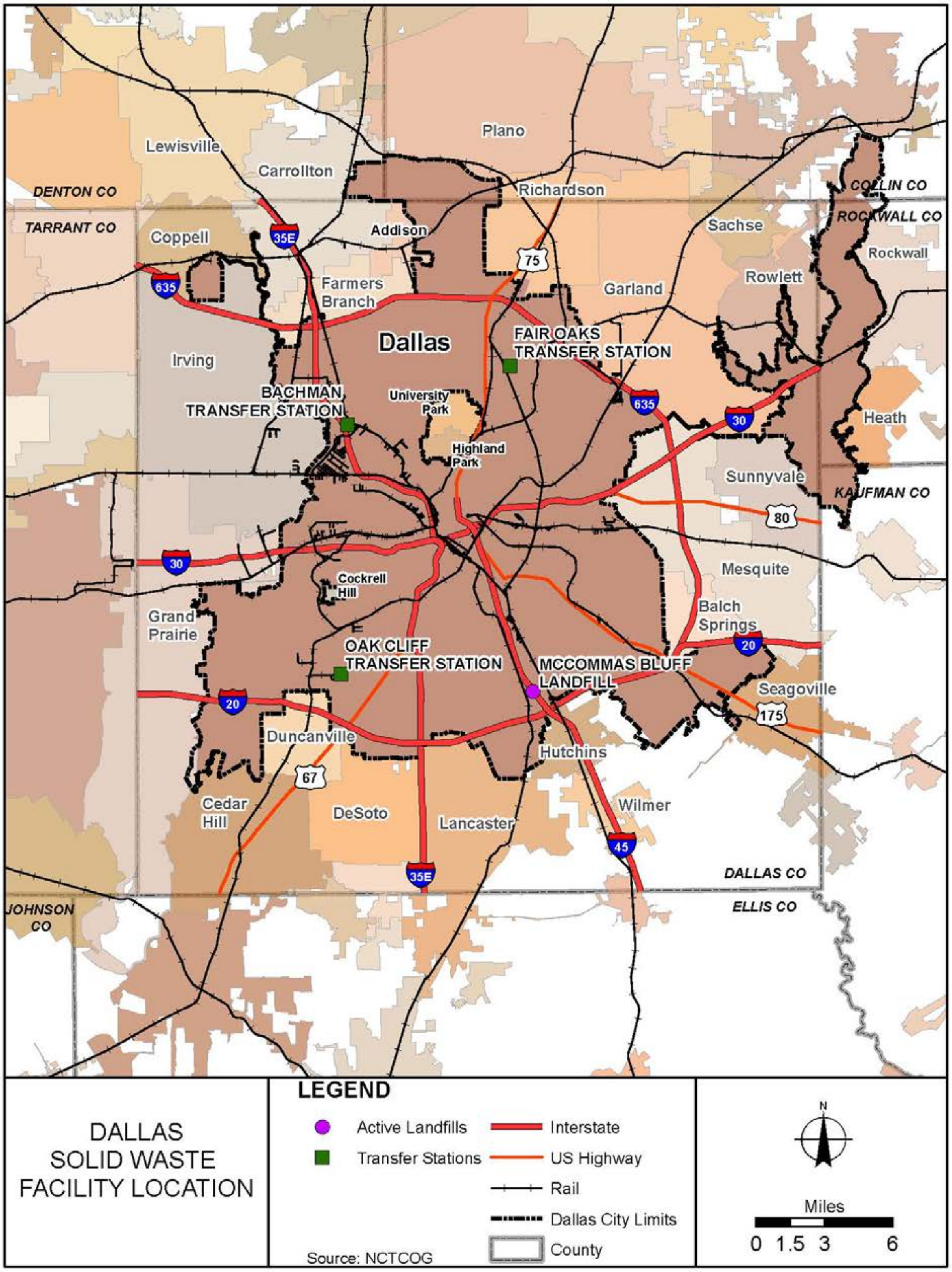
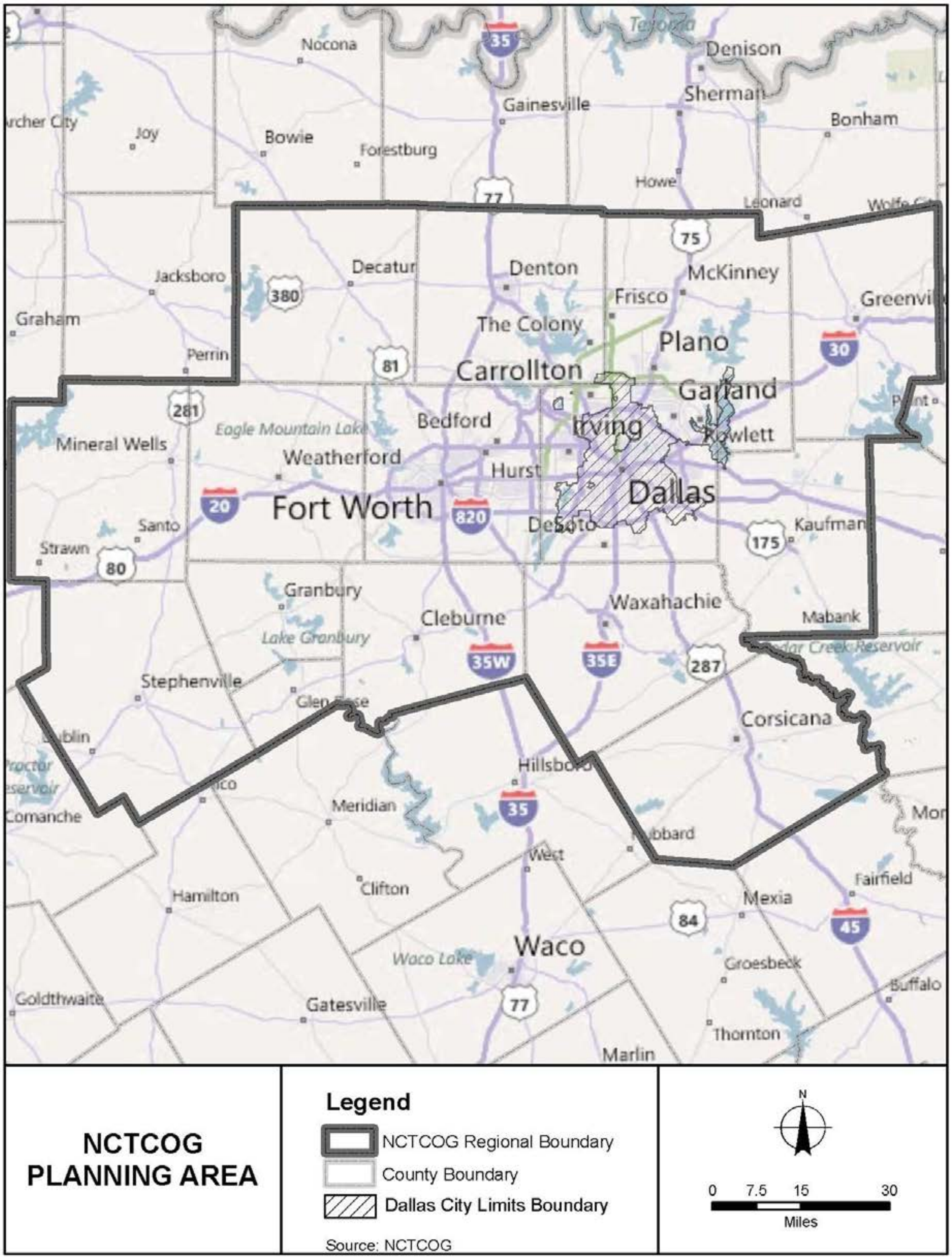


Figure II.2: Dallas Location within NCTCOG Planning Region



Land Use

Land use in the City was obtained from the NCTCOG database. The most recent information was for year 2005. The major land use in the City is residential (29%), including single-family, multifamily, and mobile homes and group quarters. Commercial, industrial, and institutional uses account for 15% of the area, while Infrastructure and Transportation account for 19%. An additional 20% of the land area is considered vacant or undeveloped with a large portion of this in the southern portion of the City. Table II.1 includes a breakdown of land uses in the City as presented by NCTCOG shape files obtained at the source indicated.

Table II.1 Land Use in Dallas

	Acres	Percent of Acres
	245,630	**100%**
Vacant	46,406	19
Single-family	60,566	25
Multifamily	9,218	4
Mobile Home & Group Quarters	639	- -
Industrial	13,825	6
Commercial	11,252	5
Institutional	10,534	4
Infrastructure	6,209	3
Parks & Flood Plain	23,229	9
Water	19,263	8
Airport	2,110	1
Undeveloped	2,031	1
Landfill	2,013	1
Transportation	38,325	16

Source: North Central Texas Council of Governments; 2005 Landuse http://clearinghouse.dfwmaps.com/ Accessed July 29, 2011.
Note: totals may not sum exactly due to rounding.

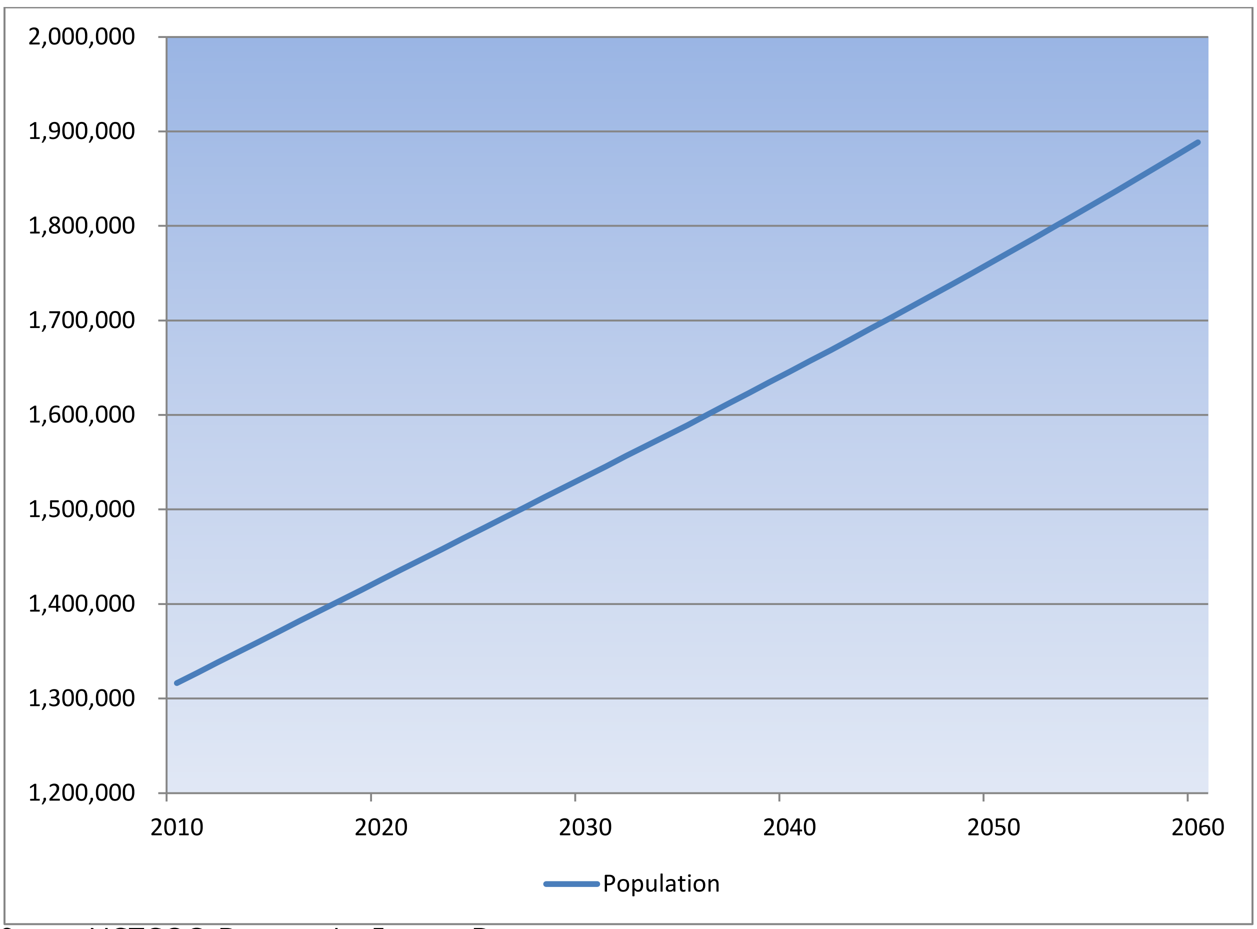
Highway Transportation

The City is at the confluence of four major interstate highways—Interstates 20, 30, 35E, and 45. The Dallas area freeway system is designed in a hub-and-spoke system. Starting from the center of the City, a small freeway loop surrounds Downtown, followed by the Interstate 635 loop about 10 miles outside Downtown, and ultimately the President George Bush Turnpike. Inside these freeway loops are other boulevard- and parkway-style loops, including Loop 12 and Belt Line Road. Radiating out of Downtown Dallas' freeway loop are the spokes of the area's highway system—Interstates 30, 35E, and 45, U.S. Highway 75, U.S. Highway 175, State Spur 366, the Dallas North Tollway, State Highway 114, U.S. Highway 80, and U.S. Highway 67. See Figure II.1.

II.1.B Demographic Characteristics

NCTCOG estimates indicated 1,316,350 people were living within the City limits in 2010. Population estimates for year 2040 are 1,645,739. Estimates from 2040 to 2060 were extrapolated based on the same growth percentage. The 2010 population data and future year projections are presented in Figure II.3. Rationale for these projections is included in Appendix A, Task 2 Waste Generation Projections. Table II.2 shows the single- and multifamily residential projections. According to data provided by NCTCOG, approximately 47% of Dallas residents live in single-family residences and approximately 53% live in multifamily residences. This provides a challenge for increasing recycling rates, as it is somewhat more difficult to provide recycling and composting services to multifamily residences.

Figure II.3 Population Projections



Source: NCTCOG: Demographic Forecast Data

Table II.2 Single-family and Multifamily Projections

Year	Population	Annual Percent Population Increase	Single-family Population (47.1%)	Multifamily Population (52.9%)
2010	1,316,350		620,001	696,349
2015	1,370,939	0.80%	645,712	725,227
2020	1,425,528	0.77%	671,424	754,104
2025	1,480,117	0.74%	697,135	782,982
2030	1,534,706	0.72%	722,847	811,859
2035	1,589,295	0.69%	748,558	840,737
2040	1,645,739	0.69%	775,143	870,596
2045	1,703,306	0.69%	802,257	901,049
2050	1,762,887	0.69%	830,320	932,567
2055	1,824,551	0.69%	859,364	965,188
2060	1,888,373	0.69%	889,424	998,949

Source: North Central Texas Council of Governments, 2010 (www.nctcog.org/ris/demographics/housing,asp)
Note that total may not sum due to rounding.

II.1.C Economic Characteristics

According to Wikipedia (http://en.wikipedia.org/wiki/Dallas), the Dallas-Fort Worth Metroplex has one of the largest concentrations of corporate headquarters for publicly traded companies in the United States. The City of Dallas has 12 Fortune 500 companies, and the Dallas-Fort Worth region as a whole has 20. In 2007-08, Comerica Bank and AT&T moved their headquarters to Dallas. Additional companies headquartered in the Metroplex include Southwest Airlines, American Airlines, RadioShack, Neiman Marcus, 7-Eleven, Brinker International, AMS Pictures, id Software, ENSCO Offshore Drilling, Mary Kay Cosmetics, Chuck E. Cheese's, Zales and Fossil. Many of these companies—and others throughout the Dallas-Fort Worth Metroplex—comprise the Dallas Regional Chamber.

In addition to its large number of businesses, Dallas has more shopping centers per capita than any other city in the United States. Dallas is home of two major malls in North Texas, the Dallas Galleria and North Park Center, which is the second largest mall in Texas.

Dallas is currently the third most popular destination for business travel in the United States, and the Dallas Convention Center is one of the largest and busiest convention centers in the country.

II.2 Current Solid Waste Management System

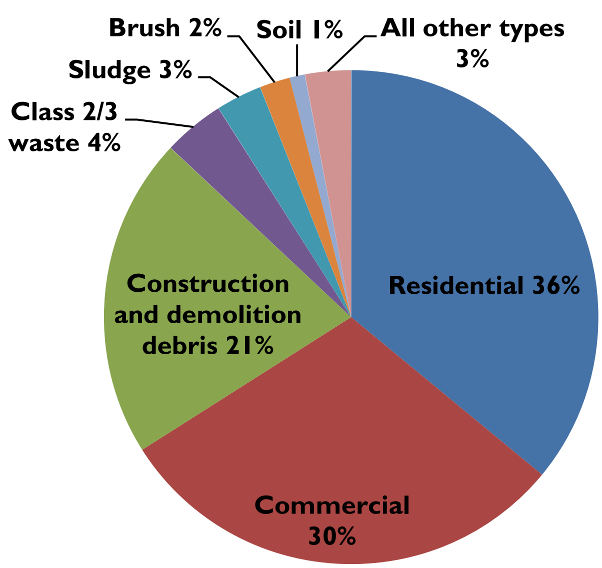
This section describes the current solid waste management system for the City, including the waste types and generation, infrastructure, activities and programs, and estimated capacities. Additional information is provided in the Technical Memoranda included in Appendix A:

- Task 1 Solid Waste System Overview;
- Task 2 Waste Generation Projections and Landfill Capacity Scenarios; and,
- Task 3 Transfer Station Operations.

II.2.A Types of Solid Waste

The largest single type of waste disposed in Texas municipal solid waste landfills in 2009 was residential waste, comprising 36 percent of the total waste stream, followed by commercial waste with 30 percent of the waste stream, and lastly, construction and demolition debris with 21 percent. These three waste types make up the vast majority of the waste stream – 87 percent of the municipal solid waste disposed in the state. This data is based on information provided to the TCEQ from active landfills. Figure II.4 provides a breakdown of waste types landfilled in Texas in 2009.

Figure II.4 Breakdown of Waste Types Landfilled in Texas, 2009



Source: TCEQ Municipal Solid Waste in Texas: A Year in Review, FY 2009 Data Summary and Analysis

The City does not track the waste type or generator type of the waste received for disposal at the landfill except for what they collect. Residential (single-family and multifamily) and commercial waste generation assumptions outlined in Appendix A, Task 2 Waste Generation and Landfill Capacity Technical Memorandum, indicates the disposal percentage of these two waste types (after accounting for the current single-family diversion estimates) are as shown in Table II.3. The current single-family waste diversion estimates are approximately 30% of that generated. The TCEQ guidelines for developing local solid waste plans request information regarding the solid waste types listed in Table II.3. However, the City does not track disposal tonnage by generator type except that collected by City crews. The other categories listed in the table represent a small percentage of the total waste disposed from the City and are not significant to these planning efforts.

Table II.3 City of Dallas Solid Waste Types

Generator Type	Percentage of Total Waste Disposed	Major Source
Residential	42%	✓
Commercial	58%	✓
Institutional	N/A	
Recreational	N/A	
Military	N/A	
Municipal Sludge	N/A	
Industrial	N/A	
Mining	N/A	
Agricultural	N/A	
Other (medical, used oil, batteries)	N/A	
Other (resource recovery)	N/A	

Source: Task 2 Waste Generation and Landfill Capacity Technical Memorandum

II.2.B Solid Waste Generation

Waste Quantities

Per TCEQ recommendation (as described in the NCTCOG Regional Solid Waste Management Plan, 2007), the amount of waste generated on a regional basis can be determined by the following formula:

Waste Generation = Waste Disposal + Waste Diversion - Waste Imports + Waste Exports

For purposes of this Plan, it is understood that there is currently a net export of waste out of the City being disposed in other landfills. There is currently little data on how much is being imported or exported into the City. According to city records for 2010, approximately 17,766 tons were imported from the cities of Garland, Richardson, Mesquite, Rockwall, University Park, Hutchins and Lancaster. This represents 1.2% of the material delivered to the landfill during Fiscal Year (FY) 2009 – 2010.

To aid the City in planning for the next 50 years of solid waste management, this Plan utilizes waste quantity estimates assuming the City must manage all waste generated within its city limits. This is a conservative estimate but considered prudent for long-range planning. The current single-family diversion rate will also be included in the baseline numbers. Based on projections calculated in Appendix A, approximately 2,172,000 tons will be generated in the City in FY 2010 – 2011 (after single-family diversion estimates based on the current diversion rate) that will need to be disposed or diverted. Based on this estimated amount, the current minor volume of imported waste is negligible and will be considered zero in this Plan. Additionally, under the conservative assumption that the City would be required to manage all waste generated in the City, there will be no net export of waste. Therefore;

Waste Generation = Waste Disposal + Waste Diversion.

The following describes the various waste generators within the City.

Residential Waste

As discussed in the Task 1 Solid Waste System Overview Technical Memorandum, the total residential waste generated during Fiscal Year 2009-2010 by 237,187 residential accounts was 449,363 tons, or approximately 1.89 tons per residence. The U.S. Census Bureau in its American Community Survey for the Years 2005-2009 indicated that the City of Dallas had 2.65 people per household. Based upon this information the residential waste generation rate for Dallas was approximately 1.89 tons/2.65 = 0.71 tons/person/year. This correlates reasonably well with the residential generation rate of 0.86 tons/person/year derived in the "Metroplex Area Sub-Regional Solid Waste Study" in 2003. This sub-regional study also calculated a generation rate of 0.76 tons/person/year for multifamily residents, as they would not generate brush at the same level as single-family residents. For purposes of this Plan, the factors calculated from the 2003 Sub-Regional Plan were used.

Commercial Waste

It is difficult to define the total amount of commercial waste generated in the City of Dallas, as most of the commercial waste is collected by private waste haulers and is then transported to private landfills. As a part of the "Metroplex Area Sub-Regional Solid Waste Study" in 2003, surveys were conducted to define collection quantities and landfill disposal quantities in a five county area (including Dallas County). From this survey data it was possible to calculate the total waste generated in the five counties with reasonable accuracy. A methodology was developed to calculate the amount of commercial waste by first calculating the single-family residential waste and the multifamily residential waste and then subtracting those quantities from the total waste collected in the five county area. From this calculation and population/employment data available for the region, a commercial waste generation rate was estimated for the region. This generation rate was applied to each city and its respective percentage of the region's employment and a base year commercial waste generation quantity was calculated for each city in the five county area.

In the "Metroplex Study" for the Base Year of 2002 in the City of Dallas, the following waste quantities were calculated for a population of 1,208,300 people:

Single-family Residential	**955,000 tons***
Multifamily Residential	**385,602 tons**
Commercial	**1,151,564**

*Reported in Survey and not calculated

The demographics of the residential population (based on NCTCOG data) is now estimated to be 47.1% of those living in single-family residences and 52.9% of the population living in multifamily residences.

For purposes of waste quantity projections, this Plan uses the following factors:

Single-family Residential	**0.86 tons/person**	**(47.1% of Population)**
Multifamily Residential	**0.76 tons/person**	**(52.9% of Population)**
Commercial (1,151,564 tons in 2002/1,208,30 population)	**0.95 tons/person**	**(Total Population)**

Wastewater Treatment and Water Treatment Sludges

Wastewater treatment and water treatment sludges are generated by the City's plants. Wastewater treatment generates approximately 100 dry tons per day (16% solids) and water treatment generates approximately 120 dry tons per day (15 to 18% solids). Wastewater treatment plant sludges are currently being land applied at the Southside Wastewater Treatment Plant. There is also a 1,400 acre sludge monofill permitted at the Southside facility which is currently not in use. Ample capacity exists within the City's wastewater program to continue management of this material well into the future. Water treatment plant sludges are periodically removed from the City's plants and taken to local landfills for potential use as an alternate daily cover material, if approved by the TCEQ.

In fiscal year 2010, only 5,451 tons of sludges were disposed at the landfill from these City programs. This minor quantity represents less than 1% of the waste delivered to the landfill during that time. Since the City has ample disposal capacity for these wastes, they are not considered in this Plan.

The City also accepts sludge (and other waste) from several area municipalities. In 2010, 17,766 tons were imported from the cities of Garland, Richardson, Mesquite, Rockwall, University Park, Hutchins and Lancaster. This amount also represents around 1% of the waste delivered to the McCommas Bluff Landfill for disposal during that time. This minor amount is considered insignificant to this planning effort.

Disposal Quantities

The solid waste quantities disposed at McCommas Bluff Landfill, based on available information, indicate that 1,362,422 tons of solid waste materials were disposed at the landfill in Fiscal Year 2009-2010, after the diversion of some material for beneficial use on site. Landfill airspace utilized during this time was reported at 2,970,242 cubic yards or approximately 1,400 pounds per cubic yard. More detailed tables and discussion of assumptions and calculations can be found in the Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum. Total estimated citywide disposal for Fiscal Year 2009-2010, based on the generation rates used, is provided in Table II.4.

Table II.4 Estimated Citywide Disposal

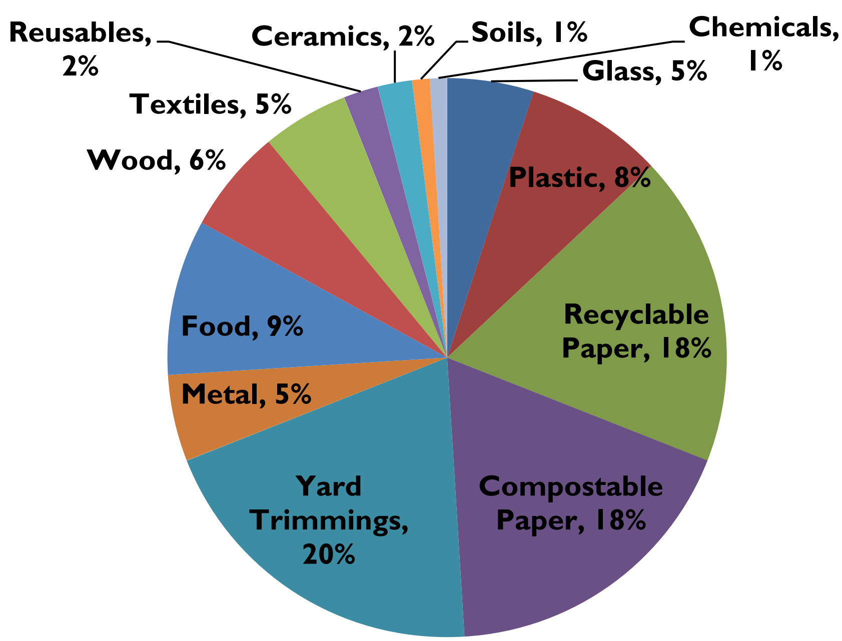
Generator Types	Tons	Percentage
Total Residential	904,000	42%
Single-family Residential	375,000	17%
Multifamily Residential	529,000	25%
Commercial	1,251,000	58%
Total	2,155,000	100%

Source: Task 2 Generation Projections and Landfill Capacity Scenarios Technical Memorandum
Note that single-family disposal is net of diversion (30%). Values are based on estimated generation quantities by generator type and not actual.

Waste Characteristics

The Plan uses the following estimated waste characterization percentages published by NCTCOG in 2002 using data from the Texas Natural Resource Conservation Commission Strategic Plan 2001-2005.[4] The following Figure II.5 provides a graphical presentation of the data.

Figure II.5 Estimated Composition of Discarded Materials



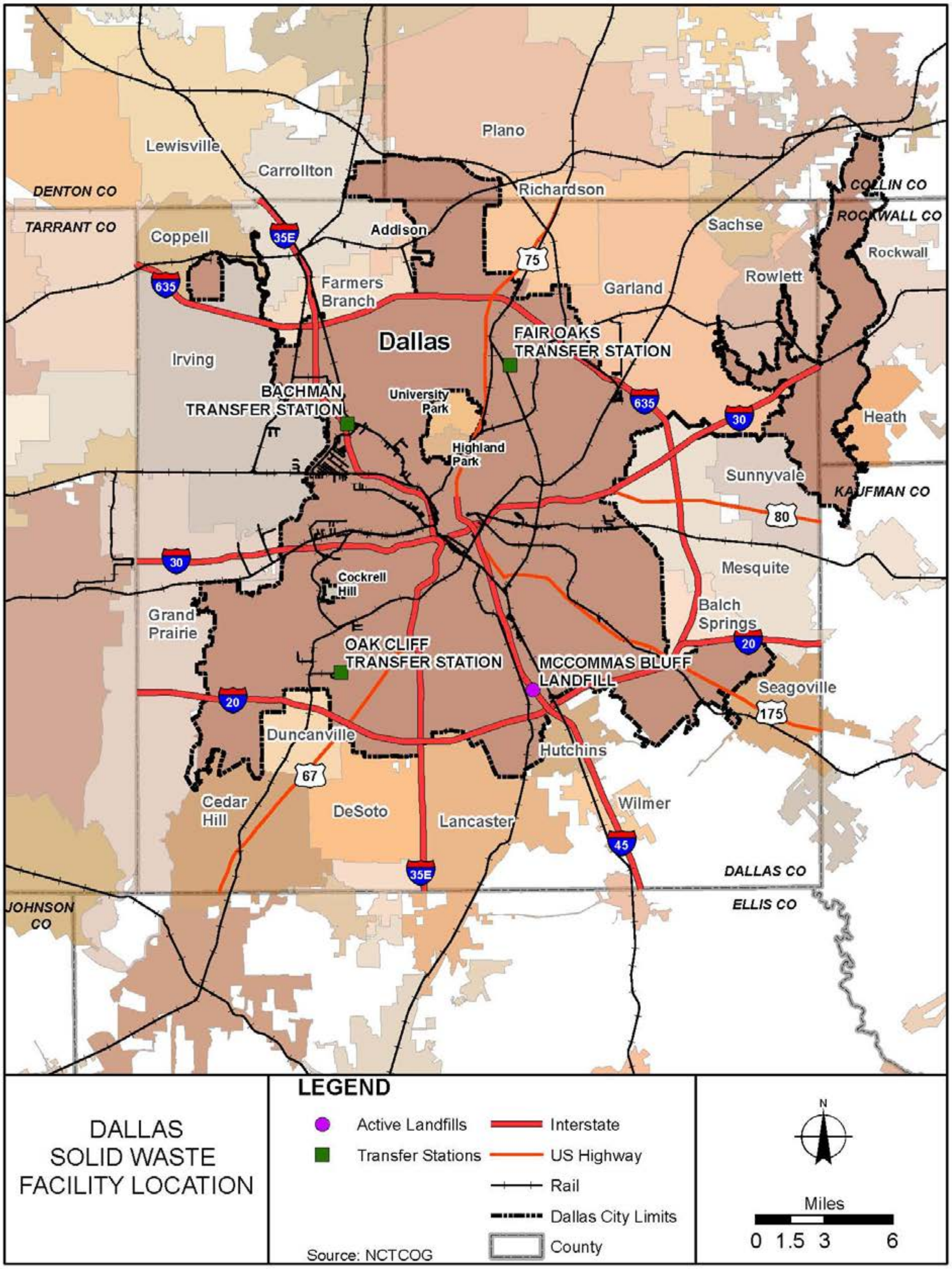
Source: *TNRCC Strategic Plan 2001-2005* with adjustments made by dividing the "other" category into textiles, reusables, ceramics, soils and chemicals and dividing the "paper" category into recyclable paper and compostable paper.

[4] The Texas Natural Resource Conservation Commission (TNRCC) was the predecessor agency to the Texas Commission on Environmental Quality (TCEQ) which is the lead environmental agency within the State of Texas.

II.2.C Solid Waste Management Entities

The Task 1 Solid Waste System Overview Technical Memorandum described the solid waste management entities operating in the City. This section provides a summary of the solid waste management entities and their general practices. Figure II.6 illustrates the City's solid waste facility locations.

Figure II.6 Dallas Solid Waste Facility Locations



Collection by City Forces – Residential

Garbage – Collected once per week in a 90 gallon gray cart in the alley (if serviceable alley available) or at the curb. ($20.34 per month in 2010). The City currently has 237,187 active single-family residential sanitation accounts for this collection service.

Brush/Bulky – Collected once per month. (Basic collection included in monthly residential fee)

Recycling – Collected once per week in a 90 gallon blue cart at same location as garbage cart. This is a voluntary program and the residents must request a blue recycle cart. (Collection included in monthly fee).

Collection by City Forces – Commercial

The City offers commercial collection services with rates varying upon frequency of service and container size. The majority of the commercial collection is provided by private hauling companies.

Transfer Operations – The City operates three transfer stations. All waste from these stations is hauled to the McCommas Bluff Landfill (see Figure II.6 for these facility locations). All three transfer stations are permitted to accept waste 24 hours a day and seven days per week. The current usage is less than this amount.

Bachman (Northwest) – (TCEQ MSW Permit No. 1145) 9500 Harry Hines Blvd. Open 6 days per week, 7:30 a.m. to 5:00 p.m. to City and private commercial haulers, and City of Dallas residents.

Fair Oaks (Northeast) – (TCEQ MSW Permit No. 60) 7677 Fair Oaks Avenue. Open Monday, Tuesday, Thursday and Friday, 8:00 a.m. to 6:00 p.m. to City collection vehicles. The facility is open to City of Dallas residents on Wednesday and Saturday from 7:30 a.m. to 5:00 p.m.

Oak Cliff (Southwest) – (TCEQ MSW Permit No. 1453) 4610 S. Westmoreland Road. Open Monday, Tuesday, Thursday and Friday, 8:00 a.m. to 6:00 p.m. to City collection vehicles. The facility is open to City of Dallas residents on Wednesday and Saturday from 7:30 a.m. to 5:00 p.m.

Disposal

All waste collected by City crews is disposed at the McCommas Bluff Landfill (TCEQ MSW Permit No. 62) 5100 Youngblood Road. The landfill is permitted to accept waste on a continuous basis (24 hours per day, seven days per week). It is currently open Monday through Friday from 5:00 am to 8:00 pm and from 6:00 am to 4:00 pm on Saturdays. Solid waste collected by private haulers is disposed at McCommas Bluff Landfill or other regional privately operated landfills. Some waste from other cities is disposed at the McCommas Bluff Landfill through contractual arrangements or by individual private haulers. Figure II.7 summarizes the City' solid waste system.

Figure II.7 Dallas Solid Waste System Overview Fiscal Year 2009-2010

- 1.3 million residents
- 237,187 active single-family residential accounts
- Weekly collection of residential waste
- 253,667 tons of residential waste collected

- Weekly collection of recyclable materials from single-family residents
- 40,920 tons recyclable materials diverted from single-family residents

- Monthly collection of Brush and Bulky Items
- 154,776 tons collected
- 92,695 tons brush diverted from brush and bulky item collection

- Multifamily and commercial collection primarily by private haulers

McCommas Bluff Landfill – 1,362,000 tons disposed
Enhanced Leachate Recirculation began in 2011, increasing available capacity by 15%
Bachman Transfer Station – 12,000 to 15,000 tons per month; capacity 48,000 tons per month
Fair Oaks Transfer Station – 4,000 to 6,000 tons per month; capacity 15,000 tons per month
Oak Cliff Transfer Station – 4,000 to 6,000 tons per month; capacity 15,000 tons per month

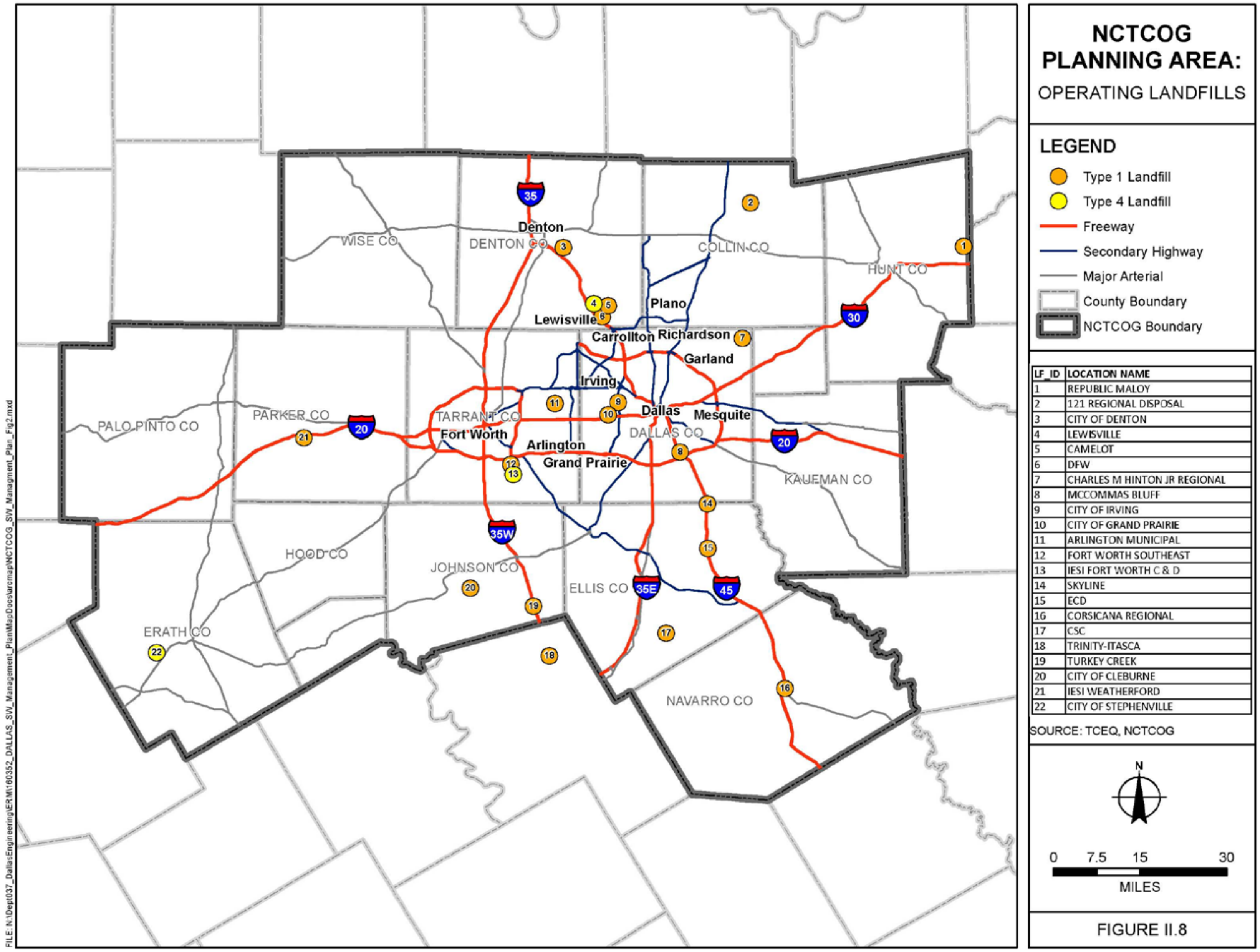
Collection by Others – Commercial

Solid waste collection from apartments, institutions, commercial establishments, and mobile home parks is performed primarily by private service providers with solid waste collection franchises granted by the City. Currently, 189 solid waste hauling companies are franchised by the City.

Disposal by Others

Some of the waste collected by private service providers is disposed at other area landfills. Figure II.8 shows the currently operating landfills in the NCTCOG region.

Figure II.8 Municipal and Private Landfills in the Dallas Region



Other Solid Waste Entities (Recycling/Organics)

The City operates a voluntary curbside recycling collection program (part of the Too Good to Throw Away program) for its single-family residential customers and diverts waste through various other programs. The City's curbside recycling participation rate is approximately 64 percent and about 30 percent of single-family residential waste is diverted from landfills. The recyclables collected in the curbside collection system are transported to a private processor, Greenstar Recycling, located in Garland, Texas, for processing and marketing. The City receives a revenue-share based on market rates for the individual commodities less costs associated with the processing operation.

Solid Waste and Recyclables collection for commercial and multifamily accounts are also provided by approximately 189 private haulers doing business in Dallas under franchise agreements. Material Recycling Facilities (MRFs) operating in the City include one operated by Community Waste Disposal (2010 California Crossing) and one operated by Waste Management (5025 Cash Road). There are also several other metal and computer recycling companies operating in Dallas. Compost and mulch producers in Dallas include Living Earth Technologies (1901 California Crossing Road), Soil Building Systems, Inc. (1770 Y Street) and Envirmulch (401 E Wheatland Road).

Locations of recycling facilities within the NCTCOG can be found on their website at http://www.nctcog.org/envir/SEELT/reduction/facilities/index.asp.

II.2.D Solid Waste Management Activities and Programs

The City operates a number of diversion programs to reduce the volume of discarded materials requiring landfill disposal. These include:

Too Good to Throw Away – This program provides curbside collection of recyclable materials from residential customers.

Yard Waste Diversion – Clean brush or yard trimmings delivered by individuals or City brush/bulky waste collection crews are segregated and diverted from disposal. The brush and yard trimmings are mulched at the Bachman Transfer Station or the McCommas Landfill. Loads of brush co-collected with bulky items are currently not diverted from disposal.

Dry Gulch Recycling Center – The City operates a Recycling Center located adjacent to the Bachman Transfer Station where residents can bring materials for recycling.

Hard to Recycle Collection Events – The City sponsors semiannual "hard to recycle" collection events where residents can deliver items to designated drop-off locations.

Tire Diversion – Tires delivered separately by individuals or City crews at the Transfer Stations or Landfill are segregated and diverted from disposal.

Don't Bag It! – This program encourages residents to mulch grass clippings rather than bag it and send it to landfills.

Hotel Pilot – The City has initiated a Pilot Program to reduce waste and increase recycling at hotels in the City.

Multifamily Pilot – The City has initiated a Pilot Program to reduce waste and increase recycling at apartment complexes in the City.

In-House Office Recycling – The City of Dallas in-house office paper recycling program diverts recyclable paper from City offices and buildings.

Community Drop-off Sites – Drop-off sites are provided in selected City Parks where residents can bring materials for recycling.

Electronics Recycling – Materials delivered to a City sponsored electronics recycling event.

Metals Recycling – White goods and other metals are separately collected by City crews and delivered to the transfer station or landfill. These materials are stored on-site and then picked up by Okon Metals for recycling.

Other Programs

In addition to the diversion activities described above, the City has implemented an Enhanced Leachate Recirculation (ELR) program at the McCommas Bluff Landfill. Clean water, leachate, and gas condensate are added to the landfill cells to increase degradation. This program is expected to speed up the waste degradation process, thus increasing the rate of landfill gas generation and settlement of the waste. The City expects to recapture approximately 10 to 30 percent of the available airspace for additional filling during the life of the landfill due to the accelerated settlement. Additionally, the practice of ELR will increase the rate of landfill gas generation, allowing the City to collect larger quantities in an accelerated timeframe.

II.2.E Capacity of Existing Solid Waste Management Facilities

Landfill Capacity

The Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum included in Appendix A provides an analysis of the City's McCommas Bluff Landfill capacity. This information is summarized below.

The Annual (FY 2010) Report to TCEQ reported a remaining disposal capacity at McCommas Bluff Landfill of approximately 100,000,000 cubic yards as of August 31, 2010. Based upon the Annual Report for the previous year, the remaining capacity of the site was reduced by approximately 1,970,000 cubic yards during Fiscal Year 2010. This space was used for the reported 1,362,266 tons disposed plus any daily and/or intermediate cover used during the two reporting dates. This equates to an in place density of 1,382.8 (approximately 1,400) pounds per cubic yard for the waste and cover material placed in the McCommas Bluff Landfill during Fiscal Year 2010. This density is sometimes referred to as the airspace utilization factor (AUF) and is expressed in tons per cubic yard typical AUFs range from 0.5 to 0.8. The site area currently permitted for filling contains approximately 835 acres. Of that total acreage permitted for filling, approximately 394 acres remain undeveloped. Utilizing an AUF of 0.7, the 100,000,000 cubic yards of airspace remaining would hold approximately 70,000,000 tons of waste. A review of the waste acceptance rates developed in the Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum (included in Appendix A), the McCommas Bluff Landfill received an average of approximately 1,750,000 tons per year over the past ten years and is expected to reach capacity between the years 2039 and 2053 based on the four scenarios that were analyzed. Increased diversion estimates, as envisioned in the Plan, would extend the landfill life by decades.

Transfer Station Capacity

The Task 3 Transfer Operations Technical Memorandum included in Appendix A provides an analysis of the three transfer stations used by City crews. This information is summarized below.

Bachman (Northwest) – Since 2004 the Bachman Transfer Station has received an average of approximately 12,000 to 15,000 tons of waste per month, of which approximately 10 to 15 percent is delivered by residents and private waste haulers. The remaining 85 to 90 percent is delivered by City collection vehicles. The total Fiscal Year 2010 tonnage transferred through this station was 162,923 tons. This Bachman Transfer Station has the design throughput capacity of 2,000 tons per day (approximately 48,000 tons per month) without physical expansion of the facility itself or increased operating hours.

Fair Oaks (Northeast) – City vehicles using the Fair Oaks Transfer Station deliver an average of approximately 4,000 to 6,000 tons of waste per month. The total Fiscal Year 2010 tonnage transferred through this station was 52,816 tons. The Fair Oaks Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself or increased operating hours.

Oak Cliff (Southwest) – City vehicles using the Oak Cliff Transfer Station deliver an average of approximately 4,000 to 6,000 tons of waste per month. The total FY 2010 tonnage transferred through this Station was 57,914 tons. This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself or increased operating hours.

The three transfer stations have the capacity to handle the estimated waste projected to be generated during the planning period. The diversion programs outlined in the Plan may require some multi-use functions to be developed to manage recyclable material as well as material to be disposed.

II.2.F Planned New Facilities or Facility Expansions

Although the current facilities are periodically updated and adjusted to meet the operational needs, there are no new solid waste facilities or facility expansions planned in the near future. This Plan identifies future facility needs for the planned diversion programs.

II.2.G Planned Solid Waste Management Activities and Programs

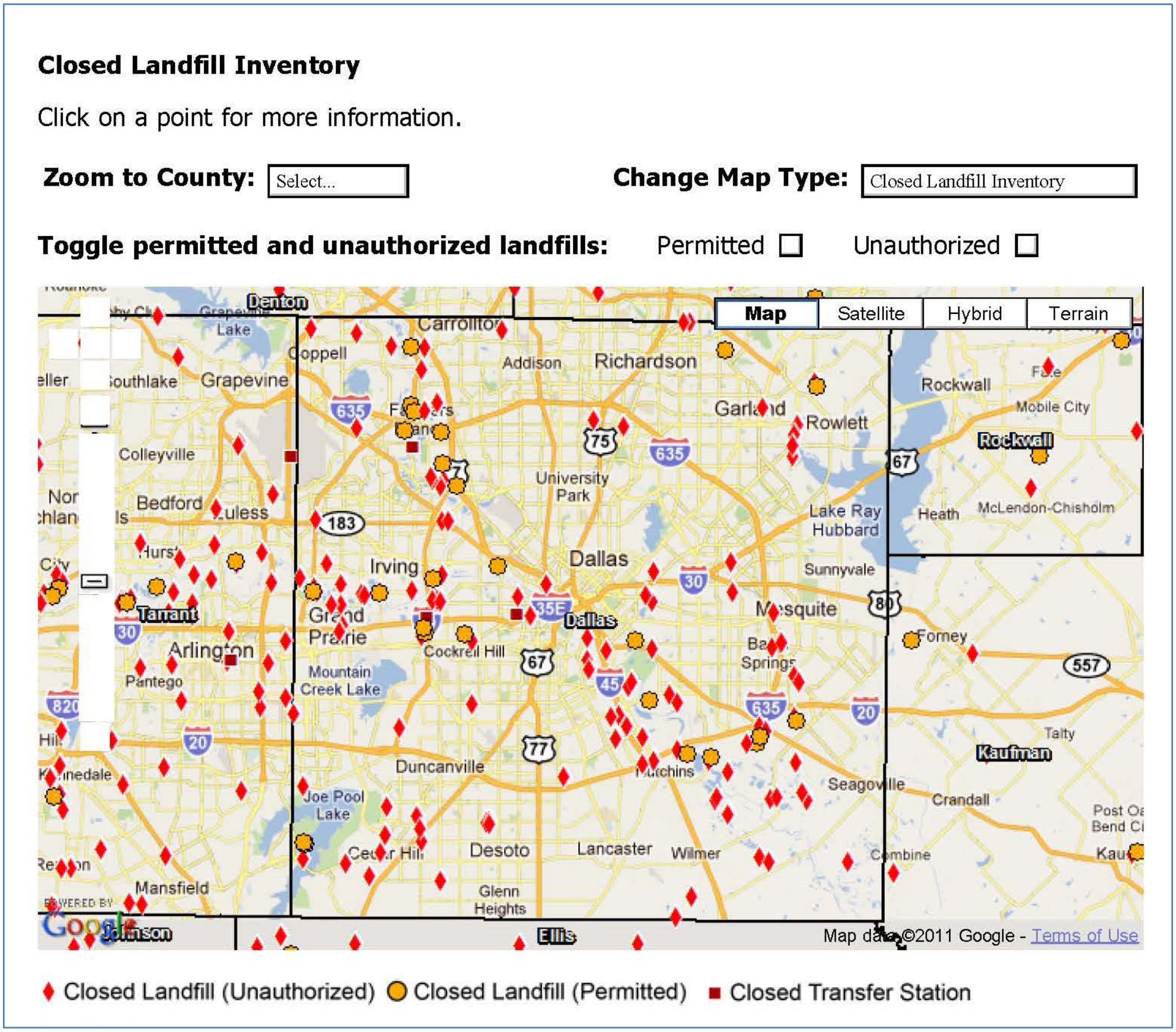
There are no new solid waste management activities or programs planned in the near futures. This Plan identifies the future activities and programs needed in the City.

II.2.H Inventory of Closed Municipal Solid Waste Landfills

The following Figure II.9 is from the NCTCOG website and shows locations of the known closed landfills in Dallas County. A listing of the closed landfill inventory for NCTCOG is included in Appendix B. More information on closed landfills can be found on the NCTCOG Closed Landfill Inventory web page located at:

http://www.nctcog.org/envir/SEELT/disposal/facilities/cli_main.asp.

Figure II-9 Closed Landfills in Dallas County



Source: North Central Texas Council of Governments; http://www.nctcog.org/envir/SEELT/disposal/facilities/map.asp?mode=Closed. Accessed July 28, 2011.

See list of sites in Appendix B.

II.3 System Evaluation and Needs Assessment

This section evaluates both the current and planned solid waste management system activities, programs, and facilities in order to determine current and future needs, problems, and opportunities to be addressed in this Plan. Additional information is provided in the Technical Memoranda included in Appendix A:

- Task 1 Solid Waste System Overview;
- Task 2 Waste Generation Projections and Landfill Capacity Scenarios;
- Task 3 Transfer Station Operations;
- Task 4a Diversion Program Options; and,
- Task 4b Organics Diversion Options.

II.3.A Existing Solid Waste System Priorities

The Task 1 Solid Waste System Overview Technical Memorandum included in Appendix A describes the City's existing solid waste practices, policies and priorities. These include:

- Providing an effective and efficient solid waste collection system;
- Maximizing the public benefits of the City's McCommas Bluff Landfill; and
- Pursuing state-of-the art programs and facilities for managing waste generated in the City.

These priorities are consistent with the state's hierarchy of preferred solid waste management methods:

- Source reduction and waste minimization;
- Reuse or recycling of waste;
- Treatment to destroy or reprocess the waste for the purpose of recovering energy or other beneficial resources in a manner that will not threaten public health, safety, or the environment; and,
- land disposal.

The policies, programs and facilities identified in this Plan will further align the City's priorities with those of the state.

II.3.B Anticipated Impact of Regulations

Since the 1960s, federal, state, and city governments have developed a regulatory framework to ensure that solid and hazardous wastes are managed in an environmentally sound manner. Multiple agencies at each governmental level have responsibility for regulating each component of the solid waste management system including collection, processing, and final disposal. Regulation is generally used to set basic standards for waste transportation, handling, and disposal to ensure consistency and to protect public health and the environment. Education and voluntary programs are used to increase recycling, waste reduction, and composting rates; and to promote producer responsibility (through voluntary take back programs).

Role of the Federal Government in Regulating Solid Waste

The federal government sets basic requirements to ensure consistency among states and regulations to protect public health and the environment. The United States Environmental Protection Agency (U.S. EPA) is responsible for hazardous and non-hazardous solid waste management through the Office for Solid Waste and Emergency Response. The Resource Conservation and Recovery Act of 1976 (RCRA) established landfill construction, management, and closure guidelines. This act also regulates hazardous waste management facilities that treat, store or dispose of hazardous waste. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), known as Superfund, was enacted by Congress to address abandoned hazardous waste sites in the U.S. CERCLA has subsequently been amended, by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Office of Air and Radiation regulates the solid waste-related air emissions, enforcing the Clean Air Act of 1976 (CAA) and subsequent amendments.

Role of the State Government in Regulating Solid Waste

Texas has a long-standing municipal solid waste regulatory program, which was initiated with the Texas Solid Waste Disposal Act, passed by the legislature in 1969.[5] The Act required the Texas Health Department to adopt regulations pertaining to the design, construction and operation of landfills and other solid waste facilities. Other major pieces of state legislation include:

- The 1983 Comprehensive Municipal Solid Waste Management, Resource Recovery and Conservation Act which established the Municipal Solid Waste Management and Resource Recovery Advisory Council and prescribed procedures and criteria for those regional planning agencies and local governments which wished to develop solid waste management plans;
- The 1987 House Bill 2051 which established a preferred hierarchy, as a state policy, for the management of hazardous waste, municipal waste and municipal sludge;
- The 1989 Senate Bill 1519 which established a solid waste disposal fee program to fund the state's municipal solid waste regulatory program and required the regional Councils of Governments to develop regional solid waste management plans and support the development of local plans through planning grants;
- The 1991 Omnibus Recycling Act which set statewide goal of 40 percent recycling for municipal solid waste by January 1, 1994;
- The 1993 Senate Bill 1051 which expanded state programs and changed the 40 percent *recycling* goal established in 1991 to a 40 percent *reduction* goal of the total amount of municipal solid waste disposed in the state through source reduction and recycling;

[5] Texas Environmental Almanac, Chapter 8 Municipal Waste
http://www.texascenter.org/almanac/Waste/MUNICIPALCH8P1.HTML#SOLID (accessed July 27, 2011).

- The 1993 House Bill 2537 which addressed the risks associated with methane gas releases from closed landfills by establishing a process for the Texas Natural Resource Conservation Commission (TNRCC, now TCEQ) to review proposals and issue permits to build atop closed municipal solid waste landfills; and,
- The 2007 Texas Computer Equipment Recycling Law which requires manufacturers to establish and implement a recovery plan for collection, recycling and reuse of computer products.

TCEQ is the environmental agency for the state and is responsible for mitigating impacts to the state's air, land and water. TCEQ promulgates regulations and enforces state and federal requirements. TCEQ also provides technical assistance to municipalities and education resources on pollution prevention, including air pollution reduction, water pollution reduction, and waste reduction.

State Legislative Trends

Each year that the legislature is in session, numerous bills are introduced addressing recycling and solid waste management. Key topics of interest to state legislators over the course of recent legislative sessions include:

- Producer responsibility for specific hazardous or difficult to recycle materials including, mercury thermostats, computers and televisions; and,
- Statewide "bottle bill" targeting cans and bottles for recycling.

No major state or federal regulations are anticipated to negatively impact the initiatives identified in this Plan.

II.3.C Waste Characterization Projections

The Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum included in Appendix A projects waste generation over the planning period as summarized in Table II.5. This table summarizes the scenario where all the waste generated in the City is disposed at the City's landfill and the current level of diversion from single-family residents is maintained. No commercial or multifamily diversion is included. Diversion and disposal estimates increase in relation to projected increases in population. The generation estimates are divided into waste types for analysis of diversion options.

Table II.5 Waste Generation and Disposal Projections by Goals (All Dallas Waste Scenario)

Generator	2011	2020	2030	2040
Single-family Diversion[1]	160,000	171,000	185,000	198,000
Single-family Disposal	378,000	406,000	437,000	469,000
Multifamily Disposal	534,000	573,000	617,000	662,000
Commercial Disposal	1,261,000	1,354,000	1,458,000	1,563,000
Total Disposal	**2,173,000**	**2,333,000**	**2,512,000**	**2,694,000**
Total Generation	**2,333,000**	**2,504,000**	**2,697,000**	**2,892,000**

Source: Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum
[1]Baseline diversion estimates include the current single-family diversion tons only.
Totals may not sum due to rounding.

The Task 4a Diversion Program Options Technical Memorandum analyzes the diversion potential of key initiatives, and projects potential diversion and disposal rates over the planning period using the following three scenarios.

- **Increase voluntary programs**— provide separate collection of organics for composting, bulk item reuse and recycling, social marketing campaign, commercial technical assistance, encourage commercial haulers to provide recycling services to all of their customers, develop a construction and demolition debris (C&D) ordinance or incentive program and provide C&D technical assistance, develop Resource Recovery Facility(ies) within the City, and work with local retailers to increase take-back programs for hard-to-recycle items and advocate for extended producer responsibility at the state level.
- **Implement mandatory requirements**—develop mandatory source-separation requirements.
- **Process residual waste**— process all solid waste prior to landfilling.

Table II.6 Diversion Estimates by Scenario[1]

	Baseline (existing programs)[2] 2011	Increasing voluntary programs 2020	Adding mandatory requirements 2030	Add residual waste processing[3] 2040
Diversion (tons)	160,000	1,011,000	1,856,000	2,421,000
Disposal (tons)	2,172,000	1,493,000	841,000	472,000
Diversion rate	7%	40%	69%	84%

[1]Assumptions by program and material type are included in Appendix A.
[2]Baseline diversion estimates include the current single-family diversion tons only. Baseline disposal tons for 2011 are based on the estimated generation within the City less the projected single-family diversion estimate. Some of the disposal ton estimate may not be currently disposed.
[3]"Residual waste processing" means separating recyclable and compostable materials from solid waste at a mixed waste material recovery facility prior to landfilling.

II.3.D Solid Waste System Facility Assessment

Landfill Capacity Projections

The Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum estimates landfill capacity based on four scenarios.

- **Scenario 1**: Assumes that only current users will continue to dispose of waste at McCommas Bluff Landfill without any new users.
- **Scenario 2**: Assumes that ALL waste generated in Dallas will be disposed (after current levels of diversion from the single-family collection programs) at the McCommas Bluff Landfill.
- **Scenario 3**: Assumes that ALL waste generated in Dallas will be disposed (after current levels of diversion from the single-family collection programs) at the McCommas Bluff Landfill AND Enhanced Leachate Recirculation will be continued during the life of the landfill.
- **Scenario 4**: Assumes that ALL waste generated in Dallas will be disposed at the McCommas Bluff Landfill AND Enhanced Leachate Circulation will be continued during the life of the landfill AND Residential Waste Quantity Diversion will be increased to 50% through additional Diversion Programs.

Table II.7 depicts the results of the landfill capacity analysis, including the year that the McCommas Bluff Landfill is projected to reach capacity under each scenario.

Table II.7 Landfill Capacity Analysis

Scenario	Year Landfill Will Reach Capacity
Scenario 1 Current Users	2054
Scenario 2 All Dallas Waste	2039
Scenario 3 All Dallas Waste with Enhanced Leachate Recirculation	2043
Scenario 4 All Dallas Waste with Enhanced Leachate Recirculation and increased residential Diversion	2045

Source: Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum

The scenarios analyzed in Appendix A, Task 2 indicated that the City's landfill will reach capacity prior to the end of the planning period. However, should additional diversion programs as outlined in this plan be implemented, the landfill life would increase dramatically.

Transfer Station Capacity Projections

The Task 3 Transfer Operations Technical Memorandum provides the City's transfer station capacity projections. The projections confirm that the City is likely to have sufficient transfer capacity throughout the planning period.

Bachman (Northwest) - This Transfer Station has the design throughput capacity of 2,000 tons per day (approximately 48,000 tons per month) without physical expansion of the facility itself or increased operating hours. This facility design capacity is over three times the current throughput at the facility (12,000 to 15,000 tons per month) and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same (85-90% City collection vehicles) and waste quantities increase as projected in the Task 2 Technical Memorandum. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, and if needed, additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, and staff.

Fair Oaks (Northeast) - This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself or increased operating hours. This facility design capacity is approximately 2.5 times the current throughput at the facility (4,000 to 6,000 tons per month) and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same (City Residential Collection Vehicles and Private Citizens only) and waste quantities increase as projected in the Task 2 Technical Memorandum. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, the facility is not designed to transfer that amount of waste, which would equal the waste stream from ¼ of the City. (Due to the geographic location of the City's Solid Waste facilities, it is projected that each of the three transfer stations plus the landfill would accept approximately ¼ of the City's waste.) Some additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, and staff. However the facility site is restricted in size due to the surrounding area's location in the 100 year flood plain of White Rock Creek and cannot be expanded to meet the overall needs from ¼ of the City.

Oak Cliff (Southwest) - This Transfer Station has a design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself or increased operating hours. This facility design capacity is approximately 2.5 times the current throughput at the facility (4,000 to 6,000 tons per month) and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same (City Residential Collection Vehicles and Private Citizens only) and waste quantities increase as projected in the Task 2 Technical Memorandum. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, the facility is not designed to transfer the entire waste stream from ¼ of the City. There is limited space for facility expansion, but the facility could be expanded in size to meet some of the future needs. Some additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, staff, and the relocation of the office and scale system. If the facility would be expected to transfer all of the waste quantities from ¼ of the City, it is anticipated that the facility would be replaced with a new facility rather than expanding the existing facility.

There are a number of options available to the City to more effectively manage the solid waste resources (types and quantities of materials) that will be generated in the City. Options would include expansion of existing programs and possible new programs and facilities.

The cost estimates presented in the following sections represent a wide variety of potential technologies, feedstocks and operational considerations. The estimates are valid for planning purposes and more up-to-date project specific information should be used when reviewing specific opportunities.

Compost Facility Development

Consistent with the hierarchy of preferred solid waste management methods and to reach the City planned diversion goals, the City will need to invest in new composting infrastructure.

Composting facilities are designed for collecting, grinding, mixing, piling, and supplying sufficient moisture and air to organic materials (including yard trimmings, food scraps, biosolids and other organic materials) to speed natural decay. The finished product of a composting operation is compost, a soil amendment suitable for incorporating into topsoil and for growing plants. Compost is different from mulch, which is a shredded or chipped organic material placed on top of soil as a protective layer. Compost facilities can vary greatly in size. Small compost facilities are typically in the range of 100 - 250 tons per day (26,000 - 65,000 tons per year), and large compost facilities range from 1,000 - 3,000 tons per day (260,000 - 780,000 tons per year), based on 260 operating days per year. Compost technologies include:

- **Windrow** – compostable material is piled in long rows and regularly turned to enhance aerobic activity and control temperature;
- **In-vessel** – compostable material is placed in enclosed reactors (metal tanks, concrete bunkers or plastic tubes) where airflow and temperature can be controlled; and,

- **Aerated static pile** – compostable material is placed in piles on perforated pipes under removable covers, and fans are used to push or pull air through the pipes to control the composting process.

The Task 4b Organics Diversion Options Technical Memorandum addresses the ability to process source separated organics at the McCommas Bluff Landfill using open windrow technology. The analysis concludes that the site will support a large windrow composting operation and identified the following to increase throughput capacity either to accommodate all of the feedstock currently generated, or to accommodate growth.

- Divert some wood or brush from composting directly to mulch.
- Improve more of the designated acreage for a larger windrow area.
- Intensive windrow management, including consolidating windrows at the earliest opportunity to conserve space.

Compost Facility Costs and Revenues

Capital Cost: $5,000 to $25,000 per ton of daily capacity (low end for traditional windrows, high end for covered Aerated Static Pile / in-vessel)

Tipping Fee: $17-60/ton

Recyclables Processing Development

Recyclables processing facilities receive and process source separated recyclables from residential blue bin programs and commercial recycling programs. These facilities use various technologies and methods to sort, bale, and ship material by commodity type to markets. Recyclables processing facilities typically recover traditional recyclable materials, including newspaper, cardboard, mixed paper, aluminum cans, bi-metal cans, plastic bottles, mixed plastics and glass containers. Typical contaminants include food scraps, auto parts, yard trimmings, wood, dirt and other inerts, glass shards, and garbage. Contaminant levels for recyclables processing facilities are strongly tied to the performance of the residential curbside recycling programs to eliminate contamination, which depends on education and enforcement. These type of facilities have been in operation in the US and internationally for over 25 years and are considered to be mature, proven technologies.

The recyclables collected through the curbside collection system are currently transported to a private processor, Greenstar Recycling, located in Garland Texas, for separation. The City pays a processing fee and shares in the revenues from the separated recyclables under a current agreement depending upon markets for the individual commodities.

It is anticipated that there will be sufficient private sector recyclables processing capacity within the region throughout the planning period. However, the City may wish to develop recyclables processing capacity in order to control its own materials and potentially increase its share of the recyclables revenues. Public ownership may also provide more flexibility and allow the City to target additional materials for recycling.

Recyclables Processing Costs and Revenues

Capital Cost: $25,000 per ton of daily capacity

Tipping Fee: pays $10-20 per ton (depending on quality of feed stock, market price, and revenue share). There is also other value to the City in the resources recovered.

Resource Recovery Parks

Resource Recovery Parks are places where materials can be dropped off for donation or buyback and typically co-locates reuse, recycling and composting, processing, manufacturing, and distribution activities. They can be centers for drop-off of hard to recycle items, including mattresses, large blocks of Styrofoam, and textiles. Typically, these facilities are located in industrially zoned areas that are reserved for companies that process secondary materials or make other products from these materials.

The Resource Recovery Park concept has been evolving naturally at landfills and transfer stations. Landfills and transfer stations have historically been located near the centers of waste generation. A Resource Recovery Park can make the landfill or transfer station more sustainable by diversifying revenue, conserving capacity, and extending the useful life of those facilities.

Resource recovery facilities provide additional recycling opportunities for self-hauled loads. Self-haul customers are typically charged by the load to dispose of waste. Reuse stores or drop-off centers may not charge a fee or in some cases may pay for some materials.

The City may wish to expand the options for self-haul generators at the landfill and transfer stations by establishing Resource Recovery Parks to divert materials prior to landfilling.

Resource Recovery Parks Costs and Revenues

Capital Cost: $50,000 per ton of daily capacity

Tipping Fee: $0 per ton (Generally offered free to the public through subsidy by local jurisdiction; costs $50-100 per ton diverted). There is also other value to the City in the resources recovered.

Mixed Material Processing Facility

A mixed material processing facility, sometimes referred to as a dirty MRF, is a facility that sorts recyclable material from MSW from residential and commercial sources. These facilities can also be adapted to sort or remove different materials to prepare MSW for composting, waste-to-energy, and other alternative technologies. Desired loads include MSW from residential and commercial generators, and undesirable loads include concentrated amounts of C&D materials or concentrated amounts of wet materials, such as restaurant food. Alternative technology facilities can include a mixed material processing facility to prepare the materials for the technology.

MSW from residential and commercial collection vehicles is tipped onto a floor. Material is sorted on the floor to remove larger items such as dimensional wood, metal, or large pieces of plastics that might clog or interrupt sort lines. Loaders or grapples then load a conveyor or surge hopper. In most cases, a mechanical device is used to open bags and containers prior to screening and sorting.

Material can be processed through dual stage screens to separate fiber (cardboard, newspaper, and mixed paper), containers, and small contaminants. Fiber is hand sorted off elevated conveyor platforms into commodities and dropped into bunkers below. Containers are processed through ferrous magnets, eddy-current magnets, and hand sorting. The small contaminant stream (dirt, rocks, broken glass and ceramics, bottle caps) may be further processed by optical/pneumatic sorting. Sorted material is move from bunkers and baled (fiber, plastic, metal) or loaded directly into roll-off trucks (glass). The remaining material is shipped for disposal.

Resource Recovery Parks Costs and Revenues

Capital Cost: $30,000 - $50,000 per ton of daily capacity

Tipping Fee: $40 - $60 per ton (varies depending on quality of feedstock, revenue from recyclables, transportation cost). There is also other value to the City in the resources recovered.

II.3.E Solid Waste Management Activity and Program Assessment

The City operates a number of diversion programs to reduce the volume of discarded materials requiring landfill disposal. These include:

- Residential Recycling Collection – weekly collection provided to all single-family residences, using wheeled carts;
- Big Blue Recycling Drop-Off Sites – targeting multifamily residences and available to all generators;
- Brush Collection – monthly collection available to all residents;
- Electronics Recycling – drop-off program available to all residents;
- Pilot Recycling Programs – targeting multifamily residences and hotels; and,
- Landfill Diversion Programs – targeting metals, concrete, asphalt, sawdust, clean soil and brush.

Consistency with State Hierarchy

The Task 1 Solid Waste System Overview Technical Memorandum included in Appendix A provides a description of the City's current programs and infrastructure.

The City's has a robust recycling and solid waste management infrastructure consistent with:

- Federal and State Regulatory Requirements;
- State Solid Waste Management Hierarchies;[6] and
- Regional Waste Management Priorities.

[6] Source reduction and waste minimization; Reuse or recycling of waste; Treatment to destroy or reprocess the waste for the purpose of recovering energy or other beneficial resources in a manner that will not threaten public health, safety, or the environment; and land disposal.

The City's recycling goals include the themes of:

- "Don't Waste Today" – Emphasizing waste prevention and recycling;
- "Too Good to Throw Away" – Maximizing participation in the City's recycling programs; and,
- "Don't Bag It!" – Encouraging residents to mulch and compost yard trimmings instead of placing them in the street for collection.

These strategies focus on the state level hierarchies of source reduction, waste minimization, reuse and recycling. The City's curbside recycling participation rate is approximately 64 percent and about 30 percent of residential waste is currently diverted from landfills.

The City is in the process of implementing an Enhanced Leachate Recirculation program at the McCommas Bluff Landfill by adding additional clean water as well as recirculating leachate and gas condensate. This program is expected to speed up the waste degradation process, thus increasing the rate of landfill gas generation and settlement of the waste. The City expects to recapture approximately 10 to 30% of the airspace available for additional filling due to the accelerated settlement.

The City's landfill gas to energy program is consistent with state level hierarchy of energy recovery from waste.

Consistency with Regional Goals

The three goals of the NCTCOG regional plan are:

- **Time to Recycle** – purchased materials are reused and recycled wherever possible;
- **Stop Illegal Dumping** – illegal dumping is significantly reduced; and
- **Assuring Capacity for Trash** – the remaining waste is handled in a safe manner at permitted facilities.

This Plan will assist the region in achieving each of these goals by developing infrastructure needed to reuse and recycle materials. By building on the needs of the City, regional recycling opportunities will be developed. It is definitely **Time to Recycle** and this Plan outlines steps for the City to take to meet its Zero Waste goals.

By **Assuring Capacity for Trash** and providing adequate access to that capacity, **Illegal Dumping** can be reduced. Additionally by educating the public on the resource value of our discards, the desire to simply "get rid" of these materials will be diminished. The City has analyzed the effect of varying disposal and diversion quantities on the site life of the McCommas Bluff Landfill in the Task 2 Technical Memorandum included in Appendix A. Under the current disposal rates, the landfill has a remaining useful life of approximately 53 years (year 2054). Using a very aggressive assumption that all waste generated in the City will be disposed at the landfill with no increase in the current levels of diversion, the City has remaining capacity for almost 28 years (year 2039). Should single-family diversion rates increase to 50% and the Enhanced Leachate Recirculation project reclaim the anticipated useful airspace, an additional four to six years of disposal capacity would be realized. Should the diversion rates be expanded to the multifamily and commercial sectors, the life of the landfill would be lengthened even further.

With the implementation of this Plan, the City is poised to transition its system from one focused on collection and disposal to one based on resource management.

This Plan will help the City to reach the landfill diversion goals of:

- 40 percent by 2020;
- 60 percent by 2030; and,
- Zero Waste by 2040.

II.3.F Needs Summary

This section summarizes the City's solid waste management needs over the planning period and addresses:

- Diversion Program Needs;
- Transfer Station Needs; and,
- Landfill Capacity Needs.

Diversion Program Needs

To meet the local and regional waste management goals, the City will need to implement new policies, programs and infrastructure. The City will also need to take an active role in supporting diversion activities for all generators, including residential generators (single-family and multifamily), commercial generators (including businesses, institutions, and industrial), and construction and demolition debris generators (including contractors, demolition companies, and self-haulers).

Policies will be needed to encourage and, potentially require, residential and commercial generators to reduce waste, recycle and compost. Policies considered for implementation could include those listed in Table II.8

Table II.8 Potential Policies for Implementation

	Residential	Commercial	Construction and Demolition Debris	All Generators
Policies	Rate structure incentives Mandatory recycling and composting	Require all businesses to have recycling service Require all businesses to recycle specific materials Require all businesses to reach a certain diversion level Ban specific materials from disposal (cardboard, C&D) Require commercial haulers to reach specific diversion levels Require commercial haulers to provide recycling services to all of their customers Require all commercial kitchens to have either pulpers or under-sink garbage disposers.	Require C&D generators to prepare C&D diversion plans Require processing of all C&D loads Require all C&D generators to reach a certain diversion level (75% for construction debris, 90% for inert materials) Ordinance requiring Resource Recovery Parks at all transfer stations and landfills	Extended Producer Responsibility Packaging legislation Voluntary take-back requirements Product bans Environmentally Preferable Purchasing Ordinance Green events ordinance

Programs will need to be provided by the City to ensure that all residential and commercial generators have access to waste prevention, recycling and composting. Programs can include collection system infrastructure provided directly by the City or technical assistance and outreach programs to assist generators in getting the services that they need. Programs considered for implementation could include those listed in Table II.9.

Table II.9 Potential Programs for Implementation

	Residential	Commercial	Construction and Demolition Debris	All Generators
Programs	Add materials to recycling program (textiles, durable plastics, film plastic, scrap metal) Source-separated organics collection (yard trimmings, food scraps) Bulky item and scrap tire reuse and recycling Recycling technical assistance	Social marketing programs for specific generator types or districts (Business Improvement Districts or Building Owner and Manager Association or other) Provide recycling and composting services to all schools Provide recycling and composting services to all multifamily complexes Commercial technical assistance	C&D diversion technical assistance	Large scale media campaign (Don't mess with Texas) Community-Based Social marketing

Infrastructure will be needed to manage the new diversion tons generated from the new policies and programs. The City will also need to invest in new infrastructure at the McCommas Bluff Landfill to maximize the public benefit of the facility and ensure sufficient capacity for the region. Facilities considered for implementation could include those listed in Table II.10.

Table II.10 Potential Facilities for Implementation

	Residential	Commercial	Construction and Demolition Debris	All Generators
Facilities	Enhanced recycling processing Expansion of mulch/composting operations	Enhanced recycling processing Expansion of mulch/composting operations	Resource recovery park at City landfill Construction and demolition debris processing	Resource recovery park at City landfill

Transfer Station Needs

The Task 3 Transfer Operations Technical Memorandum concluded that the City is well-served by its transfer stations and the City is expected to have ample transfer capacity over the planning period. The City may wish to increase diversion programs at transfer stations, including:

- Resource Recovery Parks for self-haul vehicles for separation of materials prior to disposal;
- Recyclables processing for transfer stations with the capacity to expand operations; and
- Transfer capacity for source-separated recyclables and organics.

Landfill Capacity Needs

The Task 2 Waste Generation Projections and Landfill Capacity Scenarios Technical Memorandum concluded that without additional diversion, landfill capacity available to the City will be diminished over the planning period. The City may wish to increase diversion programs to extend the landfill capacity by including:

- Resource Recovery Parks for self-haul vehicles for separation of materials prior to disposal;
- Recyclables processing for materials collected by City crews or delivered by City generators to the landfill; and,
- Expansion of organics processing to including composting of brush, yard trimmings, food scraps, and other organics.

II.4 Analysis of Alternatives

This section provides the results of the analysis of the diversion potential and greenhouse gas emissions reduction potential of the policies, programs and technologies. Additional information is provided in the Technical Memoranda included in Appendix A:

- Task 4a Diversion Program Options;
- Task 4b Organics Diversion Options;
- Task 5a Technology Options for Municipal Solid Waste; and,
- Task 5b Technology Options for Source Separated Organics.

II.4.A Alternative Technologies

The Task 5 Technical Memoranda included in Appendix A provides a description of alternative technologies for treating municipal solid waste and source-separated organics.

Technology Options for Municipal Solid Waste

The technologies discussed in the Task 5a Technology Options Technical Memorandum cover a wide spectrum of waste-processing approaches. The state of development of technologies being considered varies widely. One alternative technology is in commercial operation using municipal solid waste (MSW) as a feedstock in numerous facilities worldwide. Another is in limited commercial operation using supplemented MSW as a feedstock in Japan. A third is in operation using a selected portion of the MSW waste stream at a few commercial installations in Europe. Others have demonstration and/or pilot facilities in operation or development using MSW as a feedstock. Some have prototype facilities under construction. Some have yet to be developed commercially. Each of the technologies poses environmental considerations. Each of the technologies presents a different risk profile. These differences will be tabulated for comparison. The certainty associated with estimating capital and operating costs is limited with the less developed technologies. The economics from both a capital and operating cost vary between the alternative technology options.

Table II.11 presents a summary of the various technology options and certain critical criteria.

Table II.11 Summary of Technology Options

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
Anaerobic digestion	Proven for select Waste Stream	Odor is primary concern. Can be addressed.	Limited based on composition of the waste received; needs to be purely organic materials	At this time can only address source separated organic materials	High

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
Aerobic Composting	Proven for select Waste Stream	Odor is primary concern. Can be addressed	Limited based on feedstock and can be sited appropriately to avoid odors to nearby residents	Needs source separated organic feedstock	Low
RDF processing and combustion	Commercially proven	Emissions primary concern. APC equipment can meet standards	Limited if combustion is located with processing.	Can take entire waste stream if prepared properly	High
Mass burn combustion	Commercially proven	Emissions are primary concern. APC equipment can meet standards	Limited	Can take entire waste stream if prepared properly	High
Gasification	Limited commercial operation in Japan and Europe	Emissions are primary concern. APC equipment can meet standards	Some operability and economic risk	Can take entire waste stream if prepared properly	High
Plasma Arc Gasification	Limited commercial operation in Japan	Emissions are primary concern. APC equipment can meet standards	Some operability and economic risk	Can take entire waste stream if prepared properly	High
Pyrolysis	Limited commercial development	Emissions are primary concern. APC equipment can meet standards	High risk due to limited experience on MSW	Can take entire waste stream if prepared properly.	High
Hydrolysis	No known commercial facilities are in operation using mixed waste	Not well defined	High risk due to limited experience on MSW	Needs source separation of the cellulosic portion of the waste stream	Unknown
Catalytic Depolymerization	Laboratory scale using select materials	Not well defined	High risk due to limited experience on MSW	Needs source separation of the plastics & similar materials	Unknown
Thermal Depolymerization	Demonstration/Pilot scale using select materials	Not well defined	Medium to high risk due to limited experience on MSW; requires higher energy input than catalytic depolymerization	Needs source separation of the feedstock materials	Unknown

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
Autoclaving	Limited development using MSW as feedstock; more proven when using other homogeneous or organic feedstocks	Some minor emissions from autoclaving process; controls can mitigate these concerns	High risk due to limited experience on MSW and at commercial levels needed	Works best on source separated materials; some testing done with MSW	Medium
Mixed Waste MRF	Commercially proven	Minor emissions from mobile equipment	Very limited	Can take entire waste stream	Medium

APC – Air Pollution Control; MSW – Municipal Solid Waste; RDF – Refuse Derived Fuel; Materials Recycling Facility - MRF

Recommended Technology for Municipal Solid Waste

The technologies that appear to be most suitable at this time for consideration include: aerobic composting, anaerobic digestion, a mixed waste materials recycling facility (MRF) and continuing with landfilling and the current system of landfill gas-to-energy recovery.

Technology Options for Source-Separated Organics

Table II.12 describes several available technologies for diverting organics from landfill disposal by various processes. They produce products for beneficial use, enable energy recovery, or both. The current condition, landfilling with recovery of methane for energy, is the baseline for relative comparison.

Table II.12 Organic Waste Management Technology Comparison Matrix

Criterion Technology[1]	Environmental	Economic	Regulatory	Nuisance Potential	Operations
Windrow Composting	- decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	- low facility cost - moderate equipment cost -low operating cost -landfill diversion -decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks (registration or lower) - monitoring and reporting required	- minimal odor with careful operation and feedstock management - dust and noise potential	- highly flexible - BMPs essential to maintain product quality, marketability, and nuisance reduction -requires separate collection -contamination can be removed after processing

Criterion Technology[1]	Environmental	Economic	Regulatory	Nuisance Potential	Operations
Aerated Static Pile Composting (forced air or induced draft, enclosed or covered)	- decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	- moderate facility cost -often requires building - moderate equipment cost -low operating cost -landfill diversion decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks (registration or lower) - monitoring and reporting required -OSHA concerns ref. hazardous indoor environment if applicable	-biofilter typically required for odor control -dust reduced if enclosed or covered	-accelerates aerobic decomposition -less flexible than windrow -typically covered piles, Ag-bag, or enclosed structure -biofilter or other odor control typically required -requires separate collection or extensive pre-processing
In-Vessel Composting	decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	-high capital cost -electricity cost -high pre-processing cost -moderate operating cost -decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks - monitoring and reporting required	-reduced nuisance potential	-typically requires windrow or ASP after in-vessel pre-processing -somewhat decreased processing time & decreased footprint -increased pre-processing -less flexible than windrow and ASP -requires separate collection
Anaerobic Digestion (Wastewater Digester or Dedicated)	-efficient GHG/energy recovery -low environmental risk associated with processing -decreases available wastewater digester capacity	-high capital cost for dedicated facility or expanded digester capacity -high capital cost for pre-processing and pipeline -methane revenue -increased financial risk with new technologies -decreases methane generation and recovery at landfill	-if in wastewater sludge digester, under wastewater permit -if in stand-alone digester, under solid waste permit and likely under research and development provisions	-low for enclosed systems	-increased operational risk with new technologies -requires separate collection and extensive pre-processing -end product can be composted - not appropriate for large yard trimmings/ wood and brush
Waste-To-Fuel Conversion (ethanol, syngas, etc.)	-relatively unproven at full scale	-high capital cost -long-term financing	-permit required under Research and Development provisions	-little operating experience in U.S.	-little full-scale operational experience demonstrated -typically requires separate collection or extensive pre-processing, or both -highly specialized operation
Waste-to-Energy or Biomass-to-Energy Processing	-low environmental risk with proper operation and controls -reject and residue disposal	-high capital cost -high O&M cost -long-term financing -decreases methane generation and recovery at landfill -reject and residue disposal	-permit required	-low with proper operation and controls	-typically mixed MSW for mass-burn and RDF -typically single fuel for biomass -highly specialized operation

Criterion Technology[1]	Environmental	Economic	Regulatory	Nuisance Potential	Operations
Commercial Kitchen Pulpers Required by Ordinance (specialized machines for producing organic pulp from commercial food waste)	-low impact	-increased cost to generators -specialized hauling or on-site composting/ digestion required	none	-high potential associated with storage and transportation of pulp	-facilitates all processes -requires separate collection -public opposition due to increased cost of installation
Landfill Gas Recovery (CURRENT CONDITION)	-variable rates of GHG recovery	-preserves methane generation and recovery at landfill -decreases landfill capacity	-permit	-organics increase potential for odor	-brush and large wood may require special handling, increased compaction effort

GHG – Green House Gas, BMP – Best Management Practices, ASP – Aerated Static Pile, O&M – Operations and Maintenance, MSW – Municipal Solid Waste, RDF – Refuse Derived Fuel

[1]ASSUMPTION: Does not address mixed MSW grease/grit trap processing.

Recommended Technology for Source-Separated Organics

In the short- to mid-term, windrow composting represents a proven technology of relatively low cost, with high potential for both front-end and back-end revenues. It is highly flexible over time as feedstocks change with changing waste stream characteristics. Windrow composting will preserve landfill life through diversion without significant decrease in methane generation over time, and it will realize other environmental benefits associated with the beneficial use of compost and mulch products.

II.4.B Analysis of Goals and Objectives

The Task 4a Diversion Program Options Technical Memorandum included in Appendix A describes the policies and programs that could be implemented to achieve the City's goal of Zero Waste by 2040, with the interim steps of 40 percent diversion by 2020 and 60 percent by 2030.

To understand the effectiveness of the diversion policies and programs, the following key initiatives were evaluated.

1. Encourage commercial haulers to provide recycling services to all of their customers—targeting multifamily and commercial generators.
2. Consider requirements for mandatory separation of recyclables and compostables from trash—targeting all generator sectors.
3. Develop a construction and demolition debris (C&D) ordinance and provide C&D technical assistance -- targeting roll-off and self-haul generators.
4. Advocate for extended producer responsibility at the state level and work with local retailers to increase take-back programs—targeting all generator sectors.
5. Provide separate collection for organics—targeting all generators.
6. Provide bulk item reuse and recycling—targeting all generators.
7. Undertake a social marketing campaign—targeting all generator sectors.

8. Provide commercial technical assistance—targeting multifamily and commercial generators.
9. Develop a Resource Recovery Park at the landfill—targeting self-haul generators.
10. Develop a mixed materials processing facility to separate recyclables and compostables from trash—targeting all generators.

Diversion Results

Based on the assumptions and calculations included in the diversion model, implementing the key initiatives will increase the citywide diversion rate to 84 percent.

Table II.13 Diversion Estimates by Generator

	Single-family	Multifamily	Commercial	Total
Diversion (tons)	575,000	539,000	1,307,000	2,421,000
Disposal (tons)	92,000	123,000	257,000	472,000
Diversion rate	86%	81%	84%	84%

Note: Figures may not sum due to rounding.
Single-family diversion estimates include the current single-family diversion rate of approximately 30%.

The diversion rates are presented as a snapshot in time assuming full implementation of all programs. In reality, policies and programs will be developed over time through additional research, testing, and pilot programs before the programs are fully implemented. Several policies will require new ordinances and regulations which will require City Council action and time to implement. Based on this analysis, the City can increase its diversion rate to at least 84 percent, a very high rate of diversion, by implementing the policies and programs described in this Plan.

Greenhouse Gas Reduction Potential

The key initiatives described in the Plan can significantly reduce the City's greenhouse gas emissions. Based on the estimated diversion rates at full implementations of all programs, the following table presents the potential greenhouse gas emissions reduction of the scenarios, using U.S. EPA Waste Reduction Model (WARM) factors based on material types and diversion quantity estimates.

Table II.14 Greenhouse Gas Reduction Estimates by Generator

	Single-family	Multifamily	Commercial	Total
$MTCO_2E$[1]	(523,000)	(749,000)	(1,783,000)	(3,056,000)
Equivalent number of cars removed from the road	96,000	137,000	327,000	560,000

[1]Metric Tons of Carbon Dioxide Equivalent

The U.S. EPA created WARM to help solid waste planners and organizations track and voluntarily report greenhouse gas emissions reductions from several different waste management practices.

WARM calculates and totals greenhouse gas emissions of baseline and alternative waste management practices—source reduction, recycling, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent ($MTCO_2E$), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste.

II.4.C Analysis of Implementation Options

Phasing Recommendations

The City and its stakeholders favor a phased approach where increased outreach and technical assistance would be provided prior to mandatory requirements. The diversion results are based on these three scenarios that build upon each other:

- **Increase voluntary programs**— provide separate collection for organics for composting, bulk item reuse and recycling, social marketing campaign, commercial technical assistance, encourage commercial haulers to provide recycling services to all of their customers, develop a construction and demolition debris (C&D) ordinance programs or incentive programs and provide C&D technical assistance, develop Resource Recovery Facility(ies) within the City, and work with local retailers to increase take-back programs for hard-to-recycle items and advocate for extended producer responsibility at the state level;
- **Implement mandatory requirements**—develop mandatory source-separation requirements; and,
- **Process residual waste**— process all solid waste prior to landfilling.

Table II.15 Diversion Estimates by Scenario[1]

	Baseline (existing programs)[2] 2011	Increasing voluntary programs 2020	Adding mandatory requirements 2030	Add residual waste processing[3] 2040
Diversion (tons)	160,000	1,011,000	1,856,000	2,421,000
Disposal (tons)	2,172,000	1,493,000	841,000	472,000
Diversion rate	7%	40%	69%	84%

[1]Assumptions by program and material type are included in Appendix A.

[2]Baseline diversion estimates include the current single-family diversion tons only.

[3]"Residual waste processing" means separating recyclable and compostable materials from solid waste at a mixed waste material recovery facility prior to landfilling.

Section III Area Recommendations

III.1 Goals, Objectives and Priorities

This section describes how the policies, programs and technologies work to achieve the goals and objectives of the City. As described in section I.I.3, the City developed the following vision statement during the planning process.

The City of Dallas will:

- Strive for sustainability by considering the entire life-cycle of products, processes, and Systems;
- Demonstrate that the goals of economic growth, environmental stewardship and fiscal responsibility are inextricably linked;
- Reduce the volume of discarded materials and maximize diversion from disposal; and,
- Spur economic growth by recovering valuable raw materials and clean energy from discarded materials.

To realize this vision, the following goals were established for the Plan.

- 40 percent diversion by 2020;
- 60 percent diversion by 2030; and,
- Zero Waste by 2040.

The Task 4a Diversion Program Options Technical Memorandum included in Appendix A describes the policies and programs that will be implemented to achieve the City's goal of Zero Waste, with the interim steps of 40 percent diversion by 2020 and 60 percent by 2030.

As described in II.4.B, the City identified the following programs for implementation over the planning period.

1. Encourage commercial haulers to provide recycling services to all of their customers—targeting multifamily and commercial generators.
2. Consider requirements for mandatory separation of recyclables and compostables from trash—targeting all generator sectors.
3. Develop a construction and demolition debris (C&D) ordinance and provide C&D technical assistance -- targeting roll-off and self-haul generators.
4. Advocate for extended producer responsibility at the state level and work with local retailers to increase take-back programs—targeting all generator sectors.
5. Provide separate collection for organics—targeting all generators.
6. Provide bulk item reuse and recycling—targeting all generators.
7. Undertake a social marketing campaign—targeting all generator sectors.
8. Provide commercial technical assistance—targeting multifamily and commercial generators.
9. Develop a Resource Recovery Park at the landfill—targeting self-haul generators.

10. Develop a mixed materials processing facility to separate recyclables and compostables from trash—targeting all generators.

As described in section II.4.C, the City and its stakeholders favor a phased approach where increased outreach and technical assistance would be provided prior to mandatory requirements. These programs work together to achieve the City's goals. The diversion results are based on these three scenarios that build upon each other:

- **Increasing voluntary programs**— provide separate collection for organics, bulk item reuse and recycling, social marketing campaign, commercial technical assistance, require commercial haulers to provide recycling services to all of their customers, develop a C&D ordinance and provide C&D technical assistance, develop a Resource Recovery Park at the landfill, and work with local retailers to increase take-back programs for hard-to-recycle items and advocate for extended producer responsibility at the state level;
- **Implementing mandatory requirements**—develop mandatory source-separation requirements; and,
- **Processing residual waste**— process all solid waste prior to landfilling.

Table III.1 Diversion Estimates by Scenario[1]

	Baseline (existing programs)[2] 2011	Increasing voluntary programs 2020	Adding mandatory requirements 2030	Add residual waste processing[3] 2040
Diversion (tons)	160,000	1,011,000	1,856,000	2,421,000
Disposal (tons)	2,172,000	1,493,000	841,000	472,000
Diversion rate	7%	40%	69%	84%

[1]Assumptions by program and material type are included in Appendix A.
[2]Baseline diversion estimates include the current single-family diversion tons only. Baseline disposal tons for 2011 are based on the estimated generation within the City less the projected single-family diversion estimate. Some of the disposal ton estimate may not be currently disposed.
[3]"Residual waste processing" means separating recyclable and compostable materials from solid waste at a mixed waste material recovery facility prior to landfilling.

III.2 Action Plan

This section includes the tasks necessary to undertake the Local Solid Waste Management Plan, including the action steps, and an implementation schedule.

III.2.A Actions

Table III.2 lists all of the tasks necessary to undertake the Plan. Model ordinances and contracts that may be needed to implement some of these action steps are included in Appendix C.

Table III.2 Implementation Tasks 2013 through 2040

Programs	Voluntary Programs			
	2013-2014	2015-2016	2017-2018	2019-2020
Voluntary Programs 2013-2020				
1. Social Marketing				
a. Surveys and focus groups b. Reach out to neighborhoods across the City c. Use multiple outreach approaches, including on-line and hard copy surveys	→ ···	···	···	···→
d. Marketing plan	→			
e. Media buys	→	···	···	···→
f. Volunteer training	→	···	···	···→
g. Outreach materials	→	···	···	···→
h. Provide Support to School, Community, and Faith Organizations, to assist with environmental stewardship, outreach and education efforts	→	···	···	···→
i. Work with stakeholder community to develop recognition guidelines j. Hold business recycling recognition awards event		→	···	···→
k. Work with stakeholder community to develop Green restaurant guidelines l. Green restaurant list published		→	···	···→
m. Case studies published on website, newspaper, Chamber newspapers, church bulletins, etc.			→	···→
n. Evaluate the effectiveness of Social Marketing Activities				→
o. Update Social Marketing tools				→
2. City Facility Zero Waste				
a. Establish City "Green Team" representing City departments	→	···	···	···→
b. Department goal setting (e.g., 75% diversion)	→			
c. Increase recycling and organics collection, decrease solid waste collection	→	···	···	···→
d. Quarterly report to Green Team on Department progress	→	···	···	···→
e. Department technical assistance in diversion and purchasing		→	···	···→
f. Program monitoring		→	···	···→
g. Department recycling recognition awards event			→	···→
h. Evaluate the effectiveness of City Facility Zero Waste Activities				→
i. Implement new City Facility Zero Waste tasks, as developed				→

Task initiation →

On-going activities ···→

Programs	Voluntary Programs			
	2013-2014	2015-2016	2017-2018	2019-2020
Voluntary Programs 2013-2020				
3. Producer Responsibility				
a. Develop Council Resolution to support Product Stewardship b. Consider support to statewide legislation (bottle bill, e.g.)	→	⇢	⇢	⇢
c. Continue to provide staff support to the Texas Product Stewardship Council	→	⇢	⇢	⇢
d. Promote voluntary take-back efforts with local retailers	→	⇢	⇢	⇢
4. Commercial Technical Assistance				
a. Review status of hotel and apartment recycling pilots and evaluate for expansion	→			
b. Work with commercial generators and services providers to establish baseline diversion rate	→			
c. Facilitate quarterly meetings with commercial service providers to identify specific generators for technical assistance (such as restaurants and large generators)	→	⇢	⇢	⇢
d. Establish timelines and milestones for increasing commercial recycling	→			
e. Share information on priority generators	→	⇢		
f. Concentrate activities on generators without recycling or organics collection	→	⇢		
g. Evaluate the effectiveness of Commercial Technical Assistance Activities Implement new Commercial Technical Assistance tasks, as developed				→
5. Organics Collection				
a. Continue to support development of Community Gardens, on-site composting and home composting	→ ⇢	⇢	⇢	⇢
b. Identify pilot neighborhoods for organics collection, pilot costs, and expansion opportunities c. Target neighborhoods throughout the City d. Consider partnering with local composters for capacity	→			
e. Conduct pilot project providing weekly collection of source-separated organics, including yard trimmings and food scraps	→			
f. Evaluate results of pilot and consider expansion		→	⇢	⇢
6. Bulk Item Collection				
a. Conduct pilot project providing on-call collection of bulk items for reuse and recycling	→			
b. Evaluate results of pilot and consider expansion		→	⇢	⇢

Programs	Voluntary Programs			
	2013-2014	2015-2016	2017-2018	2019-2020
Voluntary Programs 2013-2020				
7. Resource Recovery Park				
a. Identify features of Resource Recovery Park, including new composting operation, expanded self-haul drop-off facility for reuse, recycling, and organics (past fee gate, prior to tipping at landfill face), and new recyclables processing operation	→			
b. Develop basis of design	→			
c. Based on research and basis of design implement new reuse, recycling and composting activities		→	⋯	⋯→
8. Construction & Demolition Debris Ordinance				
a. Consider new C&D ordinance		→		
b. Consider developing new non-exclusive C&D franchise agreements		→		
c. Develop C&D ordinance		→	⋯	⋯→
d. Evaluate the effectiveness of C&D ordinance changes			→	
9. Commercial Service Provider Requirements				
a. Review compliance with existing permit system, enforce existing standards for reporting diversion and disposal tonnages, identify opportunities for enhancement of existing non-exclusive franchise ordinance	→			
b. Hold stakeholder meetings		→	⋯	⋯→
Mandatory Programs (initial action steps)				
10. Universal Recycling Ordinance				
a. Conduct stakeholder meetings to identify strategies for "maximal feasible recycle" at all multifamily buildings and commercial establishments	→ ⋯	⋯	⋯	⋯→
b. Identify thresholds and milestones for participation in recycling programs (e.g., 50%, 75%, 80%)	→			
c. Evaluate status of voluntary achievement of recycling goals		—	→	
d. Monitor status of recycling program implementation		—	→	
e. Design elements of future universal ordinance			→	
f. If participation rates fall below established milestones, consider adoption of universal recycling ordinance (in phases, over time, based on generator size or type)				→
11. Disposal Bans				
a. Conduct research on materials appropriate for disposal bans (e.g., yard trimmings, cardboard, metal, C&D)	→			
b. Monitor diversion and disposal levels of targeted materials		—	→	

Programs	Voluntary Programs			
	2013-2014	2015-2016	2017-2018	2019-2020
Voluntary Programs 2013-2020				
c. Conduct stakeholder meetings to identify material types appropriate for disposal bans d. Ensure that infrastructure is in place for banned materials		→	⇢	⇢

Programs	Mandatory Programs	Plan Update	Plan Update Implementation
	2021-2025	2026-2030	2031-2040
Mandatory Programs 2021-2030			
10. Universal Recycling Ordinance (cont.)			
a. Continue implementation of universal recycling and composting requirements (if approved and based on timelines developed through stakeholder process)	→		
b. Complete implementation of new universal recycling ordinance (if approved and based on timelines developed through stakeholder process)	→		
c. Continue stakeholder meetings	→		
d. Consider changes to the non-exclusive franchise ordinance	→		
11. Disposal Bans (cont.)			
a. Consider implementation of disposal bans, such as yard trimmings and cardboard (based on timelines developed through stakeholder process)	→		
b. Conduct research on bans or requirements applicable to the City	→		
c. Continue stakeholder meetings	→		
d. Report to City Council	→		
Plan Update 2026-2030			
12. Mixed Waste Processing			
a. Conduct research on new residual waste processing technologies (on-going, as appropriate)	⇢	→	
13. Plan Update		→	
a. Review regional and state priorities		→	
b. Evaluate the Plan elements and identify modifications and updates		→	
c. Identify improvements to recycling, organics, bulk item, technical assistance, and social marketing programs		→	
Plan Update Implementation 2031-2040			
14. New Recycling and Organics Collection Activities			→
15. New Social Marketing Activities			→
16. New Technical Assistance Activities			→
17. New Materials Processing Activities			→

Long-Term Implementation Tasks

Most of the materials generated in the City will be diverted through waste reduction, recycling and composting programs and facilities. To reach the City's goal of Zero Waste by 2040, the City will investigate new technologies for processing residual waste.

The Task 5a Technology Options for Municipal Solid Waste Technical Memorandum describes the existing and emerging technologies for processing residual waste, including: aerobic composting, mixed waste processing, anaerobic digestion, refuse derived fuel processing and combustion, mass burn combustion, gasification, plasma arc gasification, pyrolysis, hydrolysis, autoclaving, and catalytic depolymerization.

The Task 5a Memo concluded that the technologies that appear to be most suitable for further consideration include: aerobic composting, anaerobic digestion, and mixed waste processing.

Once the City reaches its goal of 60 percent diversion by 2030, and well before 2040, the City will consider implementation of new technologies that best fit the City's needs for processing residual waste and maximizing diversion from disposal.

III.2.B Timetable

Table III.3 shows when implementation of the policies, programs and facilities described in the plan will be completed during the short-range, intermediate, and long-range planning periods.

Table III.3 Timetable

Short-Range 2013-2020	Intermediate 2021-2030	Long-Range 2031-2040
Increasing voluntary programs	**Adding mandatory requirements**	**Add residual waste processing**
• Provide separate collection for organics, bulk item reuse and recycling • Social marketing campaign • Commercial technical assistance • Encourage commercial haulers to provide recycling services to all of their customers • Develop a C&D ordinance and provide C&D technical assistance -Develop a Resource Recovery Park at the landfill • Work with local retailers to increase take-back programs for hard-to-recycle items • Advocate for extended producer responsibility at the state level	• Develop mandatory source-separation requirements.	• Process all residual waste prior to landfilling

III.2.C Monitoring and Enforcement

The Plan is designed to be a living document with annual updates, program assessments every five years, and detailed implementation steps to be undertaken by City staff.[7] The Task 2 Waste Generation Projections and Landfill Capacity Scenarios attempted to quantify the City's diversion and disposal rates based on tonnage information from City programs and regional diversion and disposal rates.

This information was helpful in program planning, but limited because of the data limitations. The City has very good information about the diversion and disposal tons from the programs that it manages through City operations. However, the City has very limited information about diversion and disposal tons from commercial, industrial and self-haul generators.

In order to understand the effectiveness of the Plan, the City can undertake future studies to estimate citywide generation and characterization, targeting specific materials streams (such as C&D) and specific generator sectors (such as restaurants, retailers and manufacturers). Establishing a more complete baseline will assist the City in tracking the new tons diverted through the Plan. It will also help the City to identify needed new policies and programs and develop future plan updates.

Based on new information developed through the generator-based studies, the City will be able to better estimate diversion and disposal by generator sector.

[7] Note that any and all updates to this plan, once approved by the TCEQ Executive Director and adopted by the TCEQ Commissioners, will require prior review and approval by the TCEQ's Waste Permits Division.

- Single-family residential
- Multifamily residential
- City facilities
- Commercial /Industrial
- Construction and demolition
- Self-haul

Metrics for Tracking Achievement of Goals

To track diversion and disposal tons by new initiative, the City will monitor performance from:

- City programs – where tons are tracked directly; and,
- Service provider reports – pursuant to the new ordinance requirements or franchise agreements.

For some policies and programs, the City will have to rely on diversion and disposal estimates. The direct effect of these policies and programs serve to enhance the City and private sector programs, but cannot be quantified separately.

Timeframes for Updating the Plan

The policies, programs and infrastructure identified in the Plan are slated for implementation in the short-term (2020) or in the medium term (2030). Most of the new infrastructure will be developed within those time horizons as well. The Plan also includes monitoring of new technology for future development (by 2040). The City will track performance by program annually and will conduct a plan update every five years beginning in 2016. The City will closely monitor the development of state and regional plans and will incorporate regional plans and programs into the City's Plan during the five-year updates.

Dallas Local Solid Waste Management Appendices

This page is intentionally left blank.

Appendix A: Technical Memoranda

Task 1: Solid Waste System Overview

Task 2: Waste Generation Projections and Landfill Capacity Scenarios

Task 3: Transfer Operations

Task 4a: Diversion Program Options

Task 4b: Organics Diversion Options

Task 5a: Technology Options for Municipal Solid Waste

Task 5b: Technology Options for Source Separated Organics

This page is intentionally left blank.

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

CONTRACT NO: BDZ1103

CP&Y PROJECT NO. DALL1103.00

SOLID WASTE SYSTEM OVERVIEW

Task 1

March 2012

Prepared for:

City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:

CP&Y
1820 Regal Row, Suite 200
Dallas, Texas 75235

TABLE OF CONTENTS

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

CONTRACT NO: BDZ1103

CP&Y PROJECT NO. DALL1103.00

SOLID WASTE SYSTEM OVERVIEW

Task 1
March 2012

1.0 PRIOR STUDIES AND REFERENCES

1.1 Metroplex Area Regional Solid Waste Study-2003 (provides waste and population projections for the region and capacities and expected site life of existing disposal facilities).

Major Recommendations

- Start planning and analysis to address disposal capacity issues soon.
- Examine opportunities for creation of a Regional Landfill.
- Establish a regional tracking system that can be implemented at the local level to better quantify diversion rates.
- Increase diversion rates by expanding the scope of cost-effective diversion programs.
- Conduct a feasibility analysis to better define the technical requirements, cost, and benefits of bioreactor landfills.

1.2 Evaluation of Waste Transfer Station Operations-2005 (evaluated operations of the three City of Dallas transfer stations)

Key Findings and Recommendations

- The cost to operate the transfer fleet is higher than the seven entities included in a benchmark analysis due to delays in loading, delays at the City maintenance facility, and the inefficient use of Steco trailers.
- Inefficiencies of the transfer fleet unloading at the McCommas Bluff Landfill can be corrected by driver training for unloading quicker, addition of a third inbound lane and unattended scale for City transfer vehicles, integrating scale date from the transfer stations into the landfill system to avoid weighing vehicles twice.
- At the Bachman (Northwest) Transfer Station discontinue the practice of storing waste above the pit level, improve the ventilation and lighting, implement a “drop and hook” operation to help reduce the waiting time for drivers to have their vehicles loaded, divert more brush away from the facility, and encourage the increased use of the facility to utilize the available unused transfer capacity of the station.

- At the Fair Oaks (Northeast) Transfer Station the efficiencies could be improved by reducing the number of days that private citizens can access the site, utilizing the additional unused capacity of the facility and increase revenues by accepting waste from other commercial waste haulers, and if additional haulers are accepted, implement a “drop and hook” operation.
- At the Oak Cliff (Southwest) Transfer Station the receiving floor is in poor condition and needs repair. Recommendations similar to those for the Fair Oaks Station were made for the Oak Cliff Station related to private citizen use, utilizing additional capacity and implementing a “drop and hook” operation. If the City chooses to increase the use of the station, the report further recommended the relocation of the office and scale system.
- Examine alternative operating scenarios in more detail including public-private partnerships to maximize the utilization of the facilities.

1.3 Analysis of Brush & Bulky Collection Operations 2010 (recommendations for a more cost effective alternative for the current brush and bulky collection system and determination if the City could increase the amount of clean green waste)

Recommendations

Two scenarios were presented that would achieve the purposes of the Study. It was recommended to utilize Scenario 1 which requires extensive public education and includes monthly collection of yard waste in bundles or compostable bags, twice a year collection of large brush piles, and twice a year collection of bulky items.

1.4 Regional Recycling Rate Benchmarking Study-2007 (provides recycling rates for Dallas and surrounding cities in the Metroplex)

Recommendations

Provided recommendations for conducting future surveys, as this was the first type of benchmarking study conducted in the Metroplex.

1.5 Chapter 18-Municipal Solid Waste-City Ordinances (Defined acceptable containers, regulations for the collection and disposal of solid waste in the City, charges for collection and disposal, collection and disposal of illegally dumped solid wastes, and penalties for violations) A copy of Chapter 18 is attached as an Appendix.

1.6 City of Dallas FY 2010 MSW Annual Reports to TCEQ for McCommas Bluff Landfill (Annual tonnage and remaining site life) and MSW Annual Reports for each of the City’s Transfer Stations.

1.7 City of Dallas Sanitation Department Monthly Reports for diversion, transfer and disposal operations (waste tonnage for various programs and City facilities).

1.8 City of Dallas Website-Sanitation Services (provided data for citizens to answer frequently asked questions about solid waste operations).

2.0 CURRENT SYSTEMS

2.1 Collection by City Forces-Residential

- Garbage-Once per week collection in a 95 gallon cart in the alley (if serviceable alley available) or at the curb. ($20.34 per month). The City currently has 237,187 active single family residential sanitation accounts for this collection service. Other residential waste from apartments and other multifamily units is not collected by City residential vehicles and is not included in residential waste quantities noted in various reports. Carry-out service is available for the City collected residential customers at an additional fee, or at no additional charge to certain handicapped persons meeting uniform requirements established by the Director of Sanitation. Following is a summary of the residential waste collected from these residential customers by the City during FY 2009-2010 and FY 2010-2011 through March 2011.

Month	Tons (Residential Waste)	Tons (Brush & Bulky Waste from Residents	Tons (Total Residents)
October 2009	23,157	12,562	35,719
November 2009	24,567	12,249	36,816
December 2009	23,810	12,040	35,850
January 2010	18,014	7,826	25,840
February 2010	17,969	12,452	30,421
March 2010	22,715	20,865	43,580
April 2010	24,613	16,744	41,357
May 2010	21,232	14,329	35,561
June 2010	19,712	14,085	33,797
July 2010	19,258	11,820	31,078
August 2010	19,483	8,318	27,801
September 2010	19, 137	11,486	30,623
FY 2009-2010 Totals	**253,667**	**154,776**	**408,443**
October 2010	20,327	11,486	31,813
November 2010	18,639	9,222	27,861
December 2010	19,224	14,223	33,447
January 2011	19,000	7,270	26,270
February 2011	15,025	7,563	22,588
March 2011	20,929	18,600	39,529

- Brush/Bulky-Currently collected once per month. (Basic collection included in monthly residential fee) Additional collection for brush/bulky waste on call for an additional fee (fee is determined on a case by case basis). Total brush/bulky waste collected in FY 2090-2010 was 154,776 tons and 68,364 tons have been collected during the first six months (October 2010 through March 2011) of FY 2010-2011.
- Recycling-Once per week in a blue cart at same location as garbage cart. This is a volunteer program and the residents must request a blue recycle cart. (Collection included in monthly fee).

2.2 Collection by City Forces-Commercial

Rates vary dependent upon frequency of service and container size. City competes with private hauling companies which provide commercial collection services. (See City Ordinance, Chapter 18 for Commercial Rate Schedule).

TABLE OF MONTHLY CHARGES
(Rear-end Loaders)

Qty of Solid Waste	Number of Collections Per Week					
Gallons	2	3	4	5	6	7
60	$33.74	$61.39	$83.51	$101.58	$124.06	$151.52
100	$44.80	$83.51	$103.79	$131.43	$219.92	$367.97
200	$76.13	$162.78	$210.70	$266.00	$313.94	$370.50
300	$120.38	$219.92	$291.81	$363.71	$439.29	$530.58

2.3 Collection by Others-Commercial

Solid waste collection from an apartment, institution, commercial establishment, or mobile home park may be performed by a person (collection service) who has a solid waste collection franchise granted by the City. Solid waste collected by a private collection service that contains putrescible material must be collected at least twice every seven days.

2.4 Transfer Operations-

City operates three transfer stations- All waste from these stations is hauled to the McCommas Bluff Landfill (see Figure 1 for these facility locations).

- Bachman (Northwest)-(TCEQ MSW Permit No. 1145) Open 6 days per week to City and private commercial haulers, and City of Dallas residents. Since 2004 the Transfer Station has received an average of approximately 7,000-8,000 vehicles per month. These vehicles deliver an average of approximately 12,000 -15,000 tons per month, of which approximately 10-15% is delivered by private citizens and private waste haulers. The remaining 85-90% is delivered by City collection vehicles (residential and commercial). The total FY 2010 tonnage transferred through this station was 162,923 tons. This Transfer Station has the design throughput capacity of 2,000 tons per day (approximately 48,000 tons per month) without physical expansion of the facility itself. Additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, and staff.

- Fair Oaks (Northeast)-(TCEQ MSW Permit No. 60) Open Monday, Tuesday, Thursday and Friday to City collection vehicles ONLY. The facility is open to City of Dallas residents only on Wednesday and Saturday. No private haulers are accepted. Individual deliveries by private citizens are noted in a vehicle count but their loads are not weighed. City vehicles using the facility average approximately 600-1,000 vehicles per month delivering an average of approximately 4,000-6,000 tons per month. The total FY 2010 tonnage transferred through this Station was 52,816 tons. The waste quantities delivered by City vehicles is relatively consistent day to day (M, T, Th, F) since the City implemented the once per week collection system. This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself. Additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, and staff.
- Oak Cliff (Southwest)-(TCEQ MSW Permit No. 1453) Open Monday, Tuesday, Thursday and Friday to City collection vehicles ONLY. The facility is open to City of Dallas residents only on Wednesday and Saturday. No private haulers are accepted. City vehicles using the facility average approximately 600-1,000 vehicles per month delivering an average of approximately 4,000-6,000 tons per month. The total FY 2010 tonnage transferred through this Station was 57,914 tons. The waste quantities delivered by City vehicles is relatively consistent day to day (M, T, Th, F) since the City implemented the once per week collection system. This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) without physical expansion of the facility itself. Additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, staff, and the relocation of the office and scale system.

2.5 Disposal

All waste is disposed at McCommas Bluff Landfill (TCEQ MSW Permit No. 62A) except for waste collected by private haulers. Some of the private hauler waste goes to other area landfills (Privately Owned-Skyline, ECD, DFW Regional, etc. or Municipally Owned-Garland, Grand Prairie, Irving, etc.) Some waste from other Cities is disposed at McCommas through contractual arrangements or by individual private haulers. Over the past 10 years the McCommas Bluff Landfill site has received an average of approximately 1,750,000 tons per year, with the maximum year being approximately 1,997,000 tons in FY 2008. During this 10-year period, approximately 60-65% of the waste was delivered to McCommas by private waste hauler collection vehicles, and the remaining 35-40% by City of Dallas collection vehicles.

Some of this waste received is diverted as brush for mulching, asphalt and concrete for road construction, and clean soil received is used for daily cover material as a beneficial reuse. Therefore the quantities reported to TCEQ for disposal at McCommas are equal to the tonnage received less these diversions and beneficial use quantities. As an example, during FY 2010 a total of 1,481,603 tons was received at McCommas Bluff but the Annual Report to TCEQ from the City (FY 2010) reported the tonnage disposed as 1,362,266 tons. This difference represents approximately an 8% diversion/ beneficial use of the total materials received.

The Annual Report to TCEQ also reported a remaining disposal capacity at McCommas Bluff of 99,810,182 cubic yards as of 8/31/2010. Based upon the Annual Report for the previous year the remaining capacity of the site was reduced by 1,970,242 cubic yards during FY 2010 which was used for the disposal of the 1,362,266 tons reported. This equates to an in place density of 1,382.8 pounds/cubic yard for the waste placed in the McCommas Bluff landfill during FY 2010. The site area currently permitted for filling contains approximately 835 acres. Of that total acreage permitted for filling approximately 394 acres remain undeveloped.

The City is in the process of implementing an Enhanced Leachate Recirculation (ELR) program by adding additional clean water as well as recirculating leachate and gas condensate. This program is expected to speed up the waste degradation process, thus increasing the rate of landfill gas generation and settlement of the waste. The City expects to recapture approximately 10-20% of the airspace available for additional filling due to the accelerated settlement.

2.6 Diversion

The City operates a volunteer curbside recycling collection program (Too Good to Throw Away) for the residential waste customers (not including apartment residents) as well as diverting waste through various other programs. The City currently has a participation rate of approximately 64.25% in the curbside collection system (152,387 households with a blue recycle cart of the total 237,187 active residential sanitation accounts). The recyclables collected in the curbside collection system are currently transported to a private processor, Greenstar Recycling, located in Garland Texas, for separation. The City pays a processing fee but shares in the revenues from the separated recyclables under a current agreement depending upon markets for the individual commodities. The current contract is based upon the following pricing formulas:

Commodity by Grade	Pricing Formula
ONP (#8 News)	Hi SW OBM #8 News - $35/ton processing fee w/ $45/ton Floor Price
OCC (old corrugated containers)	75% of Hi SW OBM OCC - $35/ton processing
RMP (residential mixed paper)	75% of Hi SW OBM #8 News - $35/tons processing fee
UBC (used beverage containers)	75% of Sales Invoice - $35/ton processing fee
Steel, Tin and Bi-Metal Cans	50% of Sales Invoice - $35/ton processing fee
#1 PET	50% of Sales Invoice - $35/ton processing fee
#2 HDPE - Natural	50% of Sales Invoice - $35/ton processing fee
#2 HDPE - Pigmented	50% of Sales Invoice - $35/ton processing fee
#3-7 Mixed Plastic	50% of Sales Invoice - $35/ton processing fee
Mixed Glass	No processing fee charged - glass used at the landfill

Following is data for the diversion programs in FY 2009-2010 and FY 2010-2011 through March 2011. This includes the wastes that are diverted and/or reused at the McCommas Bluff landfill noted in the previous Section. The diversion programs are defined as follows:

- Too Good to Throw Away-City curbside collection from residential customers.
- Tires-Delivered separately by individuals or City crews at the Transfer Stations or Landfill.
- Yard Waste- Clean brush or yard trimmings delivered by individuals or City brush/bulky waste collection crews. If there is any bulky waste in the brush/bulky waste loads delivered by the City crews, the entire load is landfilled and no attempt is made to divert the load. The brush and yard trimmings are mulched at the Bachman Transfer Station and/or at the McCommas Landfill. The mulch is used at the landfill for cover or erosion control or may be used by Dallas citizens. The mulch is not sold but may be picked up by Dallas residents in an unlimited quantity and at no cost. Other Bulky wastes are not diverted from the brush/bulky waste collection system. The City tries to divert these bulky items by conducting semi-

annual "hard to recycle" collection events where citizens can deliver these items to designated "drop-off" locations. The quantities received at these events are minor compared to the quantities diverted in the other diversion programs.

- Dry Gulch Recycling Center-Recyclables delivered by individuals to the Recycling Center located adjacent to the Bachman Transfer Station.
- Hotel Tonnage- This is a Pilot Program that the City has implemented with a few select Hotels in the City.
- Multi Family Pilot- This is a Pilot Program that the City has implemented with a few select apartment complexes in the City.
- Concrete, asphalt, sawdust, clean soil- This represents materials diverted at the McCommas Bluff Landfill as discussed above.
- In-House Office Recycling- Materials recovered from the City of Dallas in-house programs.
- Community Drop off Sites-Materials delivered by individuals to drop-off sites for recyclables-generally in selected City Parks.
- Electronics- Materials delivered to a City sponsored electronics recycling event.
- Okon Metals- White goods and other metals separated and delivered to a transfer station or landfill. These materials are stored on-site and then picked up by Okon Metals for recycling.
- Remaining Diversion Programs- The remainder of the programs noted below are very minor in nature and do not contribute substantial quantities of diverted wastes.

Waste Diversion Report

	FY 09 - 10																
	Oct.	Nov.	Dec.	Qtr 1	Jan.	Feb.	Mar.	Qtr 2	Apr.	May	Jun.	Qtr 3	Jul.	Aug.	Sep.	Qtr 4	Avg YTD
Residential Pounds per household	27.19	27.81	32.52		28.01	23.47	36.83		34.80	34.85	37.54		33.37	33.54	32.72		0.00
Recyclables collected by City Crews	Tons			Qtr 1	Tons			Qtr 2	Tons			Qtr 3	Tons			Qtr 4	YTD Total
Too Good To Throw Away	2887.37	2892.12	3499.00	9,278.49	3,011.41	2,483.17	3,995.39	9,489.97	3,682.58	3,767.90	4,047.55	11,498.03	3,560.18	3,589.05	3,504.19	10,653.42	40,919.91
Tires	36.00	0.00	0.00	36.00	0.00	0.00	16.70	16.70	0.00	29.68	0.00	29.68	0.00	0.00	45.29	45.29	127.67
Yard Waste (Clean Brush)	5733.25	13975	2812.50	22,520.75	3,720.13	1,625.00	28,133.25	33,478.38	11,431.25	8,877.63	16,387.50	36,696.38	0.00	0.00	0.00	0.00	92,695.51
Total				**31,835.24**				**42,985.05**				**48,224.09**				**10,698.71**	**133,743.09**
Recyclables collected by Contract Hauler				Qtr 1				Qtr 2				Qtr 3				Qtr 4	YTD Total
Dry Gulch Recycling Center	19.47	18.44	14.17	52.08	16.04	8.59	23.05	47.68	17.69	10.26	7.34	35.29	14.57	19.73	14.05	48.35	183.40
Hotel Tonnage	2.29	1.42	6.75	10.46	3.13	8.13	4.60	15.86	5.66	3.50	3.55	12.71	3.10	3.08	4.10	10.28	49.31
Multi Family Pilot	16.13	19.55	21.13	56.81	17.66	18.19	17.58	53.43	16.85	20.38	17.41	54.64	16.69	14.54	15.62	46.85	211.73
Concrete	106.11	103.57	21.63	231.31	21.62	21.63	42.85	86.10	42.84	42.85	361.03	446.72	361.03	361.03	135.12	857.18	1,621.31
Asphalt	23.10	56.18	380.40	459.68	380.39	380.40	366.06	1,126.85	366.06	366.06	256.03	988.15	256.03	256.03	280.61	792.67	3,367.35
Sawdust	63.80	97.27	92.21	253.28	92.22	92.20	171.83	356.25	171.82	171.83	117.96	461.61	117.96	117.96	118.82	354.74	1,425.88
Clean Soil	5663.76	8902.90	4488.73	19,055.39	4,488.72	4,488.75	4,361.94	13,339.41	4,361.95	4,361.94	1,293.44	10,017.33	12.93.44	1,293.44	3,973.23	5,266.67	47,678.80
In House Office recycling	116.80	87.05	121.97	325.82	101.71	102.22	131.92	335.85	270.96	293.10	320.57	884.63	271.88	283.21	289.53	844.62	2,390.92
Community Drop off sites	146.93	155.50	151.12	453.55	145.86	128.03	139.59	413.48				0.00				0.00	867.03
Out of Order Carts	4.10	6.03	5.99	16.12	2.58	5.36	13.32	21.26	4.74	1.85	4.61	11.20	6.84	0.00	6.77	13.61	62.19
Electronics	15.82	81.25	15.74	112.81	6.80	15.65	20.55	43.00	69.62	12.26	14.33	96.21	18.98	19.29	12.93	51.20	303.22
Goodwill /Salvation Army	0.00	4.46	0.00	4.46	0.00	0.00	0.00	0.00	12.39	0.00	0.00	12.39	0.00	0.00	0.00	0.00	16.85
Rebuilding Dallas	0.00	0.55	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55
Heavy Metal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Okon Metals	0.00	1.84	0.00	1.84	0.00	0.00	0.00	0.00	2.27	0.00	13.37	15.64	41.08	28.38	10.73	80.19	97.67
Commingled Recyclables	0.00	1.41	1.16	2.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.57
ELR Bulbs	0.00	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.66
Mow Clean	0.00	0.40	0.00	0.40	0.00	0.00	0.00	0.00	5.01	0.00	0.00	5.01	0.00	0.00	0.00	0.00	5.41
Interstate Batteries	0.00	0.70	0.00	0.70	0.00	0.00	0.00	0.00	2.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	2.70
Cease the Grease -Used cooking Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.52
Recycling Revolution-pl bags/alum/occ/styrofoam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.38
Greenstar -Shredpod/ Action Shred/ Sierra Shred	0.00	10.32	0.00	10.32	0.00	0.00	0.00	0.00	15.44	3.23	0.00	18.67	4.77	0.00	3.55	8.32	37.31
Medication Cleanout	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.44	0.00	0.00	0.00	0.00	0.44
Total Collected by Contract Haulers				**21,048.20**				**15,839.17**				**13,064.15**				**8,374.68**	**58,326.20**
Total Recyclables Collected				**52,883.44**				**58,824.22**				**61,288.24**				**19,073.39**	**192,069.29**
TGTA - Total Volume Collected	**3,208.91**	**3,281.09**	**3,837.03**	**10,327.03**	**3,305.19**	**2,769.34**	**4,346.00**	**10,420.53**	**4,106.72**	**4,112.48**	**4,429.17**	**12,648.37**	**3,938.09**	**3,957.28**	**3,861.47**	**11,756.84**	**45,152.77**

Waste Diversion Report

								FY 10 - 11									
	Oct.	Nov.	Dec.	Qtr 1	Jan.	Feb.	Mar.	Qtr 2	Apr.	May	Jun.	Qtr 3	Jul.	Aug.	Sep.	Qtr 4	Avg YTD
Residential Pounds per household	**51.20**	**56.50**	**60.64**		**55.87**	**47.92**	**0.00**		**0.00**	**0.00**	**0.00**		**0.00**	**0.00**	**0.00**		**0.00**
																	45%
Recyclables collected by City Crews		**Tons**		**Qtr 1**		**Tons**		**Qtr 2**		**Tons**		**Qtr 3**		**Tons**		**Qtr 4**	**YTD Total**
Too Good To Throw Away	3,412.18	3,857.06	4,237.03	11,506.27	3,885.57	3,321.56		7,207.13				0.00				0.00	18,713.40
Tires	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Yard Waste (Clean Brush)	0.00	12,687.50	10,712.50	23,400.00	7,424.00	0.00		7,424.00				0.00				0.00	30,824.00
Total				**34,906.27**				**14,631.13**				**0.00**				**0.00**	**49,537.40**
Recyclables collected by Contract Hauler				**Qtr 1**				**Qtr 2**				**Qtr 3**				**Qtr 4**	**YTD Total**
Dry Gulch Recycling Center	10.24	17.25	22.69	50.18	14.52	35.05		49.57				0.00				0.00	99.75
Hotel Tonnage	3.35	3.18	3.63	10.16	3.30	2.65		5.95				0.00				0.00	16.11
Multi Family Pilot	15.88	17.67	20.40	53.95	19.03	14.65		33.68				0.00				0.00	87.63
Concrete	55.93	55.93	68.11	179.97	68.11	68.11		136.22				0.00				0.00	316.19
Asphalt	355.42	355.42	200.65	911.49	200.65	200.65		401.30				0.00				0.00	1,312.79
Sawdust	106.62	106.62	257.06	470.30	257.06	257.05		514.11				0.00				0.00	984.41
Clean Soil	4824.34	4824.34	4786.11	14,434.79	4,786.11	4,786.10		9,572.21				0.00				0.00	24,007.00
In House Office recycling	237.74	271.93	222.47	732.14	238.07	212.47		450.54				0.00				0.00	1,182.68
Community Drop off sites				0.00				0.00				0.00				0.00	0.00
Out of Order Carts	12.57	5.60	3.57	21.74	4.09	3.72		7.81				0.00				0.00	29.55
Electronics	42.74	13.19	14.99	70.92	20.97	13.29		34.26				0.00				0.00	105.18
Goodwill /Salvation Army	3.95	0.00	0.00	3.95	0.00	0.00		0.00				0.00				0.00	3.95
Rebuilding Dallas	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Heavy Metal	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Okon Metals	44.17	22.89	14.82	81.88	20.28	23.27		43.55				0.00				0.00	125.43
Commingled Recyclables	1.38	0.00	0.00	1.38	0.00	0.00		0.00				0.00				0.00	1.38
ELR Bulbs	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Mow Clean	1.30	0.00	0.00	1.30	0.00	0.00		0.00				0.00				0.00	1.30
Interstate Batteries	0.50	0.00	0.00	0.50	0.00	0.00		0.00				0.00				0.00	0.50
Cease the Grease -Used cooking Oil	0.11	0.00	0.00	0.11	0.00	0.00		0.00				0.00				0.00	0.11
Recycling Revolution-pl bags/alum/occ/styrofoam	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Green Team Recycle-Soft Plastics	0.36	0.00	0.00	0.36	0.00	0.00		0.00				0.00				0.00	0.36
Greenstar -Shredpod/ Action Shred/ Sierra Shred	8.44	0.00	2.08	10.52	3.26	0.00		3.26				0.00				0.00	13.78
Medication Cleanout	0.00	0.00	0.00	0.00	0.00	0.00		0.00				0.00				0.00	0.00
Total Collected by Contract Haulers				**17,035.64**				**11,252.46**				**0.00**				**0.00**	**28,288.10**
Total Recyclables Collected				**51,941.91**				**25,883.59**				**0.00**				**0.00**	**77,825.50**
TGTA - Total Volume Collected	**3,794.91**	**4,208.77**	**4,541.68**	**12,545.36**	**4,209.09**	**3,626.66**	**0.00**	**7,835.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20,381.11**

Of potential note from this data is the increase between the first quarter of FY 2009 and FY 2010 (approximately 24%) in the "Too Good to Throw Away" curbside collection system after the City fully implemented the Program and collects the materials as a "single stream" without material separation requirements at the household.

2.7 City Education and Outreach Programs

The City's focus is on teaching the community about recycling, composting, electronics recycling and how to reduce impacts through home waste management. The City staff has also met with a representative from every Dallas Independent School District facility to work with them on implementing their Environmental Education Initiative. This Education Initiative is a free educational program provided to every school within the City of Dallas to educate students and faculty about what, how and why to recycle. In addition, the City staff works with neighborhood groups and home owner associations, attends town hall meetings and neighborhood events such as school carnivals and neighborhood safety fairs. Most recently, the City hosted a 1960s-style recycling rally at Whole Foods in Lakewood. The event was designed to encourage attendance at the Spring Recycling Roundup and promote environmental public awareness. The City was recently awarded the Green Cities Award in the largest city category at the 2011 Residential Recycling Conference because of their strategic outreach to residents using a variety of media outlets, such as Dallas Morning News, popular television and radio shows, automated phone bank calls, flyers at community events, promotional plugs on the City of Dallas' main website, the GreenDallas.net education website, and the City of Dallas Facebook page.

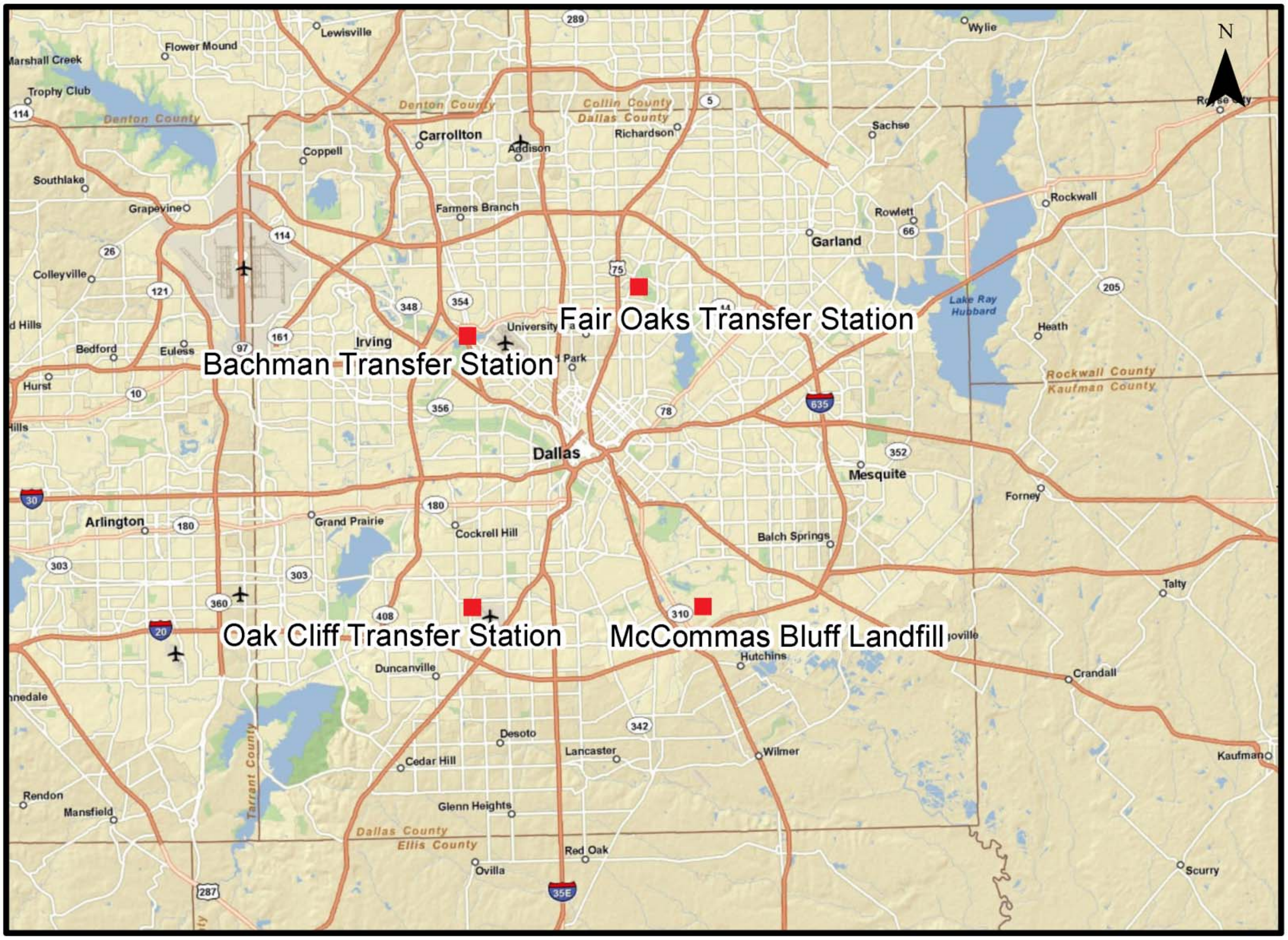
3.0 Regional Context

As noted in the Metroplex Area Sub-Regional Solid Waste Study in 2003, the McCommas Bluff Landfill is one of only a few Landfills in the Region that can provide long term waste disposal capacity within the Region. Since the completion of that Study some of the other landfills in the Region have secured Permit Amendments to extend their site life and would not reach capacity in the time frame projected in the Study. It was assumed at the time that as these other landfills were filled, the waste that normally went to them would be reallocated to the remaining landfills(including McCommas Bluff). This additional waste would in fact shorten the remaining site life of these Regional fill sites. In addition to the development of additional site capacity at other sites, the City of Dallas has implemented several waste diversion programs as noted above and is implementing a bio-reactor like program (Enhanced Leachate Recirculation) at the McCommas Bluff Landfill. The City has also been entertaining a Program of Flow Control for all wastes generated within the City of Dallas. This Program is being investigated but has not been implemented to date. All of these factors will influence the site capacity of the McCommas Bluff Landfill as a Regional resource.

A further discussion of the Regional Landfills and their influence on the site life of McCommas Bluff Landfill will be outlined in the Technical Memorandum for Task 2.

4.0 Current Policies

Current City policies are presented in Chapter 18 of the City Ordinances which is attached as an Appendix to this Technical Memorandum.



Date: 4/21/2011

Dallas Solid Waste Facility Locations

0 2.5 5 10 Miles

Figure 1

APPENDIX

For a complete copy of CHAPTER 18, MUNICIPAL SOLID WASTE, ARTICLE I, COLLECTION AND DISPOSAL ordinance, please use link provided below. Using quick search type in CHAPTER 18 MUNICIPAL SOLID WASTES to view ordinance.

http://www.amlegal.com/nxt/gateway.dll/Texas/dallas/volumei/preface?f=templates$fn=default.htm$3.0$vid=amlegal:dallas_tx

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

Waste Generation and Landfill Capacity Projections

Task 2

August 2011

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
CP&Y, Inc.
1820 Regal Row, Ste. 200
Dallas, TX 75235

Task 2-General Assumptions

As of 8/31/2010 the City reported a remaining waste capacity at McCommas Bluff Landfill of 99,810,182 cubic yards. This will be the basis for calculating the remaining site life (in years) for each of the Scenarios.

TASK 2 NOTES – This is the basis for the Scenario that Only Current Users will continue to use McCommas without any new Users

This Scenario assumes that the waste currently going to McCommas will continue to go without increasing users. Any projected increases will be based on the increasing population of Dallas only. This would be representative of the increases of all current users.

In FY 2009-2010 McCommas Landfill reported the receipt of 1,481,603 tons of waste with a net receipt of 1,362,266 tons of waste for disposal after the diversion programs conducted at McCommas (concrete, asphalt, sawdust, and clean soil). This waste was received from a 2010 Dallas population of 1,316,350 people. It is recognized that some of the waste received at the landfill was from sources other than the City of Dallas. Alternatively, some portion of the waste generated by Dallas residents and businesses is hauled to a landfill located outside of the City.

Therefore, we will use a factor of 1,362,266/1,316,350 = 1.035 tons delivered to McCommas per Dallas Resident and project the waste in the future using this factor and Dallas Population Projections.

Based upon this Scenario the McCommas Bluff Landfill will reach capacity in the year **2053.**

TASK 2 NOTES - This is the basis for the Scenario that ALL waste generated in Dallas will go to McCommas without any from others

From the Task 1 information, 253,667 tons of residential waste and 154,776 tons of brush and bulky waste was collected from single family residences by the City of Dallas for a total of 408,443 tons in FY 2009-2010.

In addition, 40,920 tons of recyclables were collected from the "Too Good to Throw Away" program and 92,695 tons of clean brush were collected and diverted from the brush and bulky total during the same FY 2009-2010. Therefore the total residential waste generated during FY 2009-2010 by 237,187 residential accounts was 449,363 tons, or approximately 1.89 tons/residence.

The diversion of residential waste is approximately 29.73% (40,920 +92,695/449,363) of the residential waste generated. This percentage will be used to show the diversion of residential generated waste in this Scenario and in the Dallas Waste with ELR Implementation. 50% diversion of the residential waste stream will be used in the Scenario related to ELR Implementation and increased Diversion.

The U.S. Census Bureau in their American Community Survey for the Years 2005-2009 indicated that the City of Dallas had 2.65 people/household. Based upon this information the residential waste generation rate for Dallas was approximately 1.89 tons/2.65 = 0.71 tons/person/year. This correlates with the residential generation rate of 0.86 tons/person/year that was derived in the "Metroplex Area Sub-Regional Solid Waste Study" in 2003. In this study, they also calculated a generation rate of 0.76 tons/person/year for multi-family residents as they would not generate brush at the same level as single family residents. For the purposes of this study we will use the residential rates of the 2003 study.

We are unable to define the total amount of Commercial Waste generated in the City of Dallas, as most of the Commercial Waste collected by Private Waste Haulers in Dallas is transported to other landfills. As a part of the "Metroplex Area Sub-Regional Solid Waste Study" in 2003, surveys were conducted to define collection quantities and landfill disposal quantities in a 5 county area (including Dallas County). From this survey data it was possible to calculate the total waste generated in the 5 counties with reasonable accuracy. This Study was also unable to directly define the total quantity of commercial waste in the area. However a methodology was developed to calculate the amount of commercial waste by first calculating the single-family residential waste and the multi-family residential waste and then subtracting those quantities from the total waste collected in the 5 county area. From this calculation and population/employment data available for the region they were able to develop a commercial waste generation rate for the region. They then applied this generation rate to each City and their respective percentage of the region's employment and calculated a base year commercial waste generation quantity for each City in the 5 county area. Even though the rate was calculated based on employment data it was equated to population data for future projections. They then projected this quantity along with the single family residential and multi-family waste quantities for the base year over the planning period based upon population growth of each City.

We are unable to better define these generation rates based upon available data due to the inability to accurately capture the commercial waste quantities in Dallas only. As we were able to correlate the single-family residential waste generation rate with these study results, we are using the generation rates for the multi-family and commercial waste from this study as the basics for our waste projections. We feel this is a very reasonable direction to proceed in the absence of more accurate data.

In the "Metroplex Study" for the Base Year of 2002 in the City of Dallas the following waste quantities were calculated for a population of 1,208,300 people:

Single Family Residential	955,000 tons*	(58.1% of Population)
Multi-Family Residential	385,602 tons	(41.9% of Population)
Commercial	1,151,564	

* Reported in Survey and not calculated

Based upon Regional Generation Rates, comparisons with other Cities data and current Residential total tonnage of 449,363 tons in FY 2009-2010, it appears that the Residential tonnage reported in the 2003 survey may include both single family and multi-family quantities. The calculated quantity utilizing the regional generation of single family rates, residential waste for 2002 should be approximately 604,000 tons. (1,208,300 x 0.581 x 0.86).

The demographics of the residential population (based on information presented in a report titled ”2010 Housing Estimates” by NCTCOG, May 2010) is now estimated to be 47.1% of those living in single family residences and 52.9% of the population living in multifamily residences. For simplicity, the 5,645 other housing units have not been included for purposes of calculating single and multi-family units.

For purposes of Projections we will utilize the following factors:

Single Family Residential	0.86 tons/person	(47.1% of Population)
Multi-Family Residential	0.76 tons/person	(52.9% of Population)
Commercial (1,151,564 tons in 2002/1,208,30 population)	0.95 tons/person	(Total Population)

The City of Dallas does not make independent population projections but works with the NCTCOG to develop population projections that are used by the City of Dallas.

NCTCOG Population Est. for the City of Dallas (2000) was 1,188,580
NCTCOG - Current Population Est. for City (2010) 1,316,350
Calculated 2005 Population (1,316,350 - 1,188,580/10) = 12,777 Increase per Year
1,188,580 + 5(12,777) = 1,252,465 in 2005

The NCTCOG estimates population based on Market Areas

Dallas includes the following Areas:

Area		2005 Population		2035 Population		2040 Population
1		3,172		21,175		23,808
7		132,009		169,304		175,437
8		20,403		45,220		49,822
10		69,347		84,304		85,904
11		64,903		83,382		86,108
12		96,676		107,896		109,658
13		185,701		206,794		210,167
14		93,732		114,636		118,526
3/4 of 18	(144,896)	108,672	(165,291)	123,968	(168,655)	126,491
1/4 of 19	(96,475)	24,118	(109,996)	27,499	(112,067)	28,017
21		82,831		109,549		114,803
22		46,673		64,606		67,827
23		91,772		102,791		105,344
25		14,635		30,975		34,223
28		101,429		112,939		114,912
29		92,138		133,514		140,961
32	(100,043)	33,348	(152,230)	50,743	(161,194)	53,731
TOTAL		1,261,559		1,589,295		1,645,739

Based upon Task 1 Tech Memo, the compaction rate in FY 2009-2010 at the McCommas Landfill was 1382.8 lbs/cy. For Projections Use 1400 lb/cy

Based upon this Scenario the McCommas Bluff Landfill will reach capacity in the year **2039**.

TASK 2 – This Scenario is based upon Total Dallas Tonnage to McCommas with ELR Implementation

The addition of moisture to solid waste, such as ELR, has shown airspace gains between 10% to 30% in relatively short periods of time. Assume that 15% of the airspace consumed in one year is recovered 5 years later.

Based upon this Scenario the McCommas Bluff Landfill will reach capacity in the year **2043**.

Task 2 - Total Dallas Tonnage with ELR Implementation and an increase of Residential Waste Quantity Diversion through additional Diversion Programs

In FY 2009-2010 the City diverted 40,920 tons through the "Too Good to Throw Away" program and 92,695 tons through the Clean Brush diversion program. This equates to 29.73% of the residential tonnage (449,363) generated by Single Family residences.

For purposes of evaluating the effects of future diversion programs we will utilize a scenario to approximately double the percentage of the Residential Waste Generated that would be diverted. Therefore, in this scenario we will assume a diversion rate of 50% of the residential waste stream recognizing that the actual additional diversion may occur in other areas (multi-family or commercial waste).

Based upon this Scenario the McCommas Bluff Landfill will reach capacity in the year **2045**.

Scenario	**Year Site Life Consumed**
Current Users Only	2053
All Dallas Waste	2039
All Dallas Waste with ELR	2043
All Dallas Waste with ELR and Current Diversion Doubled	2045

City of Dallas Solid Waste

Population and Waste Projections (2010-2040)

Current Users Only

This assumes that only the waste from the Current Users will be delivered to McCommas and no additional diversion programs, Enhanced Leachate Recirculation, or any other methods will be added to reduce landfill consumption

Year	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035	2040	2045	2050	2053	2054	2055	2060
Population (P)	1,316,350	1,327,268	1,338,186	1,349,103	1,360,021	1,370,939	1,425,528	1,480,117	1,534,706	1,589,295	1,645,739	1,703,363	1,763,005	1,799,788	1,812,219	1,824,736	1,888,628
% Population increase (per year)		0.83%	0.82%	0.82%	0.81%	0.80%	0.77%	0.74%	0.72%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
Total Tons (TT) (P)(1.035)	1,362,422	1,373,722	1,385,022	1,396,322	1,407,622	1,418,922	1,475,421	1,531,921	1,588,421	1,644,920	1,703,340	1,762,981	1,824,711	1,862,781	1,875,647	1,888,602	1,954,730
CY of Landfill Space Consumed Annually (TT at 1400 lbs/CY compaction rate)	1,946,318	1,962,460	1,978,603	1,994,746	2,010,888	2,027,031	2,107,745	2,188,459	2,269,172	2,349,886	2,433,343	2,518,544	2,606,729	2,661,116	2,679,495	2,698,002	2,792,471
Cumulative Cubic Yards Consumed	1,946,318	3,908,778	5,887,381	7,882,126	9,893,015	11,920,046	22,297,344	33,078,210	44,262,644	55,850,648	67,850,448	80,271,594	93,127,657	101,056,368	103,735,864	106,433,866	120,205,982
Remaining Capacity (CY)	99,810,182	97,847,722	95,869,119	93,874,373	91,863,485	89,836,453	79,459,156	68,678,290	57,493,855	45,905,852	33,906,051	21,484,906	8,628,843	700,131	(1,979,364)	(4,677,366)	(18,449,483)
														Out of Site Life in 2053			

Estimated material type based on tonnages received at landfill

Glass	5%	68,686	69,251	69,816	70,381	70,946	73,771	76,596	79,421	82,246	85,167	88,149	91,236	93,139	93,782	94,430	97,736
Plastic	8%	109,898	110,802	111,706	112,610	113,514	118,034	122,554	127,074	131,594	136,267	141,038	145,977	149,022	150,052	151,088	156,378
Recyclable Paper	18%	247,270	249,304	251,338	253,372	255,406	265,576	275,746	285,916	296,086	306,601	317,337	328,448	335,301	337,616	339,948	351,851
Compostable Paper	18%	247,270	249,304	251,338	253,372	255,406	265,576	275,746	285,916	296,086	306,601	317,337	328,448	335,301	337,616	339,948	351,851
Yard Trimmings	20%	274,744	277,004	279,264	281,524	283,784	295,084	306,384	317,684	328,984	340,668	352,596	364,942	372,556	375,129	377,720	390,946
Metal	5%	68,686	69,251	69,816	70,381	70,946	73,771	76,596	79,421	82,246	85,167	88,149	91,236	93,139	93,782	94,430	97,736
Food	9%	123,635	124,652	125,669	126,686	127,703	132,788	137,873	142,958	148,043	153,301	158,668	164,224	167,650	168,808	169,974	175,926
Wood	6%	82,423	83,101	83,779	84,457	85,135	88,525	91,915	95,305	98,695	102,200	105,779	109,483	111,767	112,539	113,316	117,284
Textiles	5%	68,686	69,251	69,816	70,381	70,946	73,771	76,596	79,421	82,246	85,167	88,149	91,236	93,139	93,782	94,430	97,736
Reusables	2%	27,474	27,700	27,926	28,152	28,378	29,508	30,638	31,768	32,898	34,067	35,260	36,494	37,256	37,513	37,772	39,095
Ceramics	2%	27,474	27,700	27,926	28,152	28,378	29,508	30,638	31,768	32,898	34,067	35,260	36,494	37,256	37,513	37,772	39,095
Soils	1%	13,737	13,850	13,963	14,076	14,189	14,754	15,319	15,884	16,449	17,033	17,630	18,247	18,628	18,756	18,886	19,547
Chemicals	1%	13,737	13,850	13,963	14,076	14,189	14,754	15,319	15,884	16,449	17,033	17,630	18,247	18,628	18,756	18,886	19,547
	100%	1,373,722	1,385,022	1,396,322	1,407,622	1,418,922	1,475,421	1,531,921	1,588,421	1,644,920	1,703,340	1,762,981	1,824,711	1,862,781	1,875,647	1,888,602	1,954,730

City of Dallas Solid Waste

Population and Waste Projections (2010-2040)

This assumes that 100% of the waste expected to be generated in Dallas will be delivered to McCommas without further diversions, Enhanced Leachate Recirculation, or any other methods to reduce landfill consumption

All Dallas Waste

Year	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035	2039	2040	2045	2050	2055	2060
Population (P)	1,316,350	1,327,268	1,338,186	1,349,103	1,360,021	1,370,939	1,425,528	1,480,117	1,534,706	1,589,295	1,634,450	1,645,739	1,703,306	1,762,887	1,824,551	1,888,373
% Population increase (per year)		0.83%	0.82%	0.82%	0.81%	0.80%	0.77%	0.74%	0.72%	0.69%	0.70%	0.69%	0.69%	0.69%	0.69%	0.69%
Single Family (SFRP) Residential Population (P)(0.471)	620,001	625,143	630,285	635,428	640,570	645,712	671,424	697,135	722,847	748,558	769,826	775,143	802,257	830,320	859,364	889,424
Multi-family (MFRP) Residenrtial Population (P)(0.529)	696,349	702,125	707,900	713,676	719,451	725,227	754,104	782,982	811,859	840,737	864,624	870,596	901,049	932,567	965,188	998,949
Single Family Tons (SFT) (SFRP)(0.86)	533,201	537,623	542,045	546,468	550,890	555,313	577,424	599,536	621,648	643,760	662,050	666,623	689,941	714,075	739,053	764,904
Single Family Tons Diverted (29.7%)	158,361	159,674	160,988	162,301	163,614	164,928	171,495	178,062	184,629	191,197	196,629	197,987	204,913	212,080	219,499	227,177
Net Single Family Tons(NSFT)	374,840	377,949	381,058	384,167	387,276	390,385	405,929	421,474	437,019	452,563	465,421	468,636	485,029	501,995	519,554	537,728
Multi-family Tons (MFT) (MFRP)(0.76)	529,225	533,615	538,004	542,394	546,783	551,172	573,119	595,066	617,013	638,960	657,114	661,653	684,797	708,751	733,543	759,201
Commercial Tons (CT) (P)(0.95)	1,250,533	1,260,904	1,271,276	1,281,648	1,292,020	1,302,392	1,354,252	1,406,111	1,457,971	1,509,830	1,552,728	1,563,452	1,618,141	1,674,742	1,733,324	1,793,954
Total Tons (TT) NSFT + MFT + CT	2,154,598	2,172,468	2,190,338	2,208,209	2,226,079	2,243,949	2,333,300	2,422,651	2,512,002	2,601,354	2,675,263	2,693,741	2,787,966	2,885,488	2,986,420	3,090,884
CY of Landfill Space Consumed Annually (TT at 1400 lbs/CY compaction rate)	3,077,997	3,103,526	3,129,055	3,154,584	3,180,113	3,205,642	3,333,286	3,460,930	3,588,575	3,716,219	3,821,805	3,848,201	3,982,809	4,122,125	4,266,315	4,415,548
Cumulative Cubic Yards Consumed	3,077,997	6,181,523	9,310,578	12,465,162	15,645,274	18,850,916	35,262,057	52,311,421	69,999,006	88,324,814	103,453,656	107,301,857				
Remaining Capacity (CY)	99,810,182	96,706,656	93,577,601	90,423,017	87,242,905	84,037,263	67,626,122	50,576,759	32,889,173	14,563,365	(565,477)	(4,413,678)	(24,056,657)	(44,386,736)	(65,427,948)	(87,205,169)
											Out of Site Life in 2039					

Estimated material type based on total tonnages before any diversion

Glass	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	143,595	144,586	149,644	154,878	160,296	165,903
Plastic	8%	186,571	188,106	189,641	191,175	192,710	200,384	208,057	215,731	223,404	229,751	231,338	239,430	247,805	256,474	265,445
Recyclable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	516,941	520,511	538,718	557,562	577,065	597,251
Compostable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	516,941	520,511	538,718	557,562	577,065	597,251
Yard Trimmings	20%	466,428	470,265	474,102	477,939	481,775	500,959	520,143	539,326	558,510	574,378	578,346	598,576	619,514	641,184	663,612
Metal	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	143,595	144,586	149,644	154,878	160,296	165,903
Food	9%	209,893	211,619	213,346	215,072	216,799	225,432	234,064	242,697	251,330	258,470	260,256	269,359	278,781	288,533	298,625
Wood	6%	139,929	141,080	142,231	143,382	144,533	150,288	156,043	161,798	167,553	172,314	173,504	179,573	185,854	192,355	199,084
Textiles	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	143,595	144,586	149,644	154,878	160,296	165,903
Reusables	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,438	57,835	59,858	61,951	64,118	66,361
Ceramics	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,438	57,835	59,858	61,951	64,118	66,361
Soils	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,719	28,917	29,929	30,976	32,059	33,181
Chemicals	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,719	28,917	29,929	30,976	32,059	33,181
	100%	2,332,142	2,351,326	2,370,510	2,389,693	2,408,877	2,504,795	2,600,714	2,696,632	2,792,550	2,871,892	2,891,728	2,992,879	3,097,568	3,205,919	3,318,060

City of Dallas Solid Waste				This assumes that 100% of the waste expected to be generated in Dallas will be delivered to McCommas and ELR is Implemented											
Population and Waste Projections (2010-2040)				ELR Process is assumed to recover 15% of the Landfill Space consumed 5 years after Placement											
All Dallas Waste With ELR Implementation															
Year	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035	2040	2043	2045	2050	2055	2060
Population (P)	1,316,350	1,327,268	1,338,186	1,349,103	1,360,021	1,370,939	1,425,528	1,480,117	1,534,706	1,589,295	1,645,739	1,680,041	1,703,306	1,762,887	1,824,551	1,888,373
% Population increase (per year)		0.83%	0.82%	0.82%	0.81%	0.80%	0.77%	0.74%	0.72%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
Single Family (SFRP) Residential Population (P)(0.471)	620,001	625,143	630,285	635,428	640,570	645,712	671,424	697,135	722,847	748,558	775,143	791,299	802,257	830,320	859,364	889,424
Multi-family (MFRP) Residential Population (P)(0.529)	696,349	702,125	707,900	713,676	719,451	725,227	754,104	782,982	811,859	840,737	870,596	888,742	901,049	932,567	965,188	998,949
Single Family Tons (SFT) (SFRP)(0.86)	533,201	537,623	542,045	546,468	550,890	555,313	577,424	599,536	621,648	643,760	666,623	680,518	689,941	714,075	739,053	764,904
Single Family Tons Diverted (29.7%)	158,361	159,674	160,988	162,301	163,614	164,928	171,495	178,062	184,629	191,197	197,987	202,114	204,913	212,080	219,499	227,177
Net Single Family Tons Disposed(NSFT)	374,840	377,949	381,058	384,167	387,276	390,385	405,929	421,474	437,019	452,563	468,636	478,404	485,029	501,995	519,554	537,728
Multi-family Tons (MFT) (MFRP)(0.76)	529,225	533,615	538,004	542,394	546,783	551,172	573,119	595,066	617,013	638,960	661,653	675,444	684,797	708,751	733,543	759,201
Commercial Tons (CT) (P)(0.95)	1,250,533	1,260,904	1,271,276	1,281,648	1,292,020	1,302,392	1,354,252	1,406,111	1,457,971	1,509,830	1,563,452	1,596,039	1,618,141	1,674,742	1,733,324	1,793,954
Total Tons (TT) NSFT + MFT + CT	2,154,598	2,172,468	2,190,338	2,208,209	2,226,079	2,243,949	2,333,300	2,422,651	2,512,002	2,601,354	2,693,741	2,749,887	2,787,966	2,885,488	2,986,420	3,090,884
CY of Landfill Space Consumed Annually (TT at 1400 lbs/CY compaction rate)	3,077,997	3,103,526	3,129,055	3,154,584	3,180,113	3,205,642	3,333,286	3,460,930	3,588,575	3,716,219	3,848,201	3,928,410	3,982,809	4,122,125	4,266,315	4,415,548
CY of Landfill Space Recovered as a result of ELR					461,700	465,529	484,676	503,822	522,969	542,116	561,392	573,271	581,213	601,544	622,585	644,363
Cumulative Cubic Yards Consumed	3,077,997	6,181,523	9,310,578	12,465,162	15,183,575	17,923,687	31,949,744	46,518,290	61,629,324	77,282,848	93,491,743	103,488,463	110,268,344	127,631,646	145,602,305	164,201,566
Remaining Capacity (CY)	99,810,182	96,706,656	93,577,601	90,423,017	87,704,604	84,964,492	70,938,435	56,369,889	41,258,855	25,605,331	9,396,436	(600,283)	(7,380,165)	(24,743,467)	(42,714,125)	(61,313,387)
												Out of Site Life in 2043				
Estimated material type based on total tonnages before any diversion or ELR Landfill Space Recovery																
Glass	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	147,600	149,644	154,878	160,296	165,903
Plastic	8%	186,571	188,106	189,641	191,175	192,710	200,384	208,057	215,731	223,404	231,338	236,160	239,430	247,805	256,474	265,445
Recyclable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	520,511	531,360	538,718	557,562	577,065	597,251
Compostable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	520,511	531,360	538,718	557,562	577,065	597,251
Yard Trimmings	20%	466,428	470,265	474,102	477,939	481,775	500,959	520,143	539,326	558,510	578,346	590,400	598,576	619,514	641,184	663,612
Metal	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	147,600	149,644	154,878	160,296	165,903
Food	9%	209,893	211,619	213,346	215,072	216,799	225,432	234,064	242,697	251,330	260,256	265,680	269,359	278,781	288,533	298,625
Wood	6%	139,929	141,080	142,231	143,382	144,533	150,288	156,043	161,798	167,553	173,504	177,120	179,573	185,854	192,355	199,084
Textiles	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	147,600	149,644	154,878	160,296	165,903
Reusables	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,835	59,040	59,858	61,951	64,118	66,361
Ceramics	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,835	59,040	59,858	61,951	64,118	66,361
Soils	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,917	29,520	29,929	30,976	32,059	33,181
Chemicals	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,917	29,520	29,929	30,976	32,059	33,181
	100%	2,332,142	2,351,326	2,370,510	2,389,693	2,408,877	2,504,795	2,600,714	2,696,632	2,792,550	2,891,728	2,952,001	2,992,879	3,097,568	3,205,919	3,318,060

City of Dallas Solid Waste

Population and Waste Projections (2010-2040)

This assumes that 100% of the waste expected to be generated in Dallas will be delivered to McCommas and ELR is Implemented

ELR Process to recover 15% of the Landfill Space consumed 5 years after Placement & Residential Waste Diversion Rates will Double

Dallas Total Waste with ELR and Diversion Rate of 50% of Single Family Residential Generation

Year	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Population (P)	1,316,350	1,327,268	1,338,186	1,349,103	1,360,021	1,370,939	1,425,528	1,480,117	1,534,706	1,589,295	1,645,739	1,703,306	1,762,887	1,824,551	1,888,373
% Population increase (per year)		0.83%	0.82%	0.82%	0.81%	0.80%	0.77%	0.74%	0.72%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
Single Family (SFRP) Residential Population (P)(0.471)	620,001	625,143	630,285	635,428	640,570	645,712	671,424	697,135	722,847	748,558	775,143	802,257	830,320	859,364	889,424
Multi-family (MFRP) Residenrtial Population (P)(0.529)	696,349	702,125	707,900	713,676	719,451	725,227	754,104	782,982	811,859	840,737	870,596	901,049	932,567	965,188	998,949
Single Family Tons (SFT) (SFRP)(0.86)	533,201	537,623	542,045	546,468	550,890	555,313	577,424	599,536	621,648	643,760	666,623	689,941	714,075	739,053	764,904
Single Family Tons Diverted (SFTD) @ 50%	266,600	268,812	271,023	273,234	275,445	277,656	288,712	299,768	310,824	321,880	333,312	344,971	357,037	369,526	382,452
Net Single Family Tons (NSFT)	266,600	268,812	271,023	273,234	275,445	277,656	288,712	299,768	310,824	321,880	333,312	344,971	357,037	369,526	382,452
Multi-family Tons (MFT) (MFRP)(0.76)	529,225	533,615	538,004	542,394	546,783	551,172	573,119	595,066	617,013	638,960	661,653	684,797	708,751	733,543	759,201
Commercial Tons (CT) (P)(0.95)	1,250,533	1,260,904	1,271,276	1,281,648	1,292,020	1,302,392	1,354,252	1,406,111	1,457,971	1,509,830	1,563,452	1,618,141	1,674,742	1,733,324	1,793,954
Total Tons (TT) NSFT + MFT + CT	2,046,358	2,063,331	2,080,303	2,097,276	2,114,248	2,131,221	2,216,083	2,300,945	2,385,808	2,470,670	2,558,416	2,647,908	2,740,531	2,836,393	2,935,608
CY of Landfill Space Consumed Annually (TT at 1400 lbs/CY compaction rate)	2,923,369	2,947,615	2,971,862	2,996,108	3,020,355	3,044,601	3,165,833	3,287,065	3,408,297	3,529,529	3,654,881	3,782,726	3,915,044	4,051,990	4,193,726
CY of Landfill Space Recovered as a result of ELR					438,505	442,142	460,327	478,512	496,697	514,882	533,190	552,015	571,324	591,309	611,992
Cumulative Cubic Yards Consumed	2,923,369	5,870,984	8,842,846	11,838,954	14,420,803	17,023,262	30,344,697	44,181,367	58,533,275	73,400,418	88,795,032	104,728,834	121,219,861	138,287,735	155,952,632
Remaining Capacity (CY)	99,810,182	96,862,567	93,890,705	90,894,597	88,312,748	85,710,289	72,388,854	58,552,183	44,200,276	29,333,133	13,938,519	(1,995,283)	(18,486,311)	(35,554,184)	(53,219,082)
												Out of Site Life in 2045			
Estimated material type based on total tonnages before any diversion or ELR Landfill Space Recovery															
Glass	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	149,644	154,878	160,296	165,903
Plastic	8%	186,571	188,106	189,641	191,175	192,710	200,384	208,057	215,731	223,404	231,338	239,430	247,805	256,474	265,445
Recyclable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	520,511	538,718	557,562	577,065	597,251
Compostable Paper	18%	419,786	423,239	426,692	430,145	433,598	450,863	468,128	485,394	502,659	520,511	538,718	557,562	577,065	597,251
Yard Trimmings	20%	466,428	470,265	474,102	477,939	481,775	500,959	520,143	539,326	558,510	578,346	598,576	619,514	641,184	663,612
Metal	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	149,644	154,878	160,296	165,903
Food	9%	209,893	211,619	213,346	215,072	216,799	225,432	234,064	242,697	251,330	260,256	269,359	278,781	288,533	298,625
Wood	6%	139,929	141,080	142,231	143,382	144,533	150,288	156,043	161,798	167,553	173,504	179,573	185,854	192,355	199,084
Textiles	5%	116,607	117,566	118,525	119,485	120,444	125,240	130,036	134,832	139,628	144,586	149,644	154,878	160,296	165,903
Reusables	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,835	59,858	61,951	64,118	66,361
Ceramics	2%	46,643	47,027	47,410	47,794	48,178	50,096	52,014	53,933	55,851	57,835	59,858	61,951	64,118	66,361
Soils	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,917	29,929	30,976	32,059	33,181
Chemicals	1%	23,321	23,513	23,705	23,897	24,089	25,048	26,007	26,966	27,926	28,917	29,929	30,976	32,059	33,181
	100%	2,332,142	2,351,326	2,370,510	2,389,693	2,408,877	2,504,795	2,600,714	2,696,632	2,792,550	2,891,728	2,992,879	3,097,568	3,205,919	3,318,060

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

TRANSFER OPERATIONS

Task 3

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
CP&Y, Inc.
1820 Regal Row, Ste. 200
Dallas, TX 75235

.

Task 3- Transfer Operations

The City of Dallas contracted with R.W. Beck in 2006 to conduct a review of their Transfer Operations including their Transfer Fleet, Transfer Operations for unloading at McCommas Landfill and Operations at each of their three Transfer Stations.

Much of the information from that Report will be the basis for this Task 3 Technical Memorandum. The primary emphasis of this Technical Memorandum will be to update the information from that Report and outline the relevant information from that Report that remains valid.

Transfer Operations-

The City currently owns and operates three transfer stations- All waste from these stations is hauled to the McCommas Bluff Landfill (see Figure 1 for these facility locations).

- **Bachman (Northwest)-(TCEQ MSW Permit No. 1145) -** This facility is located at 9500 Harry Hines Blvd and is shown on the Aerial Photograph (Figure Bachman-1). Open 6 days per week to City and private commercial haulers, and City of Dallas residents. This is the only Transfer Station operated by the City of Dallas that receives waste from private commercial haulers. Since 2004 the Transfer Station has received an average of approximately 7,000-8,000 vehicles per month. These vehicles deliver an average of approximately 12,000 -15,000 tons per month, of which approximately 10-15% is delivered by private citizens and private waste haulers. The remaining 85-90% is delivered by City collection vehicles (residential and commercial). The total FY 2010 tonnage transferred through this station was 162,923 tons. The facility site layout and the building layout are shown in Figures Bachman-2 and Bachman-3. This Transfer Station has the design throughput capacity of 2,000 tons per day (approximately 48,000 tons per month) at the current hours of operation without physical expansion of the facility itself. This facility design capacity is over three times the current throughput at the facility and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same (85-90% City collection vehicles) and waste quantities increase as projected in Task 2. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, and if needed, additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, operating hours and staff. Recommendations from the Beck Report of 2006 for expanded throughput for this Station are as follows:

At the Bachman (Northwest) Transfer Station discontinue the practice of storing waste above the pit level, improve the ventilation and lighting, implement a "drop and hook" operation to help reduce the waiting time for drivers to have their vehicles loaded, divert more brush away from the facility, and encourage the increased use of the facility to utilize the available unused transfer capacity of the station. It was also noted in the report that the City should minimize the use of the "Steco" brand transfer trailers for transfer operations. These trailers have a heavier tare weight due to their unloading mechanism. This minimizes the available weight for waste payload due to total vehicle weight load restrictions.

These recommendations remain valid as the annual waste receipts have remained almost constant from FY 2004 to FY 2010 (177,528 tons vs. 169,923 tons).

Since the completion of the 2006 Transfer Station Report, the City is now also receiving recycled materials at the Bachman Station from the "Too Good to Throw Away" Program. The City recyclables collection vehicles unload on the floor of the building near the "direct load" load-out hopper. The recyclables are then top-loaded into "Steco" brand transfer trailers for delivery to Greenstar (formerly Vista Fibers) in Garland for processing and separation. The "Steco" trailers are used to haul the recyclables due to their self-unloading capability and the weight of the recyclables allows a full load without exceeding total vehicle weight load restrictions. There is no tipper equipment available at Greenstar for unloading, as there is at the McCommas Landfill for transfer trailers.

Dry Gulch Recycling which collects recyclables and brush mulching operations are located on the Bachman Site area. There is sufficient area adjacent to the facility to locate additional waste diversion activities.

The current hours of operation for the Bachman Transfer Station are:

Monday	7:30am-7:00pm
Tuesday	7:30am-7:00pm
Wednesday	7:30am-5:00pm
Thursday	7:30am-7:00pm
Friday	7:30am-7:00pm
Saturday	7:30am-5:00pm
Sunday	CLOSED

- **Fair Oaks (Northeast)-(TCEQ MSW Permit No. 60)** This facility is located at 7677 Fair Oaks Avenue, and is shown on the Aerial Photograph (Figure Fair Oaks-1). Open Monday, Tuesday, Thursday and Friday to City collection vehicles ONLY. The facility is open to City of Dallas residents only on Wednesday and Saturday. No private haulers are accepted. Individual deliveries by private citizens are noted in a vehicle count but their loads are not weighed. City vehicles using the facility average approximately 600-1,000 vehicles per month delivering an average of approximately 4,000-6,000 tons per month. The total FY 2010 tonnage transferred through this Station was 52,816 tons. The facility site layout and the building layout are shown in Figures Fair Oaks-2 and Fair Oaks-3. The waste quantities delivered by City vehicles is relatively consistent day to day (M, T, Th, F) after the City implemented the once per week residential collection system. This residential once per week collection system was not in place when the 2006 Report was prepared. At that time the City collected residential waste twice per week with Monday/Thursday routes and Tuesday/Friday routes. With that system the waste quantities collected on Thursday and Friday were much less than the waste collected on Monday and Tuesday. Consequently the residential collection vehicles that were collecting on Thursday and Friday were diverted to the Bachman Transfer Station and the Fair Oaks Station was closed on Thursday and Friday. This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) at the current hours of operation without physical expansion of the facility itself. This facility design capacity is approximately 2.5 times the current throughput at the facility and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same

(City Residential Collection Vehicles and Private Citizens only) and waste quantities increase as projected in Task 2. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, the facility is not designed to transfer the entire waste stream from ¼ of the City. Some additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, operating hours and staff. However the facility site is restricted in size due to the surrounding area being in the 100 year flood plain of White Rock Creek and cannot be expanded to meet the overall needs from ¼ of the City. Recommendations from the Beck Report of 2006 for expanded throughput for this Station are as follows:

- At the Fair Oaks (Northeast) Transfer Station the efficiencies could be improved by reducing the number of days that private citizens can access the site, utilizing the additional unused capacity of the facility and increase revenues by accepting waste from other commercial waste haulers, and if additional haulers are accepted, implement a "drop and hook" operation.

The City has improved the utilization of the facility since the 2006 Report by balancing the daily loads to the Station on Monday, Tuesday, Thursday and Friday due to the implementation of a once-per-week residential collection program. The recommendations for further improvements to increase the throughput remain valid.

There is little, if any, area available for additional diversion activities at this site due to the floodplain issues.

Current Operating Hours at the Fair Oaks Transfer Station are:

Monday	7:30am-5:00pm	City Vehicles Only
Tuesday	7:30am-5:00pm	City Vehicles Only
Wednesday	7:30am-5:00pm	Dallas Citizens Only
Thursday	7:30am-5:00pm	City Vehicles Only
Friday	7:30am-5:00pm	City Vehicles Only
Saturday	7:30am-5:00pm	Dallas Citizens only
Sunday	CLOSED	

Oak Cliff (Southwest)-(TCEQ MSW Permit No. 1453) This facility is located at 4610 S. Westmoreland Avenue and is shown on the Aerial Photograph (Figure Oak Cliff-1). Open Monday, Tuesday, Thursday and Friday to City collection vehicles ONLY. The facility is open to City of Dallas residents only on Wednesday and Saturday. No private haulers are accepted. City vehicles using the facility average approximately 600-1,000 vehicles per month delivering an average of approximately 4,000-6,000 tons per month. The total FY 2010 tonnage transferred through this Station was 57,914 tons. The facility site layout and the building layout are shown in Figures Oak Cliff-2 and Oak Cliff-3.The waste quantities delivered by City vehicles is relatively consistent day to day (M, T, Th, F) since the City implemented the once per week collection system. This Transfer Station has the design throughput capacity of 700 tons per day (approximately 15,000 tons per month) at the current hours of operation without physical expansion of the facility itself. This facility design capacity is approximately 2.5 times the current throughput at the facility and should be able to meet the long term needs of the City under the assumption that the current facility user types remain the same (City Residential Collection Vehicles and

Private Citizens only) and waste quantities increase as projected in Task 2. However, if additional waste quantities (from commercial haulers) are captured and directed to the facility, the facility is not designed to transfer the entire waste stream from ¼ of the City. There is limited space for facility expansion, but the facility could be expanded in size to meet some of the future needs. If the facility would be expected to transfer all of the waste quantities from ¼ of the City, it is anticipated that the facility should be replaced with a new facility rather than expanding the existing facility. Some additional throughput can be achieved with the addition of transfer vehicles, loading equipment at the facility, operating hours, staff, and the relocation of the office and scale system. Recommendations from the Beck Report of 2006 for expanded throughput for this Station are as follows:

- At the Oak Cliff (Southwest) Transfer Station the receiving floor is in poor condition and needs repair. Recommendations similar to those for the Fair Oaks Station were made for the Oak Cliff Station related to private citizen use, utilizing additional capacity and implementing a "drop and hook" operation. If the City chooses to increase the use of the station, the report further recommended the relocation of the office and scale system.

These recommendations remain valid for increasing the throughput at the facility.

Since the completion of the 2006 Transfer Station Report, the City is now also receiving recycled materials at the Oak Cliff Station from the "Too Good to Throw Away" Program. The Oak Cliff Station has two load-out hoppers for loading transfer vehicles. Since the start of recyclable loads receipt at the Oak Cliff Station, one of these hoppers has been designated for "recyclables" and one for "waste being transported to the McCommas Landfill". The City recyclables collection vehicles unload on the floor of the building near the designated "recyclables" load-out hopper. The recyclables are then top-loaded into "Steco" brand transfer trailers for delivery to Greenstar (formerly Vista Fibers) in Garland for processing and separation. The "Steco" trailers are used to haul the recyclables due to their self-unloading capability and the weight of the recyclables allows a full load without exceeding total vehicle weight load restrictions. There is no tipper equipment available at Greenstar for unloading, as there is at the McCommas Landfill for transfer trailers.

There is sufficient area adjacent to the facility to locate additional waste diversion activities.

Current Operating Hours at the Oak Cliff Transfer Station are the same as those at the Fair Oaks Transfer Station:

Monday	7:30am-5:00pm	City Vehicles Only
Tuesday	7:30am-5:00pm	City Vehicles Only
Wednesday	7:30am-5:00pm	Dallas Citizens Only
Thursday	7:30am-5:00pm	City Vehicles Only
Friday	7:30am-5:00pm	City Vehicles Only
Saturday	7:30am-5:00pm	Dallas Citizens only
Sunday	CLOSED	

Transfer Station Needs to Handle "All Dallas Waste"

The total combined capacity of the three existing Transfer Stations is 3400 Tons per Day (Bachman-2,000 tpd, Fair Oaks-700 tpd, and Oak Cliff-700 tpd). This equates to an annual transfer capacity of approximately 1,000,000 tons, based upon a 6 day work week. Based upon the projections developed in Task 2 it is anticipated that the annual waste quantities to be managed for "All Dallas Waste" will increase from approximately 2,200,000 tons per year to approximately 3,100,000 tons per year over the 50 year planning period.

Initially, if the City was currently handling "All Dallas Waste", at least half of all of the waste must be delivered directly to McCommas Landfill, and each of the Transfer Stations must be operated at their design capacity. Without any expansion of the Transfer Stations, the percentage of waste that must be hauled directly to the McCommas Landfill would increase from approximately half to approximately two-thirds of the total waste.

In order to maintain the percentage of waste hauled directly to McCommas Landfill at approximately half of the total waste, the design capacity of the transfer stations must be increased to approximately 1,500,000 tons per year.

As previously noted, the Fair Oaks Transfer Station cannot be expanded due to the surrounding flood plain. The Oak Cliff Transfer Station design capacity could potentially be increased in size to 1000 tpd at the existing site. In order to provide the 1,500,000 tons per year (approximately 4800 tpd) of transfer station design capacity, more waste would have to be handled by the Bachman Transfer Station and its design capacity would have to be increased from 2000 tpd to 3100 tpd. This may not be feasible due to various site restrictions (ground water levels, space, increased traffic, on-site traffic flow, etc.).

Transfer Vehicles

The City currently utilizes two types of transfer trailers:

- Aluminum "possum-belly" trailers that must be unloaded with a "tipper" at the landfill. Due to their lighter tare weight than the self unloading trailers, these trailers can carry a net payload of approximately 23 tons (46,000 pounds) and not exceed the legal gross weight limit of 80,000 pounds. Most of the waste transferred to the landfill is transported in this type of transfer trailer due to the increased payload.
- "Steco" brand self unloading trailers can carry a net payload of only 20 tons (40,000 pounds) without exceeding the legal gross weight limit of 80,000 pounds. This is due to their extra tare weight which includes the self unloading mechanism. As noted above, these trailers are currently used primarily to transport recyclables due to their unloading mechanism and the weight of the recyclables allows the trailer to be fully loaded without exceeding the legal gross weight limit.

Current City records were examined to determine if the City was loading these transfer vehicles to a reasonable load limit without exceeding the legal gross weight limit of 80,000 pounds. Selected records for various months over the past 5years are shown below:

Year	Month	Avg Of GROSS_LBS	Max Of GROSS_LBS
2011	5	76,566	88,840
2011	4	75,490	122,180
2011	3	73,376	95,560
2011	2	73,704	86,700
2011	1	72,695	95,140
2010	11	72,959	97,480
2010	7	73,047	85,940
2010	6	71,709	81,720
2010	2	74,360	89,400
2009	9	75,351	89,120
2009	8	74,673	81,420
2009	6	75,815	87,540
2009	3	75,500	99,100
2009	1	74,207	80,920
2008	10	74,052	97,460
2008	8	74,477	97,860
2008	7	74,371	97,000
2008	3	76,803	102,280
2008	2	73,646	89,880
2008	1	74,900	92,980
2007	12	74,694	81,680
2007	10	75,077	85,660
2007	9	74,694	82,920
2007	7	73,878	90,080
2007	6	73,633	89,520
2007	5	73,512	87,640
2007	4	73,177	88,020
2007	2	75,220	94,440
2007	1	75,674	98,420
2006	12	75,080	96,620
2006	11	74,579	94,940
2006	10	74,421	91,820
2006	9	73,732	88,420

Year	Month	Avg Of GROSS_LBS	Max Of GROSS_LBS
2006	8	69,312	87,420

As noted in these tables, the average monthly load in the transfer vehicles is slightly below the legal maximum gross load. Based upon discussions with City personnel the City operational strategy is to load these vehicles to the maximum extent without exceeding the legal limits. This is accomplished by using a clamshell/tamper to spread and compact the loads within the trailer while the transfer vehicle is located on a set of scales. These transfer vehicles are periodically weighed in route to the Landfill by State Troopers for compliance with load limits. The City is careful not to routinely overload the trailers due to these periodic weigh inspections and potential fines. As noted in the tables above, on occasion the trailers are overloaded, but not on a routine basis.

Based upon these records and the stated City operational strategy, it appears that the City is doing a good job of maximizing the load capacity of the transfer vehicles.

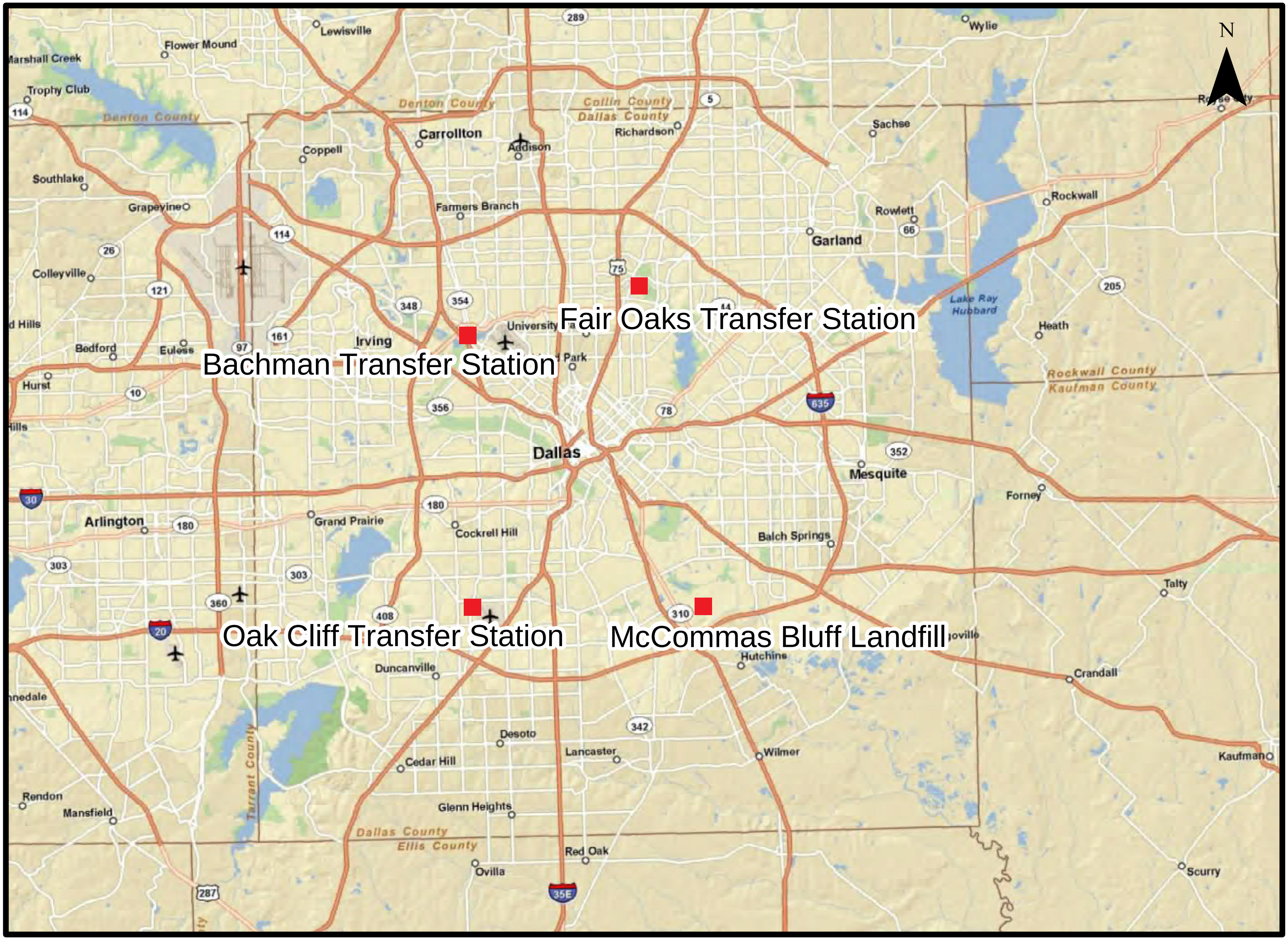
Alternate Transportation Methods for Transfer Operations

Railroads

As noted in the attached Figure RR, each of the transfer stations and the McCommas Landfill has access to rail lines within Dallas County. However, various studies have been performed over many years to examine the economic feasibility of utilizing railroads to transport waste from transfer stations to disposal sites. The consensus results of these studies are that the distance of transfer should be a minimum of 75 miles before even attempting to assess the feasibility of rail transport. Therefore rail transport has not been explored for use in the current facility configuration. In the future if the McCommas Landfill site is closed and the ultimate site for processing and disposal is at a more distant location, rail haul should be reevaluated.

Compressed Natural Gas (CNG)

In recent years many types of vehicles have been manufactured which utilize CNG as the fuel source. This is also true in the Waste Industry where many municipalities and private haulers are utilizing and evaluating CNG fueled vehicles in their collection fleet, including the City of Dallas. CNG fueling stations are also being established at various locations to provide fuel more conveniently. As the current transfer vehicle fleet is replaced, it is recommended that the City evaluate and compare CNG fueled vehicles for this transfer function as well.



Date: 5/11/2011

Dallas Solid Waste Facility Locations

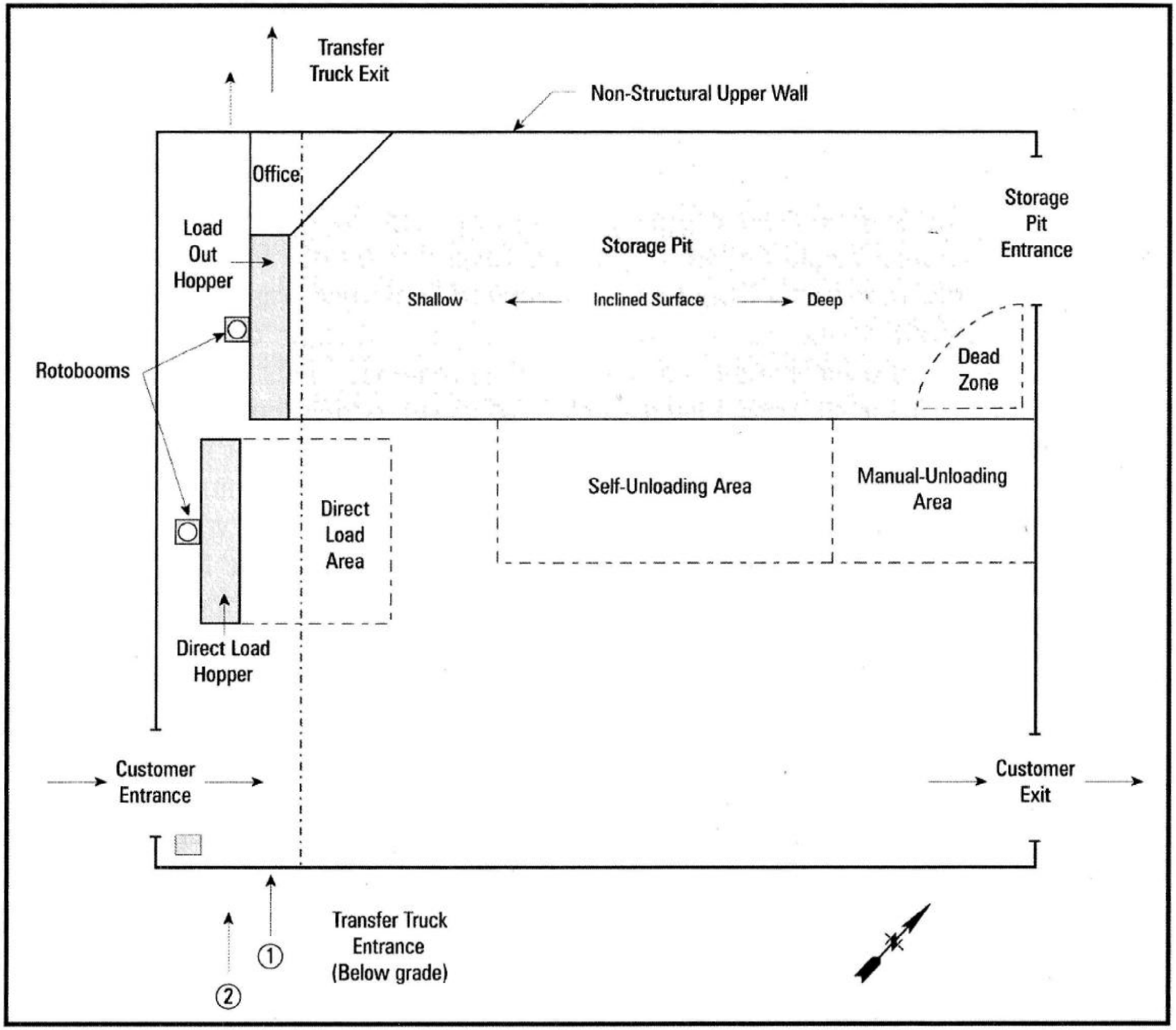
0 2.5 5 10 Miles

Figure 1

Date: 5/11/2011

Bachman Transfer Station
Aerial Photograph

Figure - Bachman-1

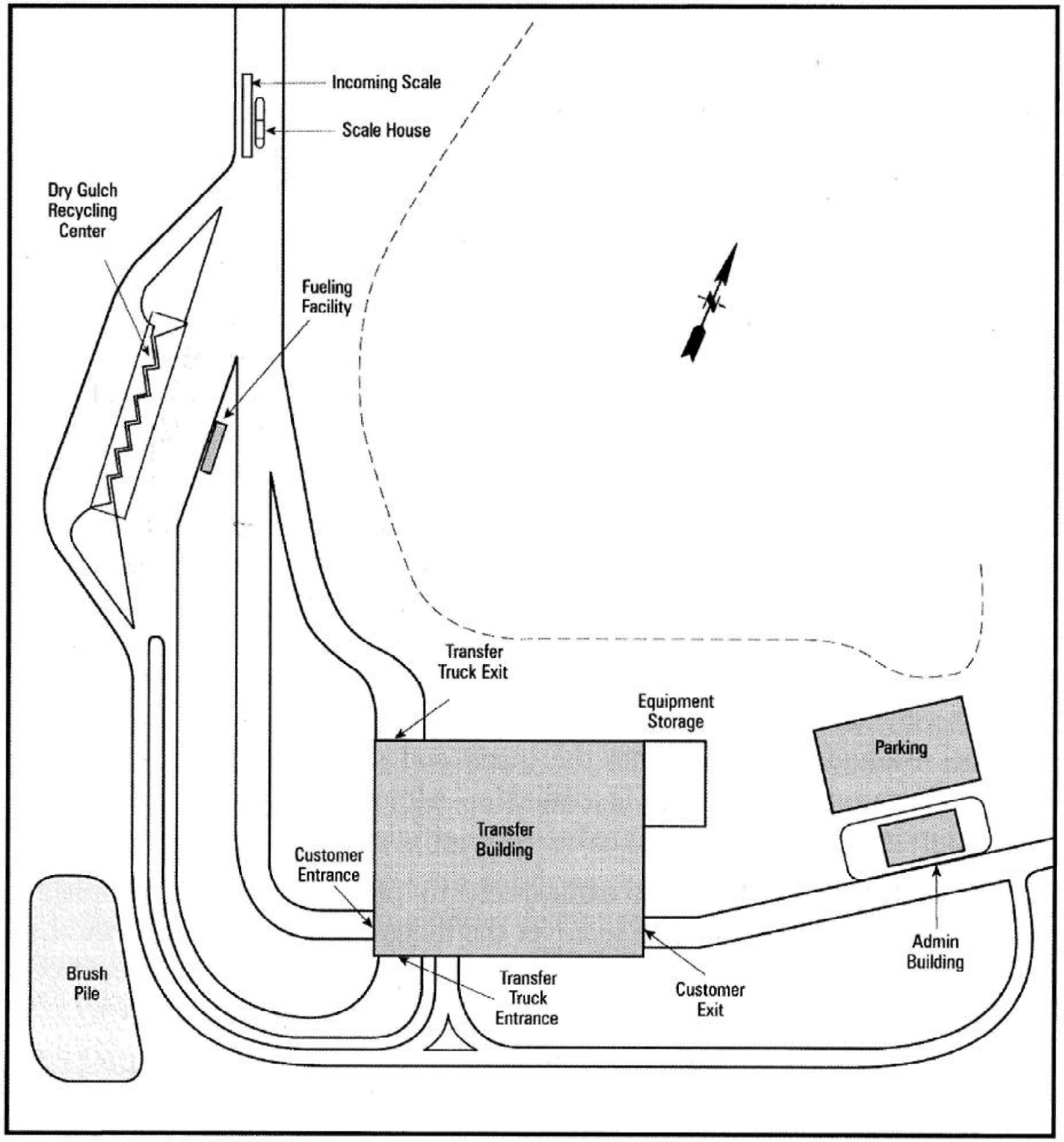


Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Bachman Transfer Station
Building Layout

Figure - Bachman-2

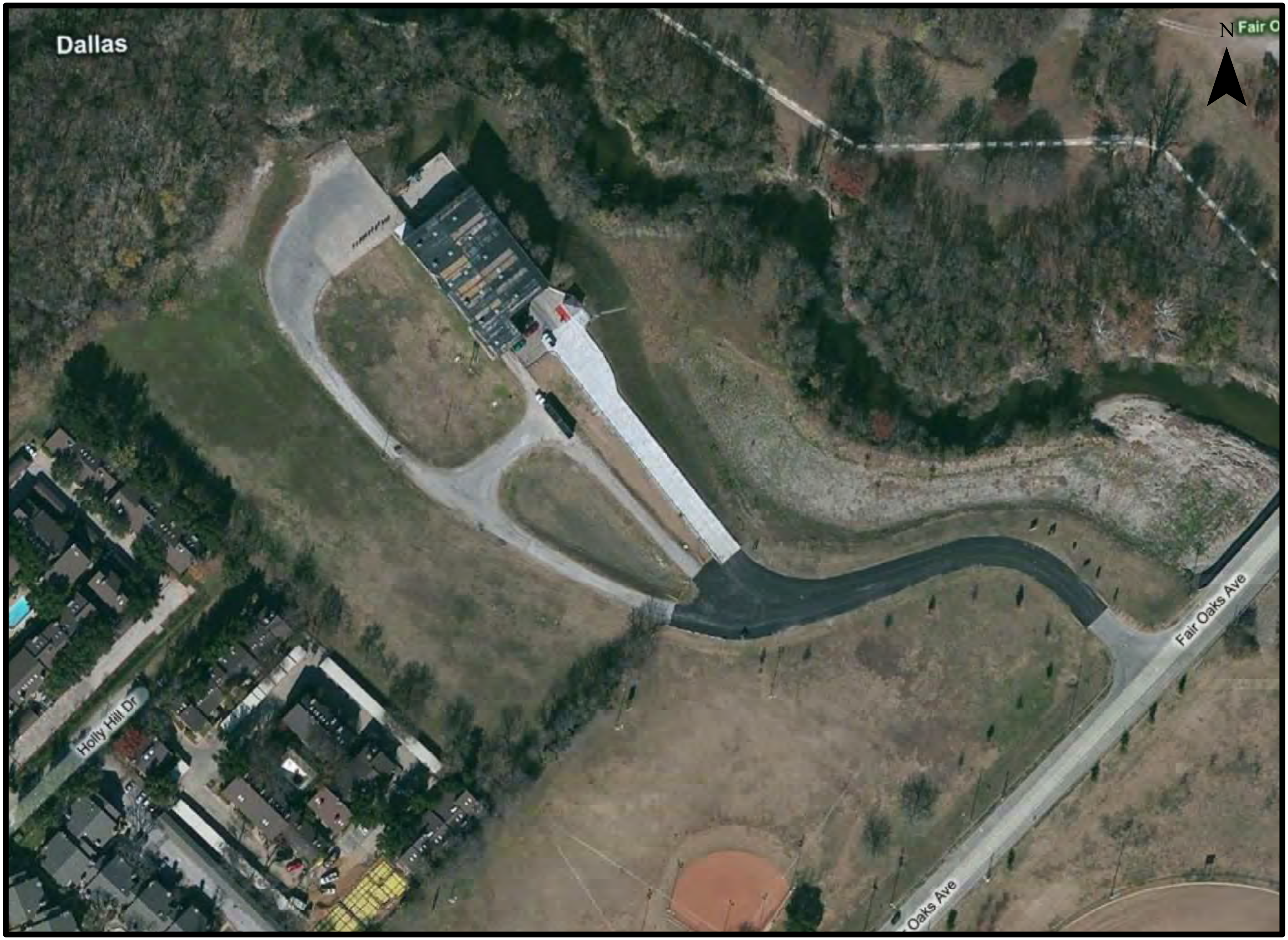


Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Bachman Transfer Station Facility Layout

Figure - Bachman-3

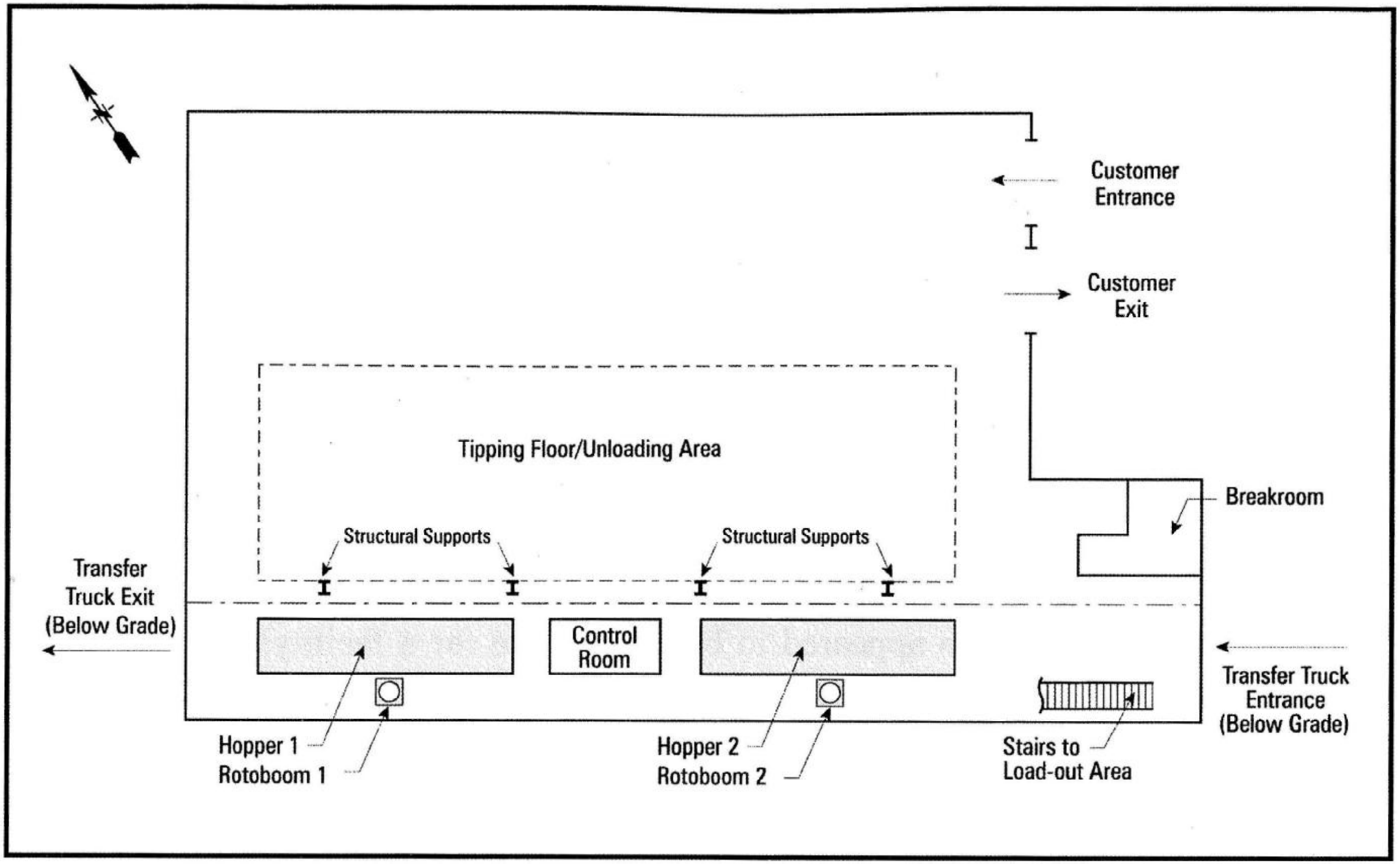


Date: 5/11/2011

Fair Oaks Transfer Station
Aerial Photograph

0 75 150 300 Feet

Figure - Fair Oaks 1

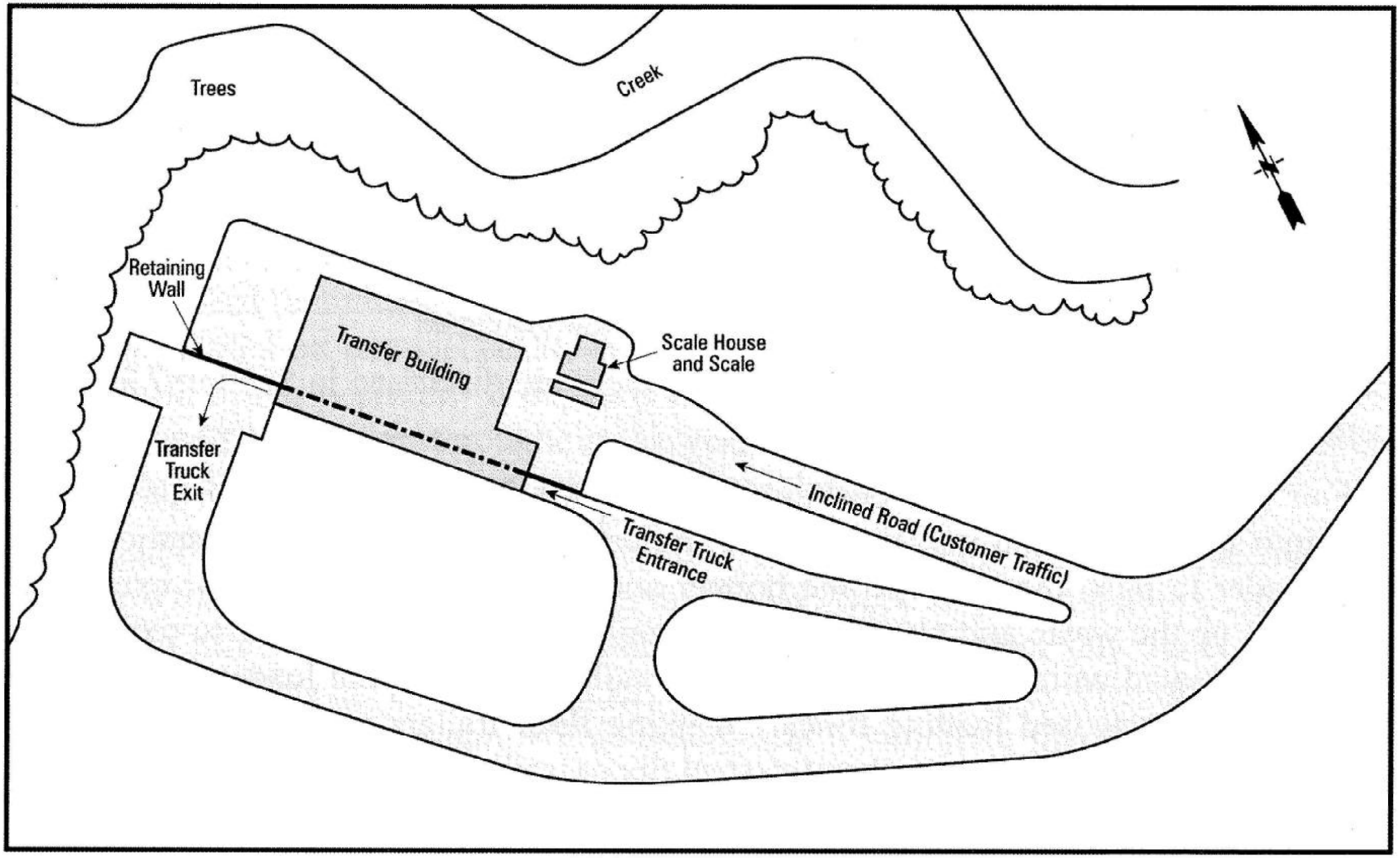


Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Fair Oaks Transfer Station
Building Layout

Figure - Fair Oaks-2



Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Fair Oaks Transfer Station
Facility Layout

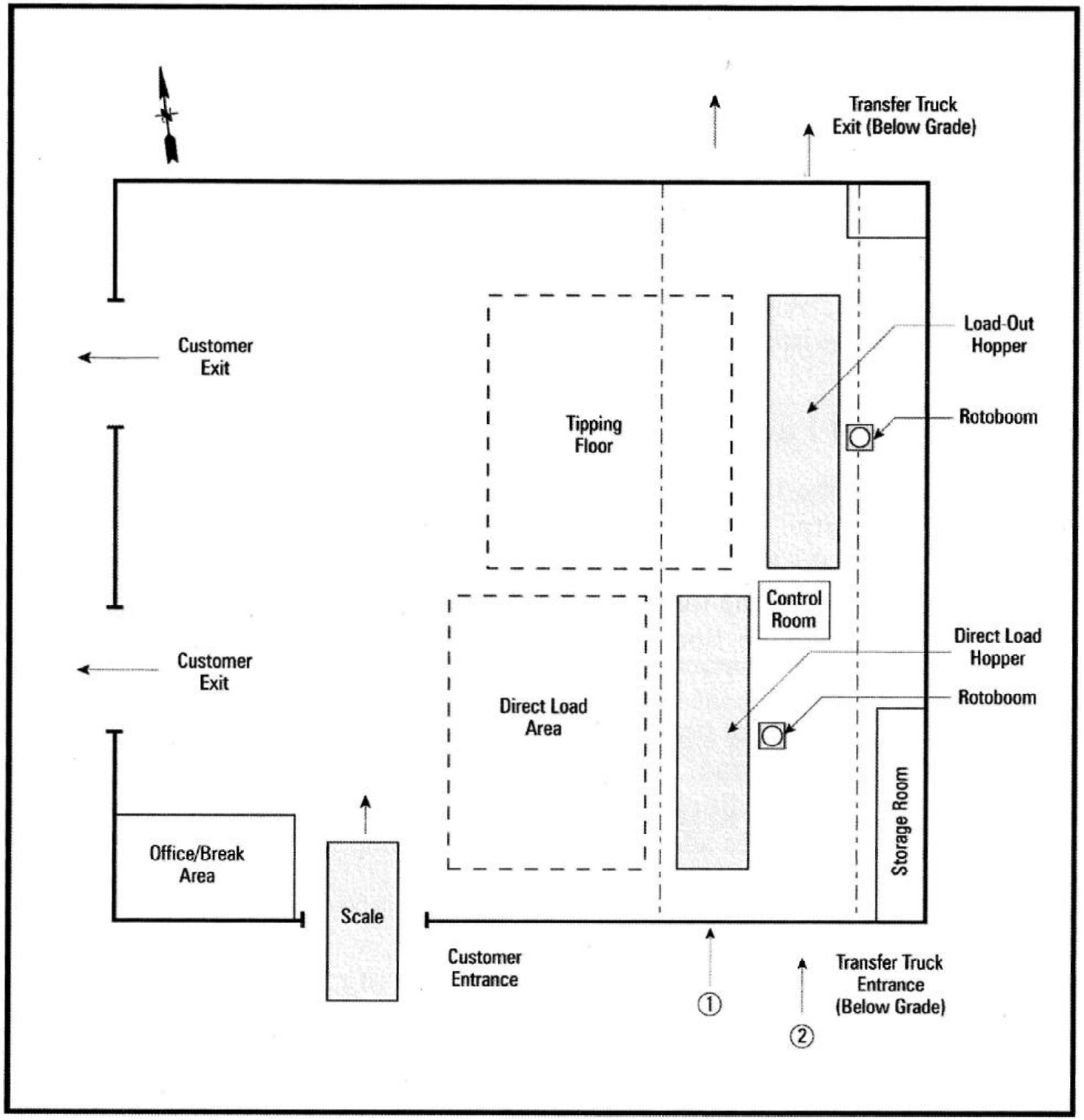
Figure - Fair Oaks-3

Date: 5/11/2011

Oak Cliff Transfer Station
Aerial Photograph

0 75 150 300 Feet

Figure - Oak Cliff-1

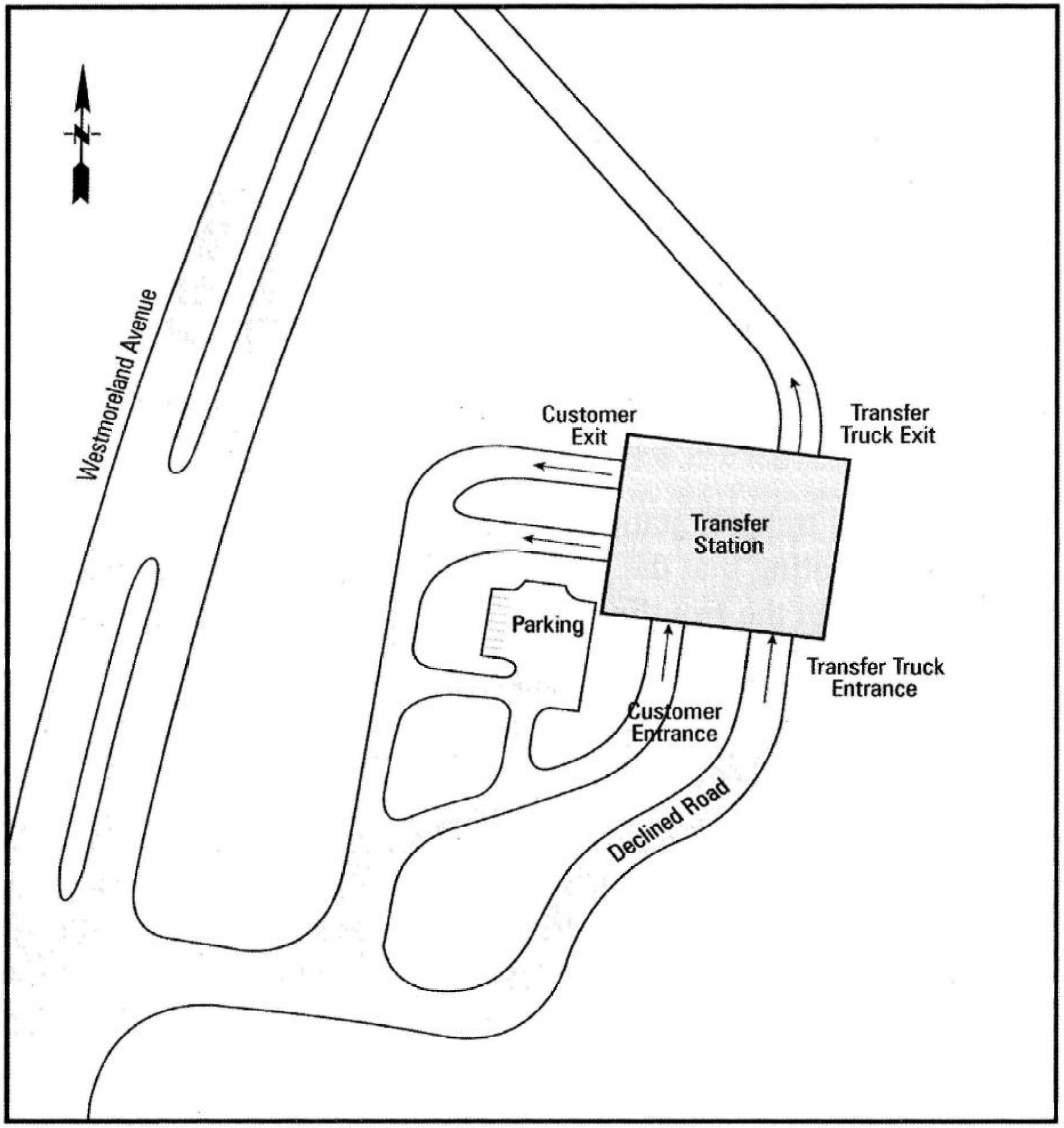


Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Oak Cliff Transfer Station Building Layout

Figure - Oak Cliff-2

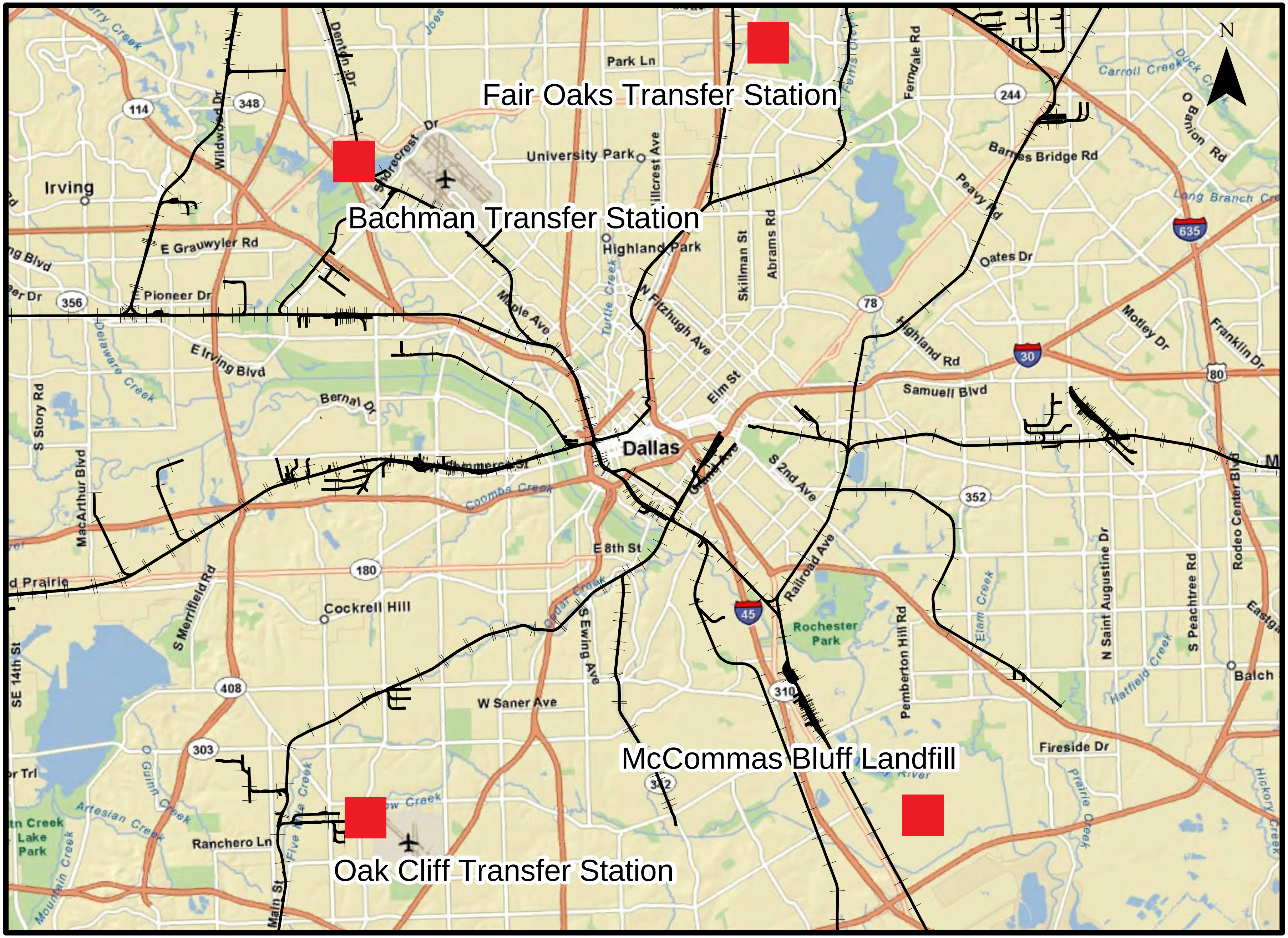


Date: 5/11/2011

Source: City of Dallas
Transfer Station Evaluation
February 2006 - RWBeck

Oak Cliff Transfer Station
Facility Layout

Figure - Oak Cliff-3



Date: 5/20/2011

Dallas Solid Waste
Facility Locations - Railroads

Figure RR

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

DIVERSION PROGRAM OPTIONS

Task 4A

August 2011

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
HDR Engineering, Inc.
17111 Preston Road, Ste. 200
Dallas, Texas 75248
Texas PE Firm Registration No. F-754

Table of Contents

Diversion Program Options

The City of Dallas (City) operates a number of diversion programs to reduce the volume of discarded materials requiring landfill disposal. These include:

- Residential Recycling Collection – weekly collection provided to single-family residences using wheeled carts
- Big Blue Recycling Drop-Off Sites – targeting multifamily residences and available to all generators
- Brush Collection – monthly collection available to all residents
- Electronics Recycling – drop-off program available to all residents
- Pilot Recycling Programs – targeting multifamily residences and hotels
- Landfill Diversion Programs – targeting metals, concrete, asphalt, sawdust, clean soil and brush

To assist with the development of the Local Solid Waste Management Plan, the City convened the Solid Waste Advisory Committee (SWAC). Members of SWAC include representatives from public agencies, private sector service providers, and community groups.

At the SWAC meeting held on May 26, 2011, SWAC reviewed potential diversion program options, as listed in Table 1.

Table 1 Diversion Program Options

	Residential	Commercial	Construction and Demolition Debris	All Generators
Policies	Rate structure incentives Mandatory recycling and composting	Require all businesses to have recycling service Require all businesses to recycle specific materials Require all businesses to reach a certain diversion level Ban specific materials from disposal (cardboard, C&D) Require commercial haulers to reach specific diversion levels Require commercial haulers to provide recycling services to all of their customers Require all commercial kitchens to have either pulpers or under-sink garbage disposers.	Require C&D generators to prepare C&D diversion plans Require processing of all C&D loads Require all C&D generators to reach a certain diversion level (75% for construction debris, 90% for inert materials) Ordinance requiring Resource Recovery Parks at all transfer stations and landfills	Extended Producer Responsibility Packaging legislation Single use bag ban Voluntary take-back requirements Product bans Environmentally Preferable Purchasing Ordinance Green events ordinance

	Residential	Commercial	Construction and Demolition Debris	All Generators
Programs	Add materials to recycling program (textiles, durable plastics, film plastic, scrap metal) Source-separated organics collection (yard trimmings, food scraps) Bulky item reuse and recycling Recycling technical assistance	Social marketing programs for specific generator types or districts (Business Improvement Districts or Building Owner and Manager Association or other) Provide recycling and composting services to all schools Provide recycling and composting services to all multi-family complexes Commercial technical assistance	C&D diversion technical assistance	Large scale media campaign (Don't mess with Texas) Community-Based Social marketing
Facilities	Enhanced recycling processing Expansion of mulch/composting operations		Resource recovery park at City landfill Construction and demolition debris processing	Resource recovery park at City landfill

After a discussion of the potential diversion options, SWAC members were asked to provide additional observations and input. SWAC members identified the following additional initiatives for consideration, as listed in Table 2.

Table 2 Additional Initiatives Identified by SWAC Members

Policies	▪ 75% of material going to the landfill is a resource. The City could establish rate structure incentives, using a tier pricing based on container size. ▪ The voluntary yard waste program (Don't Bag It) still results in a significant amount of yard waste going to the landfill. Consider making the Don't Bag It program mandatory. ▪ C&D separation and recycling could be mandatory, ▪ To ensure commercial customers can recycle, it should be required that all commercial waste haulers provide recycling options. ▪ Consider extended-producer responsibility (EPR), maintaining that the manufacturer remains responsible for its product over the product's entire life cycle ▪ Public education or incentives are preferred over any requirements or mandates. ▪ Change building codes to incorporate recycling systems.
Programs	▪ Education is key component. We need to train the next generation of residents on the value of waste as a resource. ▪ The "disposable mindset" has to be transformed into "resource thinking". ▪ Education is important and necessary goal to ensure the success of the solid waste diversion programs. ▪ There is a huge opportunity for increasing diversion through single-stream recycling for the commercial sector. ▪ The City could dramatically increase diversion percentages if commercial customers had greater access to recycling. ▪ Consider single stream recycling technology for commercial. ▪ Provide separate collection of brush from bulk items. ▪ Consider co-collection of brush, yard waste and food scraps.
Facilities	▪ Establish a "Resource Recovery Park" at the landfill. ▪ Develop a composting and mulch facility at the landfill. ▪ New technologies are not commercially proven. However, food to fuel appears to be gaining in acceptance. ▪ Dallas should be at the forefront of innovative MSW diversion and technology. ▪ The City should ensure that there is sufficient capacity at recycling and recovery facilities. Sham recycling operations present a threat to the environment and public health and welfare. ▪ In addition to a compost facility, a technology option for putrescible wastes (i.e., food wastes) would be anaerobic methane digester for generating methane gas. ▪ The City of Dallas has the opportunity to be on the forefront of innovative technology and the leader in resource recovery.

To understand the effectiveness of the diversion policies and programs, the following key initiatives were evaluated.

1. Require commercial haulers to provide recycling services to all of their customers—targeting multifamily and commercial generators
2. Consider mandatory source-separation requirements—targeting all generator sectors
3. Develop a construction and demolition debris (C&D) ordinance and provide C&D technical assistance -- targeting roll-off and self-haul generators
4. Advocate for extended producer responsibility at the state level and work with local retailers to increase take-back programs—targeting all generator sectors
5. Provide separate collection for organics—targeting all generators
6. Provide bulk item reuse and recycling—targeting all generators
7. Undertake a social marketing campaign—targeting all generator sectors
8. Provide commercial technical assistance—targeting multifamily and commercial generators
9. Develop a Resource Recovery Park at the landfill—targeting self-haul generators
10. Develop a mixed materials processing facility—targeting all generators

Note that a detailed discussion of new technology is included in the Technology Options Technical Memorandum and organics processing technology is addressed in the Organics Technology Technical Memorandum.

Description of Key Initiatives

Policies

1. Commercial Hauler Recycling Requirements

Currently, solid waste collection from an apartment, institution, commercial establishment, or mobile home park may be performed by a collection service provider that has a solid waste collection franchise granted by the City.

The City would revise the existing franchise system to direct all franchised haulers in the City to provide recycling services to commercial customers citywide. The requirement for recycling service under this program would specify that recycling must be provided to customers upon request (note that this program does not require customers to recycle, which is addressed below), and allow for the hauler to determine the collection methodology, provision of customer containers, processing arrangements, fee structure, and other components of the recycling services the hauler offers its customers. The City would specify in the franchise requirements which materials must be included in the recycling program to ensure that customers have a reasonable level of service for recycling the types of materials they generate. It is assumed that the list of target materials in this program would include those materials currently collected in the residential recycling program offered through the City.

In communities that have exclusive franchise agreements with haulers for commercial solid waste service, commercial recycling service is often included in the scope of services to ensure that customers have the option to recycle through their hauler. This program, which does not require exclusive franchise arrangements with haulers, would allow commercial customers to arrange recycling service with their waste collector, rather than making arrangements with third-party recycling companies. Many recycling firms require special conditions to be met (minimum quantities of materials, source separation by type or material grade, on-call arrangements) before they agree to provide service, which often discourages commercial customers from recycling.

Commercial haulers would be allowed to implement whatever programs work best in terms of collection efficiency and handling methods, but reporting requirements would be necessary to enable the City to monitor the program to ensure it is offered consistently throughout the commercial sector. This program would require additional City staff to conduct periodic monitoring (in the field) and to respond to any customer complaints to ensure that recycling services are being implemented by the hauler upon request by the customer.

Commercial Rate Structure Ordinance

The City does not regulate specific rates for service provided through the private sector service providers, but could provide guidance through a rate structure ordinance.

The goal of the ordinance would be to establish sufficient customer rate incentives for commercial and multi-family customers to increase recycling and decrease garbage service. This ordinance would help to minimize the common industry practice of offering price incentives based on volume discounts to customers that subscribe for higher levels of garbage service, thereby creating pricing incentives for customers to shift to increased recycling services. The following sections describe the customer rate modifications for garbage and recycling services, which the haulers would be required to implement under this program.

Garbage rate component:

Commercial customer rates could be modified by the hauler to reflect a uniform "per cubic yard" rate for the whole range of bin or container sizes and collection frequency the hauler offers to its customers. The amount of the cubic yard (unit) rate could be established by the hauler to ensure that sufficient revenues are generated to cover the hauler's costs and still compete for customers. Thus, if a hauler charges a rate of $100 for a one cubic-yard bin collected once per week, the rate could be $200 for the one cubic-yard bin collected two times per week, $400 for a four cubic-yard bin collected once per week, or $1,200 for a six cubic yard bin collected two times per week.

In addition, haulers could be required to decrease garbage services and corresponding rates for those services during the term of any contracts they have. This would address some problems that develop where businesses don't get economic benefit of reducing garbage, as they have a fixed price contract. If a contract is based on a flat fee for all the services provided, haulers could be required to provide line items in their contracts for the costs of garbage, reuse, recycling and composting services, and if garbage service is decreased, then the contracts could be required to specify how the overall contract cost will be decreased.

Haulers could also be restricted from entering into agreements for garbage collection service for more than 1 year, but have no such restrictions on reuse, recyclables or compostable collection services. This would enable haulers to invest in new reuse, recycling and composting infrastructure, and not reward continued wasting.

Recycling rate component:

Commercial haulers are assumed to offer recycling service to their customers through a proposed recycling ordinance (discussed above), therefore they would be required to offer a discount for the recycling rates compared to the garbage rates. The recycling rate set by the hauler under this program could be no higher than 75% (for example) of the garbage rate for service, as measured by the uniform "per cubic yard" rate for garbage service. If a hauler charges his customer $100 for a one cubic yard bin of garbage, he could charge no more than $75 for a one cubic yard bin of commingled or source separated recyclables.

Garbage and recycling rate modifications intended by this program would be established through City adoption of an ordinance that would describe the parameters of the rate modification haulers would need to implement in order to maintain their permits, or franchise agreements, for serving customers within the City. This program would rely on the City's right to set hauler franchise conditions, and would not require the City to implement exclusive franchises for commercial waste.

2. Mandatory Source-Separation Requirements

The City will have the most impact on increasing diversion of recyclable and organic materials through new policy drivers. This policy presents a major shift from voluntary to mandatory participation in recycling collection programs, and is intended to motivate all waste generators (residential and commercial) within the City to separate recyclable materials from the waste they generate at their home or business, and place it in the appropriate recycling collection container on a regular basis for collection. To effect this change, the City would need to develop and adopt a "Mandatory Recycling" ordinance that requires waste generators to source separate recyclables from other waste, and set the recyclables out for collection as appropriate for the recycling programs and services available through their service provider (the City for single family service, franchised waste haulers and/or recyclers for commercial service, multi-family complexes, etc.).

The recycling ordinance would need to be carefully developed based on consideration of legitimate concerns raised by various stakeholder groups and consistent with City policy directives, and publicized adequately to inform all residents, businesses, service providers, and others of the intent and purpose of the ordinance.

The South Bayside Waste Management Authority, a joint powers agency which includes ten communities within San Mateo County, California recently completed an evaluation of existing mandatory recycling programs and identified the following approaches for successful implementation:

- Use a detailed rationale
- Include all businesses, regardless of size or type
- Include all sectors
- Require source-separation of any material that is collected
- Do not specify materials by name in the ordinance
- Require haulers to deliver tags and warning notices
- Require haulers to provide information about such actions
- Establish a protocol for enforcement
- Establish that government staff have the power to clarify the ordinance through the issuance of regulations

- Establish a sliding scale of fines based on service levels
- Establish a protocol to grant limited exemptions
- Use public sector inspectors or third-party contractors to verify non-compliance
- Include specific requirements for multi-family or multi-tenant building owners and managers
- Require haulers to conduct periodic waste audits of loads
- Establish a grace period of non-enforcement
- Initiate a stakeholder and scoping process for ordinance details
- Focus service delivery on the carrots rather than the threat of the sticks, but convey expectations ("it's the law") that recycling must be taken seriously ("enforcement measures can include...")
- Use a "light touch" on enforcement (enforce flagrant violations rather than minor infractions)

Although the South Bay Waste Management Authority member agencies have exclusive franchises, the research included evaluation of mandatory ordinance requirements for both generators and haulers and was not specific to exclusive franchises.

Political Capital vs. Financial Capital

Mandatory requirements are cost-effective, particularly if the City does not have to invest in additional staff resources to address compliance issues. New regulations and requirements, just like smoking bans and seat belt laws, require implementation of policy initiatives (and use of political capital), since the City would be asking generators to change their behavior. In contrast, behind the scenes processing technologies require the expenditure of financial capital, since the City or private sector service providers would need to invest in new infrastructure. Individual generators, particularly commercial generators, may realize cost-savings by increasing recycling collection service and reducing solid waste collection service.

3. Construction and Demolition Debris Ordinance

The City has an opportunity to implement a recycling program that would significantly divert the debris that is generated during construction and demolition activities at project sites. Adoption of a Construction and Demolition (C&D) Debris Ordinance would address materials that are typically generated during C&D projects that could be reused or recycled rather than landfilled.

As much as twenty percent of waste disposed in landfills consists of C&D debris.

Adoption of a citywide C&D ordinance would require all sponsors of construction and demolition projects throughout the City to recycle or reuse minimum thresholds of debris generated from those projects. The ordinance would result in significant increased waste diversion of the target C&D materials, particularly during times of increased economic activity when more construction and renovation projects are undertaken. The City's role would be to:

- Adopt policies to increase reuse, recycling and composting of products used in remodeling and new construction;
- Require larger project building permit holders to provide C&D diversion plans;
- Transition to higher rates of diversion requirements;
- Require documentation of diversion amounts; and

- Register facilities and haulers.

A component of this initiative would be implementation of a C&D Technical Assistance program. The program would include:

- Technical assistance to construction and demolition debris generators in support of the Construction and demolition debris ordinance;
- Training in soft demolition, deconstruction, and building materials reuse;
- Promotion of building adaptive reuse;
- Information on recycling and reuse outlets and deconstruction services; and
- Information about rates and services available through private sector service providers and non-profit organizations.

4. Extended Producer Responsibility

The goal of this initiative is to provide support to statewide Extended Producer Responsibility (EPR) initiatives and to consider local initiatives.

EPR also known as "product stewardship" is a product-centered approach to environmental protection. EPR calls on those in the product life cycle—manufacturers, retailers, users, and disposers—to share responsibility for reducing the environmental impacts of products.[1]

This initiative calls for the City to take an active role in advocating for legislation that requires product manufacturers, retail establishments, wholesale distributors and other appropriate entities to take back certain products or packaging that currently are difficult to recycle, contain toxics or otherwise pose problems when they are discarded as waste. The City would work with the Texas Product Stewardship Council and other federal, state and regional agencies and community groups to ensure that effective take-back programs are enacted into law, thereby enhancing the City's goals to reduce the volume and toxicity of the materials entering the City's waste stream.

The following are the four priorities the City would focus on under this program:

- Advocate for legislation making businesses responsible for their products that contain toxics, such as pharmaceuticals, fluorescent lights, household batteries, treated wood, and other materials.
- Advocate for legislation making businesses responsible for their products that are difficult to recycle materials, such as disposable diapers, composite materials, tires, white goods, durable goods, plastic, and food packaging.
- Advocate for packaging legislation making businesses responsible for their packages, including: alternatives to expanded polystyrene (Styrofoam containers, "peanuts" and "blocks") and plastic bags; and support for reusable shipping containers.

[1] "*Wastes - Partnerships - Product Stewardship*" U.S. Environmental Protection Agency, http://www.epa.gov/osw/partnerships/stewardship/basic.htm (accessed June 23, 2011).

- Adopt a citywide single-use bag ban on plastic carry-out bags at all supermarkets and retail establishments, and impose a point-of-sale fee on all other single-use bags, such as paper or compostable bags.

Programs

5. Separate Collection for Organics

City Programs to Increase Diversion of Brush, Yard Trimmings and Food Waste

The City provides monthly collection of brush and bulk items. The City collects large limbs, shrubbery, bagged leaves (in sealed bags with a maximum 50 gallon capacity), furniture, appliances, mattresses and box springs. The City encourages residents to separate brush from bulk items. Clean loads of brush can be diverted from disposal at the landfill. However, a significant amount of brush set out for collection is commingled with bulky items and requires disposal or processing to separate the two streams.

There are two significant modifications to the residential collection system the City can consider in order to improve diversion and collection efficiency. The first is to provide carts to the residents in order to make the collection system more user-friendly, and the second is to add food waste to the list of acceptable materials (this would need to be phased in, once composting facility capacity to properly process the organic material is in place). Composting facility capacity and development of facilities are discussed in the Organics Technology Technical Memorandum.

Provide residents with carts: The residents have been provided with sets of two (2) wheeled carts with lids for convenient storage and curbside set-out of their garbage and recyclables. Use of the carts has increased collection efficiencies and, coupled with the City's single-stream recycling program, resulted in more convenience to the residents and higher participation in the recycling program. The same benefits would occur if the yard trimmings collection program provided a similar "green" cart for storing and set-outs of yard trimmings and other organic materials.

By offering a choice of "green" cart sizes (e.g., 48–gallon, 64-gallon, 96-gallon or similar capacity), residents can select a size that meets their need, based on how much yard materials they generate or how much storage space they have for an additional cart.

The City, in providing customers with garbage and recycling carts, has gained valuable experience in recent years with using automated and semi-automated vehicles to collect those materials, and residents have become familiar with the simplified set-out requirements for carts. Given this background, a cart program for handling yard trimmings would not require a pilot program to test the collection methods and equipment. Given the benefits to the residents under a cart collection program, this program modification would result in improved customer satisfaction and higher participation in the yard trimmings collection program.

Phase in food scraps and other organics in the program: If the City decides to provide customer carts for the yard trimmings collection program, the City should consider adding food scraps and other organic material such as food-soiled paper and similar compostable materials to the residential collection program. This program modification is recommended only in the event the City will have established the use of carts for yard trimming collections. Due to the high density (weight) of food scraps, the carts and automated lifting mechanism on the collection vehicle will be required for handling the material. This program also requires availability of permitted compost facilities (City and/or private facilities) within the region that would receive, process, and market yard trimmings commingled with food scraps and other organic materials suitable for conversion to compost products. Before this program could be implemented on a citywide basis, the City would need to ensure that there is sufficient processing capacity to handle the increased organics tonnages that would be collected through the expanded yard trimmings program.

The City may want to conduct a pilot program to insure that yard trimmings co-mingled with food scraps can be adequately composted for end-use markets. Pending the final results of the pilot program, the City could modify and expand its yard trimmings collection program to include other organic materials such as food scraps, food-contaminated paper, and similar compostable materials. This program is designed to increase residential waste diversion by encouraging residents to place food scraps and other organic materials in their green carts.

Expand program to Commercial and Multi-family properties serviced by the City or private haulers: Once the residential program has converted to a cart system for yard trimmings, food scraps and other organics, the City should provide the equivalent service to any of its commercial customers that generate food scraps and other organics. In the case of multi-family properties, the City could either provide the service to the complexes, or require that private haulers providing recycling services also provide yard trimmings (with food scrap) service.

6. Bulk Item Reuse and Recycling

Initiatives to Modify Bulk Item Collection to Increase Waste Diversion

Currently, the City provides monthly collection of brush and bulk items, including furniture, appliances, mattresses and box springs. Clean loads of brush are diverted from disposal at the landfill, but bulk items and loads that combine brush and bulk items are disposed. The City diverts some bulk items by conducting semiannual “hard to recycle” collection events where residents can deliver bulk items to designated “drop-off” locations. The City can also encourage residents to recycle bulk items through charitable organizations and thrift stores. This message could be conveyed through the City’s Bulk Item Collection web page, on all printed program materials, and through the Customer Service call center.

Work with reuse/recycle partners

The City could create a pilot program to partner with one or more reuse and/or recycle entities (thrift stores, repair shops, and non-profits such as Goodwill Industries and Salvation Army) to repair, reuse, and resell appropriate bulk items that are currently being set out for collection by City crews and ultimately sent to a landfill.

The City could include in its pilot service contracts with reuse partners to define operating procedures, service requirements, performance standards, and establish program parameters to ensure that the bulk item reuse program is closely coordinated with the bulk item collection program operated by the City and does not impede City operations. Under this approach, it is likely the City would provide its bulk item daily route sheets or service addresses to its reuse partners, who would then proceed ahead of the City collection crews and collect all the items it considers to be reusable or repairable. An alternative could be to have the customer contact the reuse partner directly to arrange its own separate collection of the reusable items. This would eliminate some of the scavenging of materials set out for collection and reduce the workload for the City program.

On-Call scheduling of pick-ups

To reduce operating costs, provide more opportunities for reuse and recycling, and provide better control over the materials and reduce scavenging the City could consider a pilot study to test the effectiveness of on-call scheduling of bulk item collections.

Residents would call customer service to schedule the collection day in advance. The collection crews (using crane trucks, flatbeds or collection truck-trailers) could still be utilized in the same way they are now for collecting items, but daily route assignments would be by area according to the number of households scheduled in advance. This would allow the daily routes to be balanced and distributed based on need for coverage, rather than specific areas according to the current monthly schedule.

7. Community-Based Social Marketing

Community-based social marketing or social marketing[2] is the systematic application of marketing, along with other concepts and techniques, to achieve specific behavioral goals for a social good. A variation of social marketing has emerged as a systematic way to foster more sustainable behavior. Referred to as Community-Based Social Marketing by Canadian environmental psychologist Doug McKenzie-Mohr, Community-Based Social Marketing strives to change the behavior of communities to reduce their impact on the environment.[3] Realizing that simply providing information is usually not sufficient to initiate behavior change, Community-Based Social Marketing uses tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers. Among the tools and techniques used by Community-Based Social Marketing are focus groups and surveys (to discover barriers) and commitments, prompts, social norms, social diffusion, feedback and incentives (to change behavior). The tools of Community-Based Social Marketing have been used to foster sustainable behavior in many areas, including energy conservation, environmental regulation, and recycling.

A community-based social marketing program could be implemented to help change the culture and behavior in the City and transform the "disposable mindset" into "resource management". Different messages can be targeted to different demographic groups using a wide assortment of tools. The City would work closely with electronic and print media to encourage their coverage of the City's goals, plans, and project implementation, and to challenge them to help engage the public in creative new ways. Funding programs on an on-going basis (over multiple five-year campaign periods) to educate target audiences about the new rules and changes is an important part of increasing diversion. This program would greatly enhance public awareness about where to reuse, recycle, and compost materials to keep them out of landfills, and encourage residents, businesses, workers, and visitors to fully participate in achieving a more sustainable future.

---

[2] Definition excerpted from Wikipedia article on "Social Marketing" http://en.wikipedia.org/wiki/Social_marketing (accessed June 23, 2011).

[3] McKenzie-Mohr, D. (2000). Fostering sustainable behavior through community-based social marketing. American Psychologist, 55(5), 531-537.

Similar campaigns have been very effective. The Texas Department of Transportation initiated the "Don't Mess with Texas" campaign in 1986 which was successful in reducing littering by 72% statewide.

The goal of community-based social marketing program is to create a "culture change" using social marketing and media campaign strategies. This requires efforts beyond a typical large-scale recycling campaign. Behavior change on this magnitude will require significant investment in outreach, to have a powerful impact at the beginning and to remain consistently potent over each five-year campaign. It will be essential to command the attention of the public and gradually increase their participation in the many new behaviors.

For the media and outreach campaign, the first step in this multi-year effort would be the development of a Strategic Outreach Plan to determine exactly what segments would be targeted, and identify specific messages, and tactics. The proposed strategy is to penetrate all three major aspects of each individual's life (home, work, and play) with a resource conservation message. This would not take the form of three separate campaigns, but rather an integrated lifestyle campaign. In terms of overall strategic framework, the first year would be a large-scale **Awareness** campaign, employing mostly mass media tactics with media buys. The media campaign would then shift to the **Persuasion** phase, which typically requires more hands-on, community-based work, and then revert to a media focus during the **Implementation** (how-to) phase. Finally, the **Confirmation** phase would focus on publicity for the success stories, awards ceremonies, and other positive benefits. An example of this phased approach would be as follows:

Year 1: Awareness campaign with minimal **Persuasion** (mass media-focused)

Year 2-3: Persuasion campaign with minimal decision making and **Implementation** (experiential/community-focused)

Year 4-5: Implementation campaign with minimal **Confirmation** (combination of focus on hands-on and mass media)

Year 5: Confirmation with publicity for successes, and beginning **Awareness** of the next stage; basically it becomes a circular process getting us closer to sustainable behavior (mass media-focused, again).

There is also an important role for civic leaders and elected officials, to lead by example as exemplars of the new social norms. This requires clear and consistent messages from the City Council and City management and staff to "Enable, Engage, Encourage, and Exemplify".[4]

Strategies for changing the norms of behavior include:

- Providing leadership to visibly encourage and reward successful innovation;
- Focusing financial resources on innovation, including both public and private sources;
- Using incubator models for testing and piloting innovations; and
- Establishing institutions to link small scale enterprises to larger organizations such as business

[4] *Achieving Culture Change: A Policy Framework*, David Knott with Stephen Muers and Stephen Aldridge, January 2008, http://webarchive.nationalarchives.gov.uk/20100125070726/http://cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/achieving_culture_change.pdf (accessed June 23, 2011).

and legislative bodies.

- Partnering with the business sector to engage all commercial generators in changing behaviors and improving participation.

8. Commercial Technical Assistance

Under this program, the City would provide enhanced technical assistance to commercial customers in order to encourage them to initiate or expand recycling and waste reduction practices at their place of business. The City would publicize the technical assistance program and encourage businesses to use this free service to increase recycling wherever feasible and at the same time lower their disposal costs.

The City would need to hire additional staff to work directly with commercial generators in order to assist them in setting up a recycling program tailored to their needs. Technical assistance would include conducting on-site waste assessments to identify target materials for recycling and waste reduction, providing contact information for securing recycling services, and distributing appropriate outreach materials describing best practices for setting up or expanding recycling services for different types of businesses. Technical assistance would help to minimize or overcome various obstacles to recycling faced by commercial customers (space constraints, labor and sorting requirements, lack of information or training, etc.). Technical assistance provided by the City would encourage more commercial customers to set up an effective recycling program that is suited to the customer's site, whether it be a large office complex, bar, restaurant, factory, warehouse, shopping center, small retail business or other type of commercial site.

Facilities

9. Resource Recovery Parks

Resource Recovery Parks are places where materials can be dropped off for donation or buyback and co-locate reuse, recycling and composting, processing, manufacturing, and distribution activities. Typically, these facilities are located in industrially zoned areas that are reserved for companies that process secondary materials or make products from these materials.

The Resource Recovery Park concept has been evolving naturally at landfills and transfer stations across the country. These facilities provide additional recycling opportunities for self-hauled loads. Landfills and transfer stations have been near the centers of waste generation. A Resource Recovery Park can make the landfill or transfer station more sustainable by diversifying revenue, conserving capacity, and extending the useful life of those facilities.

Resource Recovery Park are facilities open to the public that receive certain recoverable materials that typically are contained in self-hauled loads delivered by residents or businesses to a disposal site for disposal. The materials received at Resource Recovery Park are processed and marketed as recyclables, or made available for reuse/resale (either at the Resource Recovery Parks or off-site at other related reuse stores or resale facilities). At some facilities, the diversion activity takes place after the fee gate and the public is required to separate materials for recycling and reuse. If they would like to proceed directly to the disposal area, they are required to pay an extra fee. Tipping fees at Resource Recovery Park can provide a significant incentive to users. Most provide drop-off or buyback options for revenue-generating recyclables. Some charge lower rates for certain items (yard trimmings, clean fill). The Resource Recovery Park at the Cold Canyon Landfill in San Luis Obispo, California charges flat rate for all small vehicles, then an extra fee if the generator does not want to separate out materials. Cold Canyon reports that 97 percent of users elect to source-separate their materials.

Diversion levels and costs at Resource Recovery Park can vary widely depending on the extent of the diversion activities. These activities can include public area drop-off for traditional recyclables (cans, bottles, and paper), salvaging materials from the tipping area at a transfer station or landfill (large pieces of metal, cardboard or wood), diverting reusable items (furniture, building materials, and household goods), and providing retail sales on site. Some activities may be co-located at a transfer station or landfill, but others may be off-site. The concept of using off-site facilities has been described as a "serial MRF", where multiple salvage, processing, and sales activities happen in a variety of locations in close proximity that are cross-promoted.

Resource Recovery Parks provide one of the very few opportunities to divert self-hauled materials. Requiring landfills and transfer stations to provide drop-off areas for recycling and reuse is a low cost, low impact method of diverting some potentially recyclable material prior to disposal. Proper signage to direct self-haulers to the drop-off area and signs designating the materials accepted at each storage bin or off-loading area are typically sufficient to educate the public about the recycling options available at the facility. Processing self-hauled materials for recycling or providing salvage operations at landfills or transfer stations can also increase diversion, but require increased costs.

10. Mixed Materials Processing

Mixed materials processing facilities target municipal solid waste that is left-over after recycling and composting and can include residual waste from recycling and composting facilities. Mixed materials processing facilities include mixed Materials Recovery Facility (MRF), anaerobic digestion, advanced thermal recycling (waste-to-energy), and non-combustion thermal technologies, such as gasification, plasma arc gasification, and pyrolysis. These new technologies are further described in the Technology Options Technical Memorandum.

A mixed MRF, also referred to as a "dirty MRF", is a facility that processes municipal solid waste through mechanical, optical, and hand sorting to separate recyclable and compostable materials from municipal solid waste from residential and commercial sources. These facilities can also be adapted to sort or remove different materials to prepare municipal solid waste for composting, advanced thermal recycling, and other conversion technologies. Appropriate loads for processing include municipal solid waste from residential and commercial generators, and inappropriate loads for processing include concentrated amounts of C&D materials or concentrated amounts of wet materials, such as restaurant food. All of the other mixed materials processing facility types can include a mixed MRF to prepare the materials for the technology.

Anaerobic digestion is a biological process where micro-organisms break down biodegradable materials, (e.g., food and paper) in an oxygen-deficient system, creating a biogas that can be used to produce electricity or can be converted into a transportation fuel. The technology converts waste to energy using bacteria to break down waste to produce biogas. This type of biogas consists primarily of methane and carbon dioxide. These facilities process paper, compostable plastics, food scraps, and other organics. Although the first phase of the biological process (hydrolysis phase) of these facilities often operate in batch-type processes, methane generating and subsequent electrical generation phases of these facilities are designed to operate continuously and provide uninterruptible power. With a proper feedstock, these reactions can reduce the volume of waste by 70 percent, provide energy, and residuals can be sent to a compost facility.

Pyrolysis, gasification, and plasma arc gasification are all technologies used to treat waste producing a synthesis gas (“syngas”) that can be used to produce electricity or can be converted into a transportation fuel. Pyrolysis uses an indirect external source of heat in the absence of oxygen; gasification partially oxidizes the waste; and plasma arc uses a plasma torch to super-heat the waste to produce the synthesis gas. These facilities use an external heat source to heat waste to high temperatures in a low oxygen environment. This causes the waste to decompose and produce syngas. Syngas consists primarily of hydrogen, carbon monoxide, and carbon dioxide. With a proper feedstock, this process can reduce the volume of waste by 80 percent, and is intended to produce more energy than is required for processing the materials. Ideal feedstock for these facilities includes mixed paper, plastics, and other dry organics. Temperatures for treating waste using these technologies range from: 750°F to 1,650°F for pyrolysis; 1,400°F to 2,500°F for gasification; and 5,000-8,000°F for plasma arc gasification.

Gasification is used at the commercial scale for coal, and plasma arc technology is used at the commercial scale to treat hazardous and radioactive wastes. These technologies are still emerging as methods to treat municipal solid waste.

Advanced thermal recycling (waste-to-energy), uses municipal solid waste from residential or commercial generators, residual waste from other solid waste facilities, or processed (pelletized) waste known as Refuse-Derived-Fuel (RDF) to produce an uninterruptible source of energy. Waste-to-energy facilities produce energy and reduce waste volume by combusting the waste and injecting air at atmospheric pressure to reach the chemically balanced air-fuel ratio for combustion. This combustion provides energy to produce steam, which is used to turn a steam turbine that generates electricity. Exhaust air is treated to remove air pollutants to meet clean air emissions standards from the EPA and other environmental regulatory agencies. Some of the air pollutants that are monitored and treated include: mercury, lead, furans, dioxins, nitrogen oxides, sulfur oxides, particulate matter, volatile organic compounds, ozone, and methane. The amount of ash produced by waste-to-energy facilities depends on the amount of processing and the composition of waste that goes to the waste-to-energy facility. Typically, the volume of waste is reduced by 75 to 90 percent through advanced thermal technology. Highly processed, homogenous dry organic waste with low levels of glass, metal, ash, and other inerts is the most efficient feedstock, both for volume reduction and energy production. Waste-to-energy facilities should not be used for construction waste, industrial waste, ashes, and liquids.

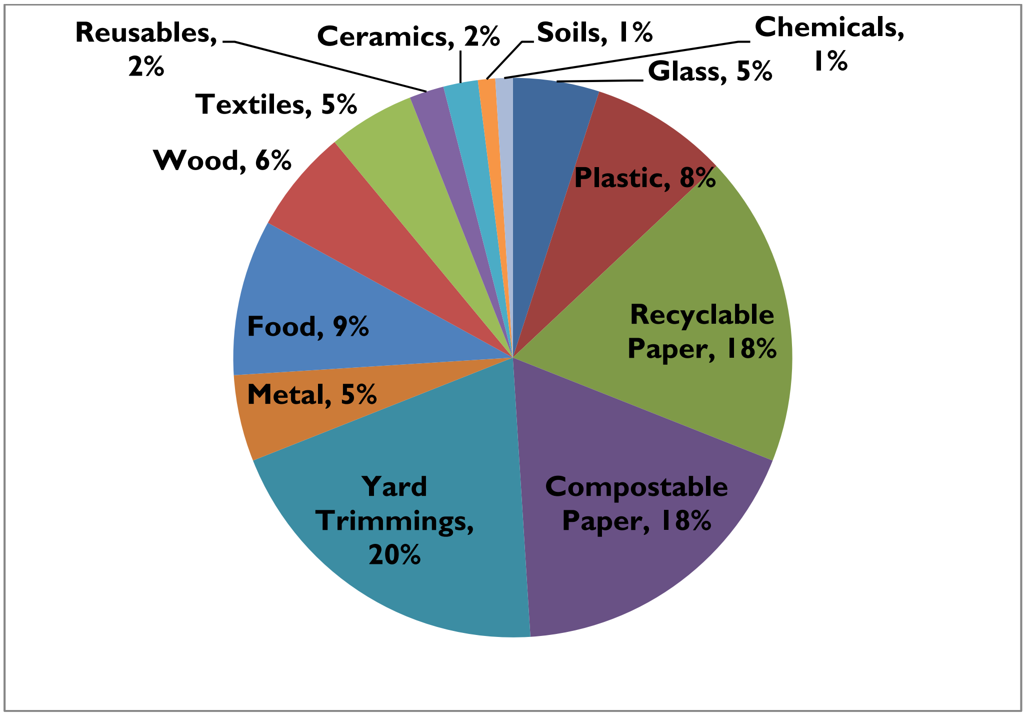
Analysis of Diversion Potential of Key Initiatives

Diversion Model

The diversion model was developed to evaluate the effects of the key initiatives on disposal and diversion throughout the City. The generation, diversion and disposal data for 2010 were used for the baseline tons and include estimates by generator type (single family, multifamily, and commercial).

The diversion model uses composition estimates published by North Central Texas Council of Governments (NCTCOG) in 2002 using data from the Texas Natural Resource Conservation Commission

Strategic Plan 2001-2005.[5] The "other" material category was divided into additional types (textiles, reusables, ceramics, soils and chemicals). The "paper" material category was further divided into "recyclable paper" and "compostable paper."



Source: *TNRCC Strategic Plan 2001-2005* with adjustments made by dividing the other category into textiles, reusables, ceramics, soils and chemicals and dividing the "paper" category into recyclable paper and compostable paper.

Through research of comparable programs and policies reasonable assumptions were developed to calculate the waste diversion associated with each option. The assumptions regarding participation and efficiency associated with each program were developed to reflect diversion potential once the program is fully implemented and has been in place for two to three years; therefore, reflecting sustainable levels of diversion potential.

Table 3 lists the participation rates and efficiency rates developed for the diversion model. "**Participation rates**" means the percentage of total generator sector tons available that are targeted by the program; "**efficiency rates**" means the percentage of the targeted tons that can be reasonably diverted by the program; and "**capture rate**" is the yield or product of the participation rate and efficiency rate which is used to estimate the net tons diverted. These participation and efficiency rates are inputs in the waste flow model and are used to calculate the net additional tons that can be diverted for each program and policy implemented. For example, if the target generator sector produces 100

[5] The Texas Natural Resource Conservation Commission (TNRCC) was the predecessor agency to the Texas Commission on Environmental Quality (TCEQ) which is the lead environmental agency within the State of Texas.

tons/year of aluminum cans, and the program has a 50 percent participation rate and 30 percent efficiency rate, then the total resulting capture rate would be 15 percent and the program would yield 15 additional tons of diversion (e.g., 100 tons available x (50% participation x 30% efficiency = 15% capture) = 15 tons).

Table 3 provides the residential policy and program assumptions for the "participation rate", "efficiency rate" and the resulting "capture rate" for each program.

Table 3 Capture Rates for Key Initiatives

Program Option	Targeted Materials	Participation	Efficiency	Capture Rate
Policies				
1. Commercial hauler requirements	Recyclable materials	20%	90%	18%
2. Mandatory source-separation requirements	Paper	100%	75%	75%
	Metal, glass	100%	80%	80%
	All other recyclable materials	75%	75%	56%
	Food scraps, compostable paper, wood	90%	30%	27%
	Yard trimmings	95%	90%	86%
3. C&D ordinance	Selected C&D materials[4]	100%	50%	50%
4. Extended producer responsibility	Plastic bags, polystyrene, household hazardous waste	80%	75%	60%
Programs				
5. Source-separated organics collection (yard trimmings, food scraps)	Yard trimmings	95%	90%	86%
	Food scraps, compostable paper, wood	30%	30%	9%
6. Bulk item reuse and recycling	Major appliances	90%	75%	68%
	Bulky items	90%	23%	21%
7. Social marketing	Recyclable materials, compostable materials, bulk items	20%	25%	5%
8. Commercial recycling technical assistance	Recyclable materials and compostable materials	15%	30%	5%
Facilities				
9. Resource recovery parks	Recyclable materials, yard trimmings, bulky items, electronics	50%	40%	20%
	Selected C&D materials	75%	50%	38%
	Major appliances	75%	100%	75%
10. Mixed materials processing	Recyclable materials, compostable materials, wood	100%	50%	50%

[1]**Recyclable materials:** Glass, Plastic, Recyclable Paper, Metal
[2]**Compostable materials:** Compostable paper, Food, Yard Trimmings
[3]**All other materials:** Textiles, Reusables, Chemicals, Wood, Ceramics (rocks, asphalt, concrete), Soils
[4]**Selected C&D Materials:** Wood, Ceramics (rocks, asphalt, concrete), Soils

Diversion Results and Greenhouse Gas Reduction Potential

Diversion Results

Based on the assumptions and calculations included in the diversion model, implementing the key initiatives will increase the citywide diversion rate to 84 percent. Table 4 summarizes the diversion estimates by generator type.

Table 4 Diversion Estimates by Generator

	Single Family	Multifamily	Commercial	Total
Diversion (tons)	575,000	539,000	1,307,000	2,421,000
Disposal (tons)	92,000	123,000	257,000	472,000
Diversion rate	86%	81%	84%	84%

Note: Figures may not sum due to rounding.
Single family diversion estimates include the current single family diversion rate of approximately 30%.

The diversion rates are presented as a snapshot in time assuming full implantation of all programs. In reality, policies and programs will be developed over time through additional research, testing, and pilot programs before the programs are fully implemented. Several policies will require new ordinances and regulations which will require City Council action and time to implement. Based on this analysis, the City can increase its diversion rate to at least 84 percent, a very high rate of diversion, by implementing the policies and programs described in this Technical Memorandum.

Greenhouse Gas Reduction Potential

The key initiatives described in this Technical Memorandum can significantly reduce the City's greenhouse gas emissions. Based on the estimated diversion rates discussed above, Table 5 presents the greenhouse gas emissions reduction potential of the scenarios using U.S. EPA Waste Reduction Model (WARM) factors to estimate greenhouse gas emissions reduction based on material types and amounts diverted.

Table 5 Greenhouse Gas Reduction Estimates by Generator

	Single Family	**Multifamily**	**Commercial**	**Total**
$MTCO_2E$[1]	(523,000)	(749,000)	(1,783,000)	(3,056,000)
Equivalent number of cars removed from the road	96,000	137,000	327,000	560,000

[1]Metric Tons of Carbon Dioxide Equivalent

The U.S. EPA created WARM to help solid waste planners and organizations track and voluntarily report greenhouse gas emissions reductions from several different waste management practices.

WARM calculates and totals greenhouse gas emissions of baseline and alternative waste management practices—source reduction, recycling, composting, and landfilling. The model calculates emissions in metric tons of carbon equivalent (MTCE), metric tons of carbon dioxide equivalent ($MTCO_2E$), and energy units (million BTU) across a wide range of material types commonly found in municipal solid waste.

City of Dallas

THE CITY OF DALLAS, TEXAS
DEPARTMENT OF SANITATION SERVICES
LOCAL SOLID WASTE MANAGEMENT PLAN

CONTRACT NO: BDZ1103

Composting Analysis
Source Separated Organics

June 22, 2011

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
Risa Weinberger & Associates, Inc.
5200 Keller Springs Road, Suite 927
Dallas, Texas 75248

Table of Contents

Compost Analysis – Source Separated Organics

List of Tables

Composting Analysis

Source Separated Organics

This analysis addresses the ability to process source separated organics at the McCommas Landfill using open windrow technology. It reflects a short-term option for the management of source separated organics. Mid-and long-term considerations are addressed only conceptually.

Feedstocks

The basis of analysis is a feedstock made up of all of the brush and yard waste projected to be collected by a modified Brush and Bulky collection system. Although there is some brush and yard waste hauled to City of Dallas facilities by private haulers, the quantity of this material is reported by the City to be insignificant at this time. Digested municipal wastewater sludge (biosolids) generated by Dallas Water Utilities is also assumed to be available. Data collected by the City of Dallas throughout 2010 on a tonnage basis were manipulated by SAIC, who reported them in a memorandum dated May 10, 2011 referencing Brush and Bulky Collection Analysis and Implementation Outline. These data, converted to a volume basis, are the basis of this analysis of composting. They reflect implementation of a new Brush and Bulky collection scheme.

Although this analysis only considers organic feedstock materials currently collected by City of Dallas forces, additional feedstocks may be available in the future. Non-hazardous, organic feedstocks suitable for composting in the future may include food residuals, selected industrial wastes and sludges, selected commercial wastes, many agricultural residuals, or any compostable materials which are currently disposed or processed at facilities other than those controlled by the City of Dallas.

The following table reflects the basis of analysis relative to feedstocks.

Table 1. Feedstocks/yr (based on 2010, modified B&B program, current generators)

COD collected brush and yard waste	82,666T	371,997 yd^3
Sludge is available at 16% solids		

Site Capacity

The City of Dallas has identified an area including all or parts of the areas designated for Cells 8 through 14, which is available for windrow composting. Although the entire area is nominally approximately 100 acres, not all of it is available for windrow composting. Some of this area is often flooded. Some of the acreage will be required for access, materials receiving and storage, grinding, mixing, curing, screening, blending, and distribution. The area readily available for windrow development is considered to be approximately 58 acres, or an area about 1500 feet wide and 1700 feet long. The most efficient use of space is with use of the largest size of windrow feasible. The following table provides data relative to site capacity and utilization.

Table 2. Site Capacity

Approximate area for windrows	58 acres (1500' X 1700')
Windrows 21' base, 7' top, 7' tall	98 ft^3/ft
Windrows 300' long	240 windrows
Site capacity in windrows	261,333 yd^3

Throughput Analysis

The following is an overview of whether the identified acreage will be adequate to accommodate an open windrow process for the identified feedstocks at current generation rates, and in the future. In order to analyze how much material that the site can handle in windrows, it is necessary to make a number of design and operational assumptions. First, the type of feedstock and the method with which it is processed has a significant bearing on the area required for the windrow process. A feedstock with a low Carbon-to-Nitrogen Ratio (C:N) will biodegrade faster, and produce a hotter windrow, than one with a higher C:N. Brush, wood and yard trimmings have a relatively high C:N, so it is assumed for this analysis that these feedstocks alone will require six months in the active windrow phase. Whereas, a feedstock mix with more biosolids, or food residuals will require much less time to biodegrade. Adding these materials to yard waste at a typical ratio of one volume of biosolids or food residual to three volumes of wood and yard trimmings is assumed to reduce the required time for active windrow processing to approximately three months. Aggressive windrow management, including effective volume reduction through turning and consolidating windrows after their volumes are reduced, also increases site capacity. The criteria used to conduct this analysis are all based on rules of thumb. Results will vary in actual practice.

The following illustrates the capacity of the site for windrowing, under assumed conditions, with and without the addition of biosolids or food residuals.

Table 3. Throughput Analysis

Scenario 1 – Without Biosolids or Food Residuals

Assumed Minimum Time in Windrow 6 months

- Approximately 71% of the site will be required for windrows for all wood, brush and yard waste currently delivered by the City of Dallas.
- Available acreage will allow just over 8 months in windrows.

Table 3. Throughput Analysis (continued)

Scenario 2 – With Biosolids or Food Residuals	
Assumed Minimum Time in Windrow	3 months
• Approximately 47% of the site will be required for windrows for all wood, brush, and yard waste currently delivered by the City of Dallas and the addition of biosolids. • Available acreage will allow just over 6 months in windrows.	

Without the addition of biosolids or food residuals, or other higher nitrogen feed stocks, it is estimated that a windrow operation will produce approximately 185,000 yd^3 of compost product per year. With the addition of higher nitrogen feedstocks, the operation is estimated to produce approximately 250,000 yd^3 of product per year. Both estimates are based on very broad operating assumptions, approximately 50% reduction by volume throughout the entire process, no recycle of process materials (screened "overs"), and no additional feedstocks beyond that currently controlled by the City. Production rates can very significantly depending on process parameters, feedstocks, and recycle rates.

Conclusions

This analysis is very general in nature, but leads to the conclusion that the site will support a large windrow composting operation. Even without the addition of nitrogen to wood and yard trimmings, the site will accommodate the entire available feedstock without additional measures to increase available acreage for windrows or to increase operating efficiencies.

The following are measures that may be considered to increase throughput capacity either to accommodate all of the feedstock currently generated, or to accommodate growth.

- Divert some wood or brush from composting directly to mulch.
- Improve more of the designated acreage for a larger windrow area.
- Intensive windrow management, including consolidating windrows at the earliest opportunity to conserve space.

Growth might be the result of increased development within the City, additional organic feedstocks diverted to composting, reduction of disposal and processing alternatives outside the City of Dallas, or aggressive feedstock marketing efforts.

Additional feedstocks that the City might consider composting, depending on market conditions and future city policies, include:

- Paper
- Food residuals from residential, commercial, and industrial sources
- Agricultural residuals
- Untreated wood from C&D waste
- High-value feedstocks generated outside the City of Dallas, such as liquids, sludges, and compostable materials from generators with sustainable goals

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

TECHNOLOGY OPTIONS
Municipal Solid Waste

Task 5A

September 2011

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
HDR Engineering, Inc.
17111 Preston Road, Ste. 200
Dallas, Texas 75248
Texas PE Firm Registration No. F-754

Table of Contents

TECHNOLOGY OPTIONS – MUNICIPAL SOLID WASTE

1.0 Introduction

As we move into the future, there will be opportunities to globally use the resources of municipal solid waste (MSW) to be transformed into useful products, such as energy, fuel and products for commercial applications such as aggregates, compost, mulch and other specific materials. The City of Dallas (City) needs to consider the realm of technology options for future solid waste infrastructure expansion to handle their materials through technology options including the new emerging technologies for treating waste prior to landfilling residues.

This section both generally defines and evaluates the MSW technology options that are either currently being developed or in some stage of operation at this time. The technology options included in this review are those that have been implemented successfully, technologies that have been tried but failed to date to successfully and/or economically handle an MSW stream on a commercial scale, those that are either in the demonstration or pilot phases and those that are currently considered theoretical. While example vendors are listed that propose particular technologies, the listed vendors are neither represented as all vendors that offer the technology. The specifics of individual vendors' technology would be considered for a more in-depth review should a specific technology be considered by the City. Technologies that are discussed in this section include thermal, biological, chemical and mechanical technologies. These include:

- Anaerobic digestion
- Aerobic composting
- Mechanical biological treatment (MBT)
- Refuse-derived fuel (RDF)
- Mass-burn combustion
- Gasification
- Plasma arc gasification
- Pyrolysis
- Hydrolysis
- Catalytic depolymerization
- Autoclaving
- Mixed waste MRF
- Combined technologies

2.0 Description of Technology Options

2.1 Anaerobic Digestion

Anaerobic digestion (AD) is typically a process in which the organic matter found in the waste stream is converted in an aqueous environment in the absence of oxygen into a combustible gas. Potential waste-derived organic feedstocks are MSW-derived organics, wastewater treatment plant bio-solids, manure, and food waste. Anaerobic digestion can take place in one or two phases. Typically, anaerobic digestion is a two-phase process in which the first phase blends into the second one without a noticeable interruption. These two phases are known as the "acid phase" and the "methane-producing phase." Generally, in a digester that is working on a continuous basis, the two phases are not noticeable since "raw" wastes are added to wastes already in the process of being broken down. However, some designs of anaerobic digestion systems purposely and physically segregate the acid phase process from that of the methane-producing stage, with the objective being an overall more efficient processing system. There are several factors that influence the design and performance of anaerobic digestion. Some of these factors include: the concentration and composition of nutrients in the feed, temperature of the digesting mass, retention time of the material in the reactor, pH, acid concentration, and oxygen level.

In the past, the material to be digested was mixed with water to reach a concentration of solids on the order of 8% to 9%. This process is known as "wet" digestion. Makeup water is required for the wet digestion process since the waste by itself does not have sufficient water content for the process. Water from the process is recovered and recycled internally as a component of the wet digestion process; however, some water is lost through evaporation and in the form of the residual moisture content of the dewatered process residue (sludge). Thus, some makeup water must be provided in the process.

During the last few years, the technology associated with anaerobic digestion of MSW **organics** has made advances. These advances have been particularly achieved in member countries of the European Union in response to the need to meet current strict regulations limiting quantities of biodegradable waste that can be disposed in landfills. As a consequence, the conventional "wet" digestion has been, in some instances, replaced by "solid state" digestion or "dry" digestion. In the process, the organic material is maintained in the reactor at solids concentrations on the order of 50% to 70%. This technology requires a different method of mixing than that employed for "wet" digestion. Additionally, the residue (digested) material from a dry digestion process is solid in character so it does not require dewatering prior to the further processing that is required to biologically stabilize the mass (e.g., composting) prior to use. As indicated in the prior paragraph, the solids remaining after wet digestion must be dewatered from the digester effluent after it is discharged so that the solids can be effectively bio-stabilized using further biological processing, such as composting.

As discussed, usually the process is applied to food and green waste, agricultural waste, sludge, or other similarly limited segments of the waste stream. The availability of suitable feedstock can be a limiting factor in development of this technology.

The end products of anaerobic digestion are: biogas, compost, and a solid or liquid residue. The biogas consists primarily of methane (60% to 70% by volume), carbon dioxide (29% to 39%), and trace amounts of hydrogen, hydrogen sulfide, and other gases. The gas produced can be used as a fuel for boilers, directly in an internal combustion engine or, in sufficient quantities, in a gas turbine to produce electricity.

Odor is a characteristic of AD. Site location and odor control are a major factor in the implementation of this technology.

Figure 1 - Anaerobic Digestion Facility, Spain

AD is widely used on a commercial-scale basis for industrial and agricultural wastes, as well as wastewater sludge. AD technology has been applied on a larger scale in Europe on mixed MSW and source separated organics (SSO), but there is only limited commercial-scale application in North America. The Greater Toronto Area is home to two of the only commercial-scale plants in North America that are designed specifically for processing SSO; the Dufferin Organic Processing Facility and the Newmarket AD Facility. There are a number of smaller facilities in the U.S. operating on either mixed MSW, SSO, or in some cases co-digested with bio-solids. However, in the US there are no large-scale commercial facilities currently operating using mixed MSW as a feedstock.

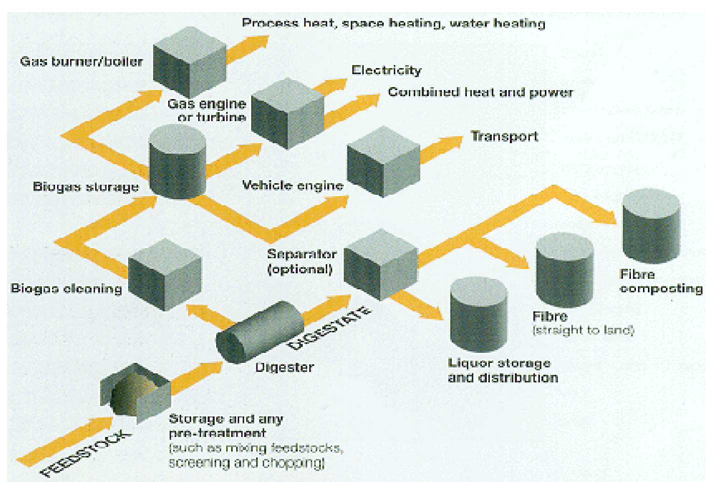


Figure 2 - Anaerobic Digestion Block Diagram

The block diagram illustrates the anaerobic digestion process. The digestion process is similar to what occurs in a landfill and can be quite malodorous. Most systems are smaller in size due to the limited feedstock. A low-Btu gas might be collected for energy recovery in a boiler, engine, or other device, or in small quantities it could be flared. The remaining residue or sludge, which can be more than

50% of the input, could be screened and used as a soil amendment.

The environmental risks include potential emissions of methane and other greenhouse gases. Minor hydrocarbon emissions can occur and result in odor complaints from neighbors. Some water might be used; however, in many cases, excess water can be discharged from the facility. Depending on the feedstock, the soil amendment product could have trace metals or other contaminants. Upon combustion of the methane NOx emissions may require control.

The primary risk associated with this technology would be the potential for odors. If feedstock other than source separated organic materials is utilized, there would be risk of difficulties with processing materials as well as performance issues associated with deleterious materials in the waste stream. This technology would be able to handle food waste or other source separated organic materials, but it would not be applicable to the entire waste stream without up-front screening and processing.

Example of Vendors: Arrow Ecology, Urbaser (Valorga International), Mustang Renewable Power Ventures, Ecocorp, Organic Waste Systems, Greenfinch and On Site Power.

A process flow diagram is provided in Figure A.1 in Appendix A.

2.2 Aerobic Composting

Aerobic composting is usually implemented through a windrow, aerated static pile or in-vessel type processes. These and other technologies for handling source separated organic materials are discussed in more detail in the Technical Memorandum, “Technology Options – Source Separated Organics”.

2.3 Mechanical Biological Treatment (MBT)

Mechanical biological treatment (MBT) is a variation on composting and materials recovery that incorporates a two-stage process of mechanical and biological treatments. During the mechanical stage the materials are sorted to remove recyclables and contaminants and then shredding or grinding takes place for size reduction of the materials prior to the biological stage. The biological stage includes either digestion or composting in an enclosed system to produce a potential bio-gas for energy production and a material that is usually utilized as a refuse-derived fuel (RDF) product as described below.

This technology is generally designed to process a fully mixed MSW stream. Materials usually derived from the process include marketable metals, glass, and other recyclables. As described, RDF is also produced that can be used for energy generation. Limited composting is used to break the MSW down and dry the fuel. The order of mechanical separating, shredding, and composting can vary. It is an effective waste-management method and can be built in various sizes. The RDF produced by an MBT process must be handled in some way: fired directly in a boiler; converted to energy via some thermal process (e.g., combustion, gasification, etc.); or selling it to a third party (e.g. Cement Kiln).

This technology has been used in Europe, including Herhof GmbH facilities in Germany. There has not been widespread commercial application of this technology in North America. The City of Toronto is currently developing a commercial-scale MBT facility.

Owing to its similarity to RDF processing and its use of composting rather than an energy recovery technology, RDF, as described below is used for further consideration.

2.4 Refuse-Derived Fuel (RDF) Processing and Combustion

2.4.1 RDF Processing

An RDF processing system prepares MSW by using shredding, screening, air classifying and other equipment to produce a fuel product for either on-site combustion, off site combustion, or use in another conversion technology that requires a prepared feedstock. As with mechanical biological treatment (MBT), the goal of this technology is to derive a better fuel (limited variations in size and composition) that can be used in a more conventional solid-fuel boiler as compared to a mass-burn boiler. The theory is that the smaller boiler and associated equipment would offset the cost of the processing equipment. The fuel goes by various names but generally is categorized as a refuse-derived fuel (RDF).

All of the post-recycling municipal waste stream can be processed by this technology with limited presorting. This same technology, perhaps with some differences such as finer shredding, is required to prepare MSW as a feedstock for other conversion technologies.

Figure 3 - RDF Processing Facility, Virginia

RDF technology is a proven technology that is used at a number of plants in the U.S., Europe and Asia (generally larger plants with capacities greater than 1,500 tons per day). There are also a number of commercial-ready technologies that convert the waste stream into a stabilized RDF pellet that can be fired in an existing coal-boiler or cement kiln. Some RDF plants within the US include facilities at Ames, IA; Southeastern Public Service Authority, VA; French Island, WI; Mid-Connecticut; Honolulu, HI; and West Palm Beach, FL.

RDF facilities can be used to address nearly the entire mixed waste stream. Facilities can range in size from several hundred ton per day to more than 3,000 ton per day. Historically, RDF facilities were large to take economic advantage of the reduced size of the combustion equipment. Recycling processes can also be built into an RDF facility; however, these mixed waste MRFs (which sort mixed MSW and recyclables) usually are limited in their productivity. Metals can usually be sorted by magnets and eddy current separators. An RDF facility strives to develop a consistently sized fuel with a relatively constant heating value relative to mass-burn incineration. These facilities can employ multiple shredding stages, large trommel screens or other types of screens for sizing, several stages of magnets, and possibly air separation and eddy current magnets. The product would typically have a nominal particle size of 3 to 4 inches, have the grit and metals largely removed, and be ready to feed into a boiler.

The complexity of an RDF facility can be quite high, since the plant attempts to produce a fuel with a consistent size, moisture and ash content. The fuel user might be dedicated and/or located onsite or nearby. It is also possible that the fuel produced could be supplied to an existing off-site boiler that can handle the RDF as a supplemental feedstock. Some existing wood or coal-fired boilers could be able to process the RDF and save on fuel costs. However, corrosion is a concern for boilers that are not designed for RDF.

Other RDF facilities can be classified as a "shred and burn" style, which shred the material and magnetically remove ferrous metals without removing fines. Some RDF facilities have converted to shred and burn through blanking the small holes in trommels. The purpose for this is to reduce the overall amount of residue (fines) landfilled.

There are several examples of RDF plants in the U.S. that use varying degrees of preprocessing and RDF production. RDF front-end processing can create challenges for the facility. Explosions can occur in the shredders, thus requiring, at a minimum, the primary shredders to be placed in explosion-resistant bunkers. Trash is very abrasive, which causes wear and tear on all components. All systems are subject to high maintenance costs and require extensive repairs and frequent cleaning to keep the facility online. Normally, processing occurs on one or two shifts with a shift reserved each day for cleaning and maintenance. Therefore, processing systems need to be sized larger than the associated boilers, and storage capacity must be provided both for incoming waste and for RDF to keep the facility running smoothly.

Full-scale commercial facilities exist in the U.S., so it is considered a demonstrated technology.

When the combustion and power generation is not collocated with the RDF processing, arrangements can be hard to establish and maintain which increases the operating risk to the RDF facility if the power plant decides to stop accepting the supplemental fuel. As an example, during site visits to Germany in March 2007, study team members observed significant RDF stockpiles.

Figure 4 - Stockpiled RDF in Rennerod, Germany

RDF facilities will have some air emissions directly from the processing as well as from the boiler. Fugitive particulates from the process must be controlled. Odors could be an issue from the processing facility. The combustion system will have similar air emission issues and similar APC equipment as mass-burn facilities. The residue from the processing could be landfilled and could be used as landfill cover material in some cases. Ash from the boiler facility would also need to be landfilled. Water will be required for the facility, and wastewater might be discharged. All of these issues can be addressed.

Examples of Vendors: Energy Answers, RRT

A process flow diagram is provided in Figure A.2 in Appendix A.

2.4.2 RDF with Stoker Firing

This technology uses a spreader stoker type boiler to combust RDF. A front-end processing system is required to produce a consistently sized feedstock as described above. The RDF is typically blown or mechanically injected into a boiler for semi-suspension firing. Combustion is completed on a traveling grate. Thermal recovery occurs in an integral waterwall boiler. Air-pollution control equipment (APC) on existing units includes good combustion practices, dry scrubbers for acid gas neutralization, carbon injection for control of mercury and complex organics (e.g., dioxins), and fabric filters for particulate removal. These facilities are capable of meeting stringent air emission requirements. New units would likely require additional Nitrogen Oxide (NOx) control such as selective non-catalytic reduction (SNCR), selective catalytic reduction (SCR) or flue gas recirculation.

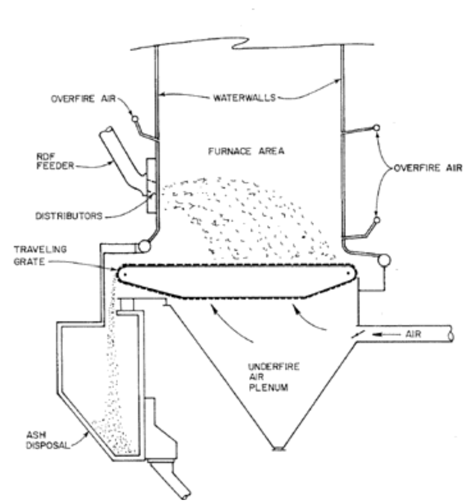


Figure 5 - Spreader Stoker Unit

This technology is used at the following facilities mentioned above: Southeastern Public Service Authority, VA; Mid-Connecticut; Honolulu, HI; and West Palm Beach, FL.

Examples of Boiler Vendors: Alstom; Babcock and Wilcox; Babcock Power

2.4.3 RDF with Fluidized Bed Combustion

This technology uses a bubbling or circulating fluidized bed of sand to combust RDF. A front-end processing system is required to produce a consistently sized feedstock. Heat is recovered in the form of steam from waterwalls of the fluidized bed unit as well as in downstream boiler convection sections. The required APC equipment is generally similar to that described above for spreader stoker units. Lime can be added directly to the fluidized bed to help control acid gases such as sulfur dioxide (SO_2). RDF may be co-fired with coal, wood (as in the case of the French Island facility shown), or other materials.

Figure 6 - Fluidized Bed RDF Combustion, Wisconsin

This technology is in limited commercial use in North America for waste applications with one operating facility at French Island, WI. Fluidized bed combustion is more commonly used today for combustion of certain other biomass materials and coal than it was at the time most of the existing RDF facilities were developed. This technology would be suitable for combustion of RDF alone or together with biomass and other combustible materials that are either suitably sized or can be processed to a suitable size.

Examples of Fluidized Bed Boiler Vendors: EPI, Von Roll Inova, Foster Wheeler, and Ebara

2.5 Mass Burn Combustion

Mass burn combustion technology can be divided into two main types: (a) grate based, waterwall boiler installations; and (b) modular, shop erected combustion units with shop fabricated waste heat recovery boilers. The modular units are typically limited to less than 200 tons per day (tpd) and are historically used in facilities where the total throughput is under 500 tpd. The larger Mass Burn Combustion process with waterwall boilers feed MSW directly into a boiler system with no

Figure 7 - Mass Burn Facility, Florida

preprocessing other than the removal of large bulky items such as furniture and white goods. The MSW is typically pushed onto a grate by a ram connected to hydraulic cylinders. Air is admitted under the grates, into the bed of material, and additional air is supplied above the grates. The resulting flue gases pass through the boiler and the sensible heat energy is recovered in the boiler tubes to generate steam. This creates three streams of material: Steam, Flue Gases and Ash. The steam is sent to a turbine generator and converted into electrical power. In the smaller modular mass burn systems, MSW is fed into a refractory lined combustor where the waste is combusted on refractory lined hearths, or within a refractory lined oscillating combustor. Typically there is no heat recovery in the refractory combustors, but rather, the flue gases exit the combustors and enter a heat recovery steam generator, or waste heat boiler, where steam is generated by the sensible heat in the flue gas, resulting in the same three streams, steam, flue gas and ash. The steam is either sent to a steam turbine to generate electricity or it can be piped directly to an end user as process steam, or a combination of these uses.

Ash residue generated will be about 30% of the incoming weight and about 10% of the volume. Ferrous and nonferrous metals can be recovered from the ash. It has been demonstrated that the combined ash can achieve the requirements to be classified as nonhazardous and can be disposed in a landfill. Often the material is used as daily cover and for other landfill uses. Some demonstration projects have shown that at least the bottom ash can be screened for use as an aggregate and used as roadbed subgrade material, formed into artificial reefs, used for mine capping, or employed for other uses. However, large-scale commercial end uses for the ash have not occurred in North America. In Europe, bottom ash is kept separate from fly ash, and all the bottom ash is typically used as aggregate.

Mass burn technologies utilize an extensive set of air pollution control (APC) devices for flue gas clean-up. The typical APC equipment used include: either selective catalytic reduction (SCR) or non-catalytic reduction (SNCR) for NOx emissions reduction; spray dryer absorbers (SDA) or scrubbers for acid gas reduction; activated carbon injection (CI) for mercury and dioxins reduction; and a fabric filter baghouse (FB) for particulate and heavy metals removal.

Water will be required for the facility and discharges will be likely without special design considerations. Discharge permit requirements will define the systems required. If needed to comply with stringent requirements, a zero discharge design could be developed.

Mass-burn technology is the most demonstrated and commercially viable of the technologies available. Projects of various sizes exist in the U.S. and throughout the world. Large-scale and modular mass-burn combustion technology is used in commercial operations at more than 80 facilities in the U.S., two in Canada, and more than 500 in Europe, as well as a number in Asia. Waste is a difficult and variable material to deal with, and the mass-burn approach minimizes the handling and processing of this material.

Examples of larger-scale grate system technology vendors: Martin GmbH, Von Roll Inova, Keppel Seghers, Steinmuller, Fisia Babcock, Volund, Takuma, and Detroit Stoker.

Examples of smaller-scale and modular mass burn combustion vendors: Enercon, Laurent Bouillet, Consutech, and Pioneer Plus.

A process flow diagram is provided in Figure A.3 in Appendix A.

2.6 Gasification

Gasification converts carbonaceous material into a synthesis gas or "syngas" composed primarily of carbon monoxide and hydrogen. This syngas can be used as a fuel to generate electricity directly in a combustion turbine, or fired in a heat recovery steam generator (HRSG) to create steam that can be used to generate electricity through a steam condensing turbine. The syngas generated can also be used as a chemical building block in the synthesis of gasoline or diesel fuel. The feedstock for most gasification technologies must be prepared from incoming MSW through shredding and pre-sorting to pull out recyclables or non-conforming materials (e.g., bulky or household hazardous waste) or the technology may only process a specific subset of waste materials such as wood waste, tires, carpet, scrap plastic, or other waste streams. Similar to Fluidized Bed Combustion, these processes typically require more front end separation and more size reduction, and result in lower fuel yields (less fuel per ton of MSW input).

The feedstock reacts in the gasifier with steam and sometimes air or oxygen at high temperatures and pressures in a reducing (oxygen-starved) environment. In addition to carbon monoxide and hydrogen, the syngas consists of water, smaller quantities of CO_2, and some methane. Processing of the syngas can be completed in an oxygen-deficient environment, or the gas generated can be partially or fully combusted in the same chamber. The low to mid British Thermal Unit (BTU) syngas content can be combusted in a boiler, gas turbine, or engine or used in chemical refining. Of these alternatives, boiler combustion is the most common, but the cycle efficiency can be improved if the gas can be processed in an engine or gas turbine, particularly if the waste heat is then used to generate steam and additional electricity in a combined cycle facility. If the gasification facility is sited near an industrial gas user, the syngas produced and be used to supplement the gas used in the industrial processes.

Figure 8 - Gasification Facility, Tokyo

Air pollution control equipment similar to that of a mass burn unit will be required if the syngas is used directly in a boiler. If the syngas is conditioned for use elsewhere, the conditioning equipment will need to address acid gases, mercury, tars and particulates.

Gasification has been proven to work on select waste streams, particularly wood wastes. Gasification of wood has been practiced successfully on a large scale since

World War II, and coal gasification is receiving a lot of attention right now. However, the technology does not have a lot of commercial-scale success using mixed MSW when attempted in the U.S. and Europe. At least two large commercial-scale gasification systems were developed and built in Germany. Operational problems have resulted in the shutdown and closure of the facilities. No other more recent attempts at commercialization have been made in Europe. Japan has several operating commercial-scale gasification facilities that claim to process at least some MSW. In Japan, one goal of the process is to generate a vitrified ash product to limit the amount of material having to be diverted to scarce landfills. In addition, many university-size research and development units have been built and operated on an experimental basis in North America and abroad.

Gasification and pyrolysis are somewhat similar technologies. Gasification technology generally involves higher operating temperatures. Gasification technology has been in development in a number of locations in the U.S. and around the world. Generally, the process and physical design of the units require a prepared fuel with much of the inert materials (glass, metals, etc.) removed and the remaining material sized to the requirements of the unit. The technology can process nearly the entire post-recycled waste stream.

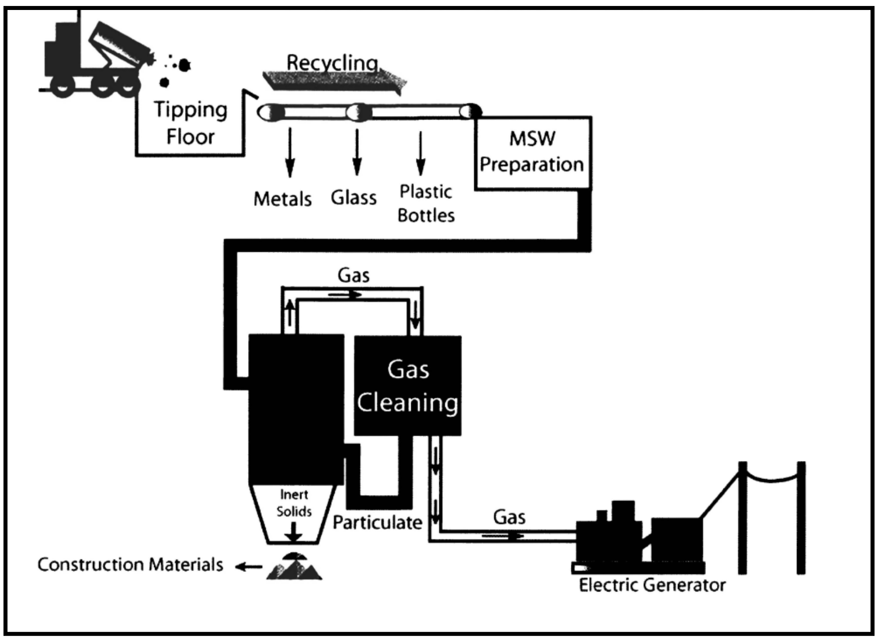


Figure 9- Gasification Block Diagram

Economically, units have not fared well. For mixed waste, if significant preprocessing is required, the capital and operating cost for the front-end equipment drives up the facility cost. Generally efficiency and availability have been lower than for some other technologies. If the facility is designed to handle only limited waste stream products, the size of the facility is limited, which makes economics harder to achieve.

Facilities will have some of the same air emissions issues as mass-burn facilities. Units that heat the feedstock in an oxygen-deficient environment would produce less NOx. Mercury would be expected to be largely driven off with the gas and would have to be dealt with from the exhaust of the gas combustion device. Other metals would likely remain with the char.

Some water will be required for the facility, and wastewater could be discharged. Odors could be an issue from the processing facility and residue will need to be addressed. The residue from the processing could be landfilled and could be used as landfill cover material in some cases. Ash remaining after combusting the char from the boiler facility would also need to be landfilled.

Examples of gasification vendors: Ebara, Thermoselect, Primenergy, Brightstar Environmental, Energos, Taylor Biomass Energy, SilvaGas, Technip, Compact Power, PKA, and New Planet Energy.

A process flow diagram is provided in Figure A.7 in Appendix A.

2.7 Plasma Arc Gasification

Figure 10 - Plasma Arc Gasification, Ottawa

Plasma arc technology uses carbon electrodes to produce a very-high-temperature arc ranging between 3,000 to 7,000 degrees Celsius that "vaporizes" the feedstock. The high-energy electric arc that is struck between the two carbon electrodes creates a high temperature ionized gas (or "plasma"). The intense heat of the plasma breaks the MSW and the other organic materials fed to the reaction chamber into basic elemental compounds. The inorganic fractions (glass, metals, etc.) of the MSW stream are melted to form a liquid slag material which when cooled and hardened encapsulates toxic metals. The ash material forms an inert glass-like slag material that may be marketable as a construction aggregate. Recyclable and contaminated materials can be recovered through a pre-processing system. Metals can be recovered from both feedstock pre-processing and from the post-processing slag material.

Plasma arc processing uses graphite electrodes to cause an electrical arc through the feedstock. The temperature within the arc is often stated to be hotter than the surface of the sun. In such an environment, the feedstock gasifies. A low-Btu gas is generated that could, with some cleanup, be suitable for use in a gas turbine, engine, or boiler as a fuel source. The remaining ash and metal will liquefy, forming a slag-and-metal mixture. The slag can then be separated from the metal when it is removed from the arc vessel.

Generally the gasification process and physical design of the units require a prepared fuel to remove much of the larger, inert materials (glass, metals, etc.) and the remaining material to be sized to the requirements of the unit. Other units might allow waste to be charged without much preprocessing. The technology can process nearly all the post-recycled waste stream.

Similar to gasification and pyrolysis (described below) processes, the MSW feedstock is pre-processed to remove bulky waste and other undesirable materials, and usually shredded for size reduction. Plasma technology also produces a syngas; this fuel can be combusted and the heat recovered in a HRSG, or the syngas can be cleaned and combusted directly in an internal combustion engine or gas turbine. Electricity and/or thermal energy (i.e. steam, hot water) can be produced by this technology. Vendors of this technology claim efficiencies that are comparable to conventional mass burn technologies (600-700+ kWh/ton (net)). Some vendors are claiming even higher efficiencies (900-1,200 kWh/ton (net)). These higher efficiencies may be feasible if a combined cycle power system is proposed. However, the electricity required to generate the plasma arc, as well as the other auxiliary systems required, brings into question the amount of parasitic electrical load required.

This technology claims to achieve lower harmful emissions than more conventional technologies, like mass burn and RDF processes. However, APC equipment similar to other technologies would still be required for the clean-up of the syngas or other off-gases. This is due to the facilities generally having similar air emissions issues as other gasification or mass-burn facilities. Mercury and some other more volatile metals are expected be driven off with the gas and would have to be dealt with from the exhaust of the gas combustion device. Other metals will melt, and the ash will become a liquid slag material. The metals might be recoverable and the slag solidified into a glasslike material. Some water will be required for the facility, and wastewater might have to be discharged.

Plasma technology has received considerable attention recently, and there are several large-scale projects being planned in North America (e.g. Saint Lucie County, Florida; Atlantic County, New Jersey). In addition, there are a number of demonstration facilities in North America, including the Plasco Energy Facility in Ottawa, Ontario and the Alter NRG demonstration facility in Madison, Pennsylvania and PyroGenesis Canada, Inc., which also has a demonstration unit (approximately 10 tpd) located on Hurlburt Air Force Base in Florida that has been in various stages of start-up since 2010.

No operating facilities exist in North America. A project in Ottawa has been in extended startup for several years. Facilities operate in Japan, most notably three developed by Hitachi Metals, in Yoshii, Utashinai, and Mihama-Mikata. These facilities are referred to as plasma direct melting reactors. This is significant owing to the desire in Japan to vitrify ash from mass burn waste to energy facilities. Many gasification facilities in Japan accept ash from conventional WTE facilities for vitrification. The facilities are in many cases intended as ash vitrification facilities rather than energy recovery facilities. The benefit of the vitrified ash is to bind potentially hazardous elements thereby rendering the ash inert.

According to an October 2002 presentation by the Westinghouse Plasma Corporation to the Electric Power Generating Association, the Yoshii facility accepts 24 tons per day of unprocessed MSW together with 4% coke and produces 100 kWh of electricity per ton of MSW. The facility also produces steam for a hotel/resort use. This facility started operation in 2000. According to the same presentation, the Utashinai facility processes 170 tpd of MSW and automobile shredder residue (ASR) together with 4% coke and produces 260 kWh/ton. This is less than half the energy production that would be expected of a mass burn WTE facility.

The technology should be capable of handling the entire waste stream with required processing depending on the fuel feed system requirements.

Examples of Plasma Arc vendors: Startech, Geoplasma, PyroGenesis Canada, Inc., Westinghouse, Alter NRG, Plasco Energy, and Coronal.

2.8 Pyrolysis

Pyrolysis is generally defined as the process of heating MSW in an oxygen-deficient environment to produce a combustible gaseous or liquid product and a carbon-rich solid residue. This is similar to what is done to produce coke from coal or charcoal from wood. The feedstock can be the entire municipal waste stream, but, in some cases, pre-sorting or processing is used to obtain a refuse-derived fuel. Some modular combustors use a two-stage combustion process in which the first chamber operates in a low-oxygen environment and the combustion is completed in the second chamber. Similar to gasification, the gas or liquid derived from the process can be used in an internal combustion engine or gas turbine or as a feedstock for chemical production. Generally, pyrolysis occurs at a lower temperature than gasification, although the basic processes are similar.

Figure 11 - Pyrolysis, California

Historically, a few large-scale facilities were built in the U.S. and had mechanical and other problems when processing mixed waste. Of particular note were large-scale pyrolysis plants built near Baltimore and San Diego. They were scaled up from pilot projects and were never able to function at a commercial level. Several other projects were also completed but none have proved to be economically viable. In Germany, at least one pyrolysis facility is operating. It was built in the mid-1980s and appears to still be operating today. It is a relatively low capacity facility and has not been replicated on a larger scale. At least one other larger-scale project was attempted in the mid-

1990s in Germany using another technology, but operational problems forced its closure after a short time.

Pyrolysis has also been attempted to process specific waste components such as shredded wood or used tires. Pyrolysis systems have had some success with wood waste feedstocks. A high-carbon-content char and a low-energy gas or a liquid fuel is produced. Formation of charcoal from wood or coke from coal is a pyrolytic process. Normally, the process is completed in an oxygen-deficient environment to limit the combustion of the feedstock and maximize the fuel generation. A larger quantity of residue remains for pyrolysis than for other thermal processes. The char could conceivable be recovered and combusted or used for other purposes.

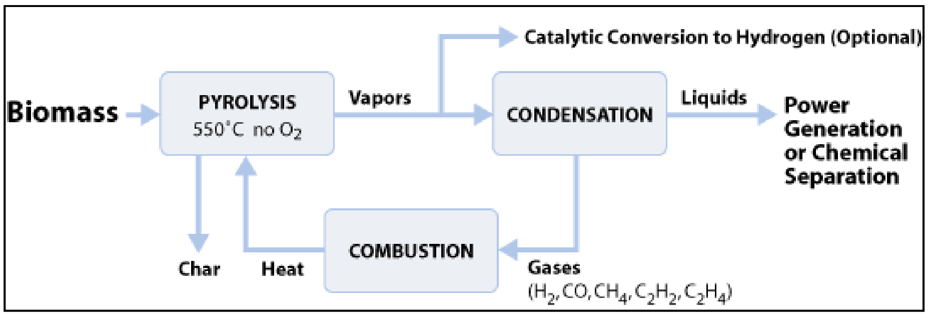


Figure 12 - Pyrolysis Block Diagram

Facilities using the pyrolytic oil and other products as fuel could have some of the same air emissions issues as mass-burn facilities. Less SO_2 might be generated in the gas or oil, because most of the sulfur is expected to stay with the char. However, if the char is combusted, the sulfur could be released. Units that heat the feedstock in an oxygen-deficient environment would produce less NOx. Mercury would be expected to be largely driven off with the gas and would have to be dealt with from the exhaust of the gas combustion device. Other metals could remain with the char and could largely be separated from the char prior to combustion with a suitable processing system.

Some water will be required for the facility, and wastewater might be discharged. Odors could be an issue from the processing facility. Residue will need to be addressed. The residue from the processing could be landfilled and could be used as landfill cover material in some cases. Ash remaining after combusting the char from the boiler facility would also need to be landfilled after demonstrating nonhazardous properties.

Examples of pyrolysis vendors: Brightstar Environmental, Mitsui, Compact Power, PKA, Thide Environmental, WasteGen UK, International Environmental Solutions (IES), SMUDA Technologies (plastics only), and Utah Valley Energy.

A process flow diagram is provided in Figure A.6 in Appendix A.

2.9 Hydrolysis

There is much interest and development in the area of cellulosic ethanol technology to move from corn based ethanol production to the use of more abundant cellulosic materials. Applying these technologies to waste materials using hydrolysis is part of that development.

The hydrolysis process involves the reaction of the water and cellulose fractions in the MSW feedstock (e.g., paper, food waste, yard waste, etc.) with a strong acid (e.g., sulfuric acid) to produce sugars. In the next process step, these sugars are fermented to produce an organic alcohol. This alcohol is then distilled to produce a fuel-grade ethanol solution. Hydrolysis is a multi-step process that includes four major steps: Pre-treatment; Hydrolysis; Fermentation; and Distillation. The pre-treatment step includes separation of the MSW stream as necessary to remove the inorganic/inert materials (glass, plastic, metal, etc.) from the organic materials (food waste, yard waste, paper, etc.). The organic material is shredded to reduce the size and to make the feedstock more homogenous. The hydrolysis step places the shredded organic material into a reactor where it is introduced to the acid catalyst, with the cellulose in the organic material converted into simple sugars as discussed above. The fermentation step utilizes these sugars to be fermented and converted into an organic alcohol. The distillation step takes the organic alcohol and distills it into fuel-grade ethanol. The byproducts from this process are carbon dioxide (from the fermentation step), gypsum (from the hydrolysis step) and lignin (non-cellulose material from the hydrolysis step). Since the acid acts only as a catalyst, it can be extracted and recycled back into the process.

Like Catalytic Depolymerization, hydrolysis will address only a portion of the total waste stream. This process would use the cellulose-rich portion of the waste. Few demonstration projects and tests have been completed, and those that have were focused on the use of corn stover and other biomass materials for ethanol production. Tests with mixed waste or even paper feedstock have been limited, and therefore cost information is limited. No known commercial facilities are in operation with mixed waste as a feedstock.

Similarly, the environmental risks are not well defined. In addition to the environmental risks of any associated technology, there would be some emissions risks related to methane emissions or issues dealing with potential chemical spills. It is expected that significant quantities of water and wastewater use would be required.

There have been some demonstration and pilot-scale hydrolysis applications completed using mixed MSW and other select waste streams. However, there has been no widespread commercial application of this technology in North America or abroad. A commercial-scale hydrolysis facility has been permitted for construction in Monroe, New York in the U.S., but this project is currently on-hold.

Examples of hydrolysis vendors: Masada OxyNol, Bluefire Ethanol, Biofine and, Arkenol Fuels.

A process flow diagram is provided in Figure A.5 in Appendix A.

2.10 Catalytic Depolymerization

Figure 13 – Catalytic Depolymerization, Spain
Feedstock: Unknown

In a catalytic depolymerization process, the plastics, synthetic-fiber components and water in the MSW feedstock react with a catalyst under non-atmospheric pressure and temperatures to produce a crude oil. This crude oil can then be distilled to produce a synthetic gasoline or fuel-grade diesel. There are four major steps in a catalytic depolymerization process: Pre-processing, Process Fluid Upgrading, Catalytic Reaction, and Separation and Distillation. The Pre-processing step is very similar to the RDF process where the MSW feedstock is separated into process residue, metals and RDF. This process typically requires additional processing to produce a much smaller particle size with less contamination. The next step in the process is preparing this RDF. The RDF is mixed with water and a carrier oil (hydraulic oil) to create a sludge-type material. This sludge is sent through a catalytic turbine where the catalytic reaction under high temperature and pressure produces a light oil. The light oil is then distilled to separate the synthetic gasoline or diesel oil.

This catalytic depolymerization process is somewhat similar to that used at an oil refinery to convert crude oil into usable products. This technology is most effective with processing a waste stream with a high plastics content and may not be suitable for a mixed MSW stream. The need for a high-plastics-content feedstock also limits the size of the facility.

There are no large-scale commercial catalytic depolymerization facilities operating in North America that use a purely mixed MSW stream as a feedstock. There are some facilities in Europe and one in Mexico that utilize this or a similar process to convert waste plastics, waste oils, and other select feedstocks. One vendor claims to have a commercial-scale facility in Spain that has been in operation since the second half of 2009. However, operating data (including feedstock used) or an update on the status of this facility could not be obtained.

Catalytic depolymerization has been proposed in some locations for select portions of the waste stream with concentrated plastics content. It might be most effectively applied at a very large plastics manufacturing facility or similar industry that can become the source of the feedstock. Because such arrangements are very rare, limited interest in this technology has developed. Some vendors claim that oil products could be produced. This process would be able to address a small percentage of the waste stream – the plastics, which would have to be segregated.

In addition, the environmental risks are not well defined. In addition to the environmental risks of any similar technology, catalytic cracking could emit some hydrocarbons from the process. There could also be some other risks resulting from the handling of the catalysts or solvents and related compounds that might be required for the process. Water and wastewater use is not known.

There are also technology vendors that utilize a process that is thermal in nature (e.g., gasification, pyrolysis) to convert the MSW stream to a syngas that is further treated by a chemical process, such as depolymerization or an associated refining process (e.g., Fischer Tropsch synthesis), to generate a synthetic gasoline or diesel fuel. The City of Edmonton project in Alberta, Canada that uses the Enerkem technology is an example of a commercial-scale facility that will use such a process. The City of Edmonton has conducted some pilot testing, and the commercial-scale project is currently in construction (scheduled to be operational by 2012).

Examples of catalytic depolymerization-type vendors: ConFuel K2, AlphaKat/KDV, Enerkem, Changing World Technologies, and Green Power Inc.

A process flow diagram is provided in Figure A.4 in Appendix A.

2.11 Autoclaving

Autoclaving is classified as a "mechanical" process that uses heat and pressure in a mechanical rotating cylinder to separate the cellulosic material from other portions of the municipal solid waste stream. The basic autoclave technology has been in use for sterilization of hospital wastes and equipment and other related applications for many years.

Figure 14 – Autoclaving, California

Like anaerobic digestion, autoclaving addresses only a portion of the waste stream, namely the cellulose-fiber-containing portion, which is usually 40% to 50% of the total MSW input stream. However, this technology can also be used as a "front-end" to many of the other emerging technologies such as hydrolysis for production of a fuel product, gasification or pyrolysis for energy generation, anaerobic digestion for energy and compost production, or for fiber recovery for the pulp/paper industry. A trommel screen is usually utilized after autoclaving to separate out the various mixes of fibrous organic materials produced from autoclaving and other materials (i.e., fine organics stream, bulky organics stream, and overs, such as recyclable glass, metals and plastics). If the goal for the autoclaving technology is recovery for paper production, because the fibers are of such a mixed grade, the main product that can be produced is a lower-grade cardboard.

Autoclaves are large rotating vessels that have steam injected and kept at a certain temperature and pressure over a 2 to 3 hour period to convert the MSW. Autoclaves are currently operating in batch mode accepting from approximately 1 to 25 tons per batch (2-3 hour).

All of the demonstration projects have been completed on a fairly small scale (less than 300 tpd) on different feedstocks besides MSW.   No known commercial operation exists at this time in the U.S. or elsewhere for processing MSW.

HDR general conclusions on autoclave process are:

- Potential for over 60% reduction in waste volume
- Cellulose recovery has potential to be used as feedstock for
    - Paper production
    - Ethanol production feedstock
    - Compost feedstock
    - Digester feedstock for methane production
- If and when proven viable on the commercial level, autoclaving can be an important part of sustainable waste management system.

2.12 Mixed Waste Materials Recovery Facility (MRF)

There are a number of types of materials recovery facilities (MRFs) in the US and internationally. Most can be classified into two groups, 1) those that accept source separated recyclables, sometimes referred to "clean" MRFs, as currently used in the City and 2) those that take the residual or black bin waste (mixed solid waste) and process these materials to recover recyclables and reusable materials leaving the residual waste for landfill, or another appropriate waste reduction applications. This section describes the latter technology, a MRF that handles mixed solid waste materials.

The MRF process begins with mixed solid waste from residential and commercial collection vehicles being off-loaded onto a tipping floor. Materials are first sorted on the floor using manual labor and mobile equipment to remove larger or bulky items such as appliances, dimensional wood, metal, or large pieces of plastics that might clog or interrupt operations of the processing system. Loaders or grapples then load a conveyor or surge hopper to convey the material to the sort lines and mechanical equipment for landfill diversion separation. In most cases either a mechanical device or manual labor is used to open bags and containers prior to screening and sorting. Material is usually processed through multi-stage screens to separate fiber (OCC, ONP, and mixed paper), containers, and small contaminants. This is usually accomplished through the use of mechanical or pneumatic screening equipment to separate materials into size classifications and/or light versus heavier materials. Fiber is usually hand sorted off elevated conveyor platforms into commodities and dropped into bunkers below. Containers are processed through ferrous magnets, eddy-current magnets, air screens and hand sorting. The small contaminant stream (dirt, rocks, broken glass and ceramics, bottle caps, etc.) may be further processed by optical/pneumatic sorting. Sorted material is moved from bunkers and baled (fiber, plastic, metal) or loaded directly into roll-off trucks (glass). The remaining material is shipped to a local landfill. Sometimes these materials are shipped to composting facilities with multiple and fine screening processes to remove contaminants.

The main purpose of this type of MRF is to removes recyclable material from mixed municipal solid waste. Commodities that are removed are usually stored in boxes or bunkers and then baled or consolidated and sold and shipped to markets. These types of facilities usually recover about 10% to 20% (about 15% on average); although some facilities have reported recovery above these figures.

Usually the residual from this process are in the form of garbage, food scraps, yard trimmings, electronic waste, hazardous waste, wood, dirt and other inert materials.

Most of the useable products from this process are in the form of traditional recyclables (OCC, ONP, mixed paper, aluminum cans, metal cans, HDPE, PET, mixed plastics, glass bottles, etc.) and alternative daily cover (ADC) for landfills.

Examples of equipment vendors: CP Manufacturing, Bulk Handling Systems, Krause Manufacturing, Harris, IPS, Ptarmigen

2.13 Combined Technologies

Gasification systems have been proposed to be combined with other technologies to attempt to produce a liquid fuel. The Enerkem Alberta Biofuels project in Calgary proposes to use gasification followed by catalytic synthesis of the syngas to produce ethanol. A gasification facility proposed by Interstate Waste Technologies (IWT) in Taunton, Massachusetts that ran into approval difficulties owing to a statewide incineration ban had also proposed converting the syngas to ethanol.   There are facilities that would be considered demonstration facilities because the technology has not previously been proven commercially on a municipal solid waste feedstock.

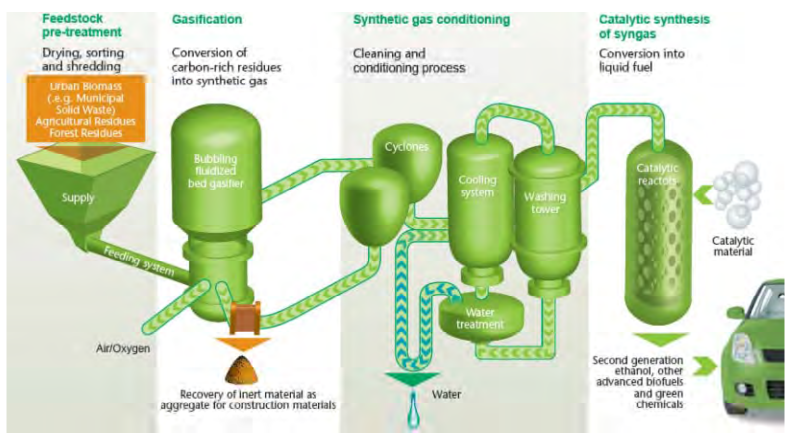


Figure 15 – Gasification & Catalytic Synthesis, Alberta

Source: www.enerkem.com

Vendors: Enerkem, IWT

In addition, autoclaving is being looked as the front-end of several combined technology processes. In Salinas, California the Waste Authority has looked first autoclaving the waste materials and then using the fiber in a paper mill or conversion into a fuel product and gasification of the residuals materials.

3.0 Summary of Technology Options

The technologies discussed in Section 2.0 cover a wide spectrum of waste-processing approaches. The state of development of technologies being considered varies widely. One technology is in commercial operation using MSW as a feedstock in numerous facilities worldwide. Another is in limited commercial operation using supplemented MSW as a feedstock in Japan. A third is in operation using a selected portion of the MSW waste stream at a few commercial installations in Europe. Others have demonstration and/or pilot facilities in operation or development using MSW as a feedstock. Some have prototype facilities under construction. Some have yet to be developed commercially. Each of the technologies poses environmental considerations. Each of the technologies presents a different risk profile. These differences will be tabulated for comparison.

The certainty associated with estimating capital and operating costs is limited with the less developed technologies. The economics from both a capital and operating costs vary between the technology options.

Table 1 below presents a summary of the various technology options and certain critical criteria.

Table 1- Summary of Technology Options

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
Anaerobic digestion	Proven for select Waste Stream	Odor is primary concern. Can be addressed.	Limited based on composition of the waste received; needs to be purely organic materials	At this time can only address source separated organic materials	High
Aerobic Composting	Proven for select Waste Stream	Odor is primary concern. Can be addressed.	Limited based on feedstock and can be sited appropriately to avoid odors to nearby residents	Needs source separated organic feedstock	Low

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
RDF processing and combustion	Commercially proven	Emissions primary concern. APC equipment can meet standards.	Limited if combustion is located with processing.	Can take entire waste stream if prepared properly	High
Mass burn combustion	Commercially proven	Emissions are primary concern. APC equipment can meet standards.	Limited	Can take entire waste stream if prepared properly	High
Gasification	Limited commercial operation in Japan and Europe	Emissions are primary concern. APC equipment can meet standards.	Some operability and economic risk	Can take entire waste stream if prepared properly	High
Plasma Arc Gasification	Limited commercial operation in Japan	Emissions are primary concern. APC equipment can meet standards.	Some operability and economic risk	Can take entire waste stream or appropriate portions if prepared properly	High
Pyrolysis	Limited commercial development	Emissions are primary concern. APC equipment can meet standards.	High risk due to limited experience on MSW	Can take entire waste stream if prepared properly.	High
Hydrolysis	No known commercial facilities are in operation using mixed waste	Not well defined	High risk due to limited experience on MSW	Needs source separation of the cellulosic portion of the waste stream	Unknown
Catalytic Depolymerization	Laboratory scale using select materials	Not well defined	High risk due to limited experience on MSW	Needs source separation of the plastics & similar materials	Unknown
Thermal Depolymerization	Demonstration/Pilot scale using select materials	Not well defined	Medium to high risk due to limited experience on MSW; requires higher energy input than catalytic depolymerization	Needs source separation of the feedstock materials	Unknown

Technology	State of Development	Environmental Considerations	Risk	Applicability to the waste stream	Relative Cost (High, Medium & Low)
Autoclaving	Limited development using MSW as feedstock; more proven when using other homogeneous or organic feedstocks	Some minor emissions from autoclaving process; controls can mitigate these concerns	High risk due to limited experience on MSW ant at commercial levels needed	Works best on source separated materials; some testing done with MSW	Medium
Mixed Waste MRF	Commercially proven	Minor emissions from mobile equipment	Very limited	Can take entire waste stream	Medium

3.1 Summary

From the list of the many technology options described above, the current feasibility of each option for the City of Dallas whether through technology, environmental, risk or economic viability was assessed. Those technologies that do not appear that the City should consider for implementation at this time due mainly to economic or technical viability include: Anaerobic digestion, RDF processing and combusting, Mass burn combustion, Gasification, Plasma arc gasification, Pyrolysis, Hydrolysis, Autoclaving, and Catalytic depolymerization. As these technologies could become increasingly feasible in the future, the City should monitor the progress of each technology at least every five (5) years. If there has been one or more of these technologies that have significantly advanced within the five year monitoring period (through cost decreases and technical viability), the City should conduct a feasibility review to understand if it suits the City of Dallas.

Through vendors or other cities and sources, the City may have become aware of some of these technologies discussed above that do not appear to be currently feasible for implementation by the City. These technologies are of interest in other communities because of several reasons: no landfill space available, no other diversion opportunities available, high water tables (unsuitable for landfills) such as in areas of Florida, and tip rates for disposal very high and close in comparison to these technologies.

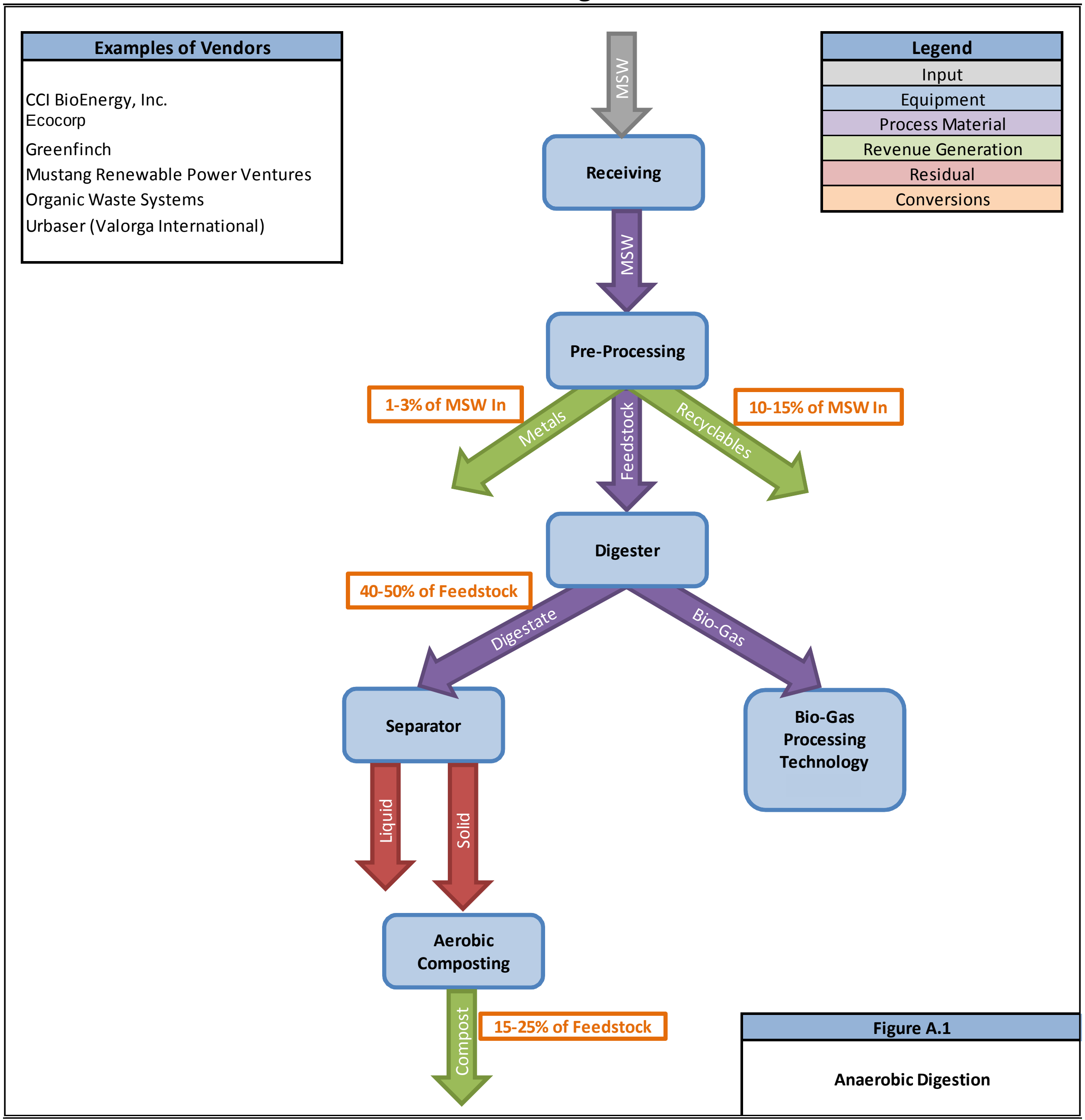
The technologies that appear to be most suitable at this time for consideration include: aerobic composting, anaerobic digestion, a mixed waste materials recovery facility (MRF) and continuing with landfilling and the current system of landfill gas-to-energy recovery.

Estimated costs for the most feasible technology options discussed above are as follows:

- **Aerobic Composting** – This will be handled in a separate memorandum.
- **Mixed Waste MRF** – This type of facility would include an enclosed building that receives mixed waste, separates the bulky and potentially hazardous materials from the rest of the materials received on the tipping floor and then conveys the remaining materials through a sorting process that includes both manual and mechanical recovery processes. The mechanical equipment should include screens and pneumatic separation, ferrous magnets and eddy current systems to recover metals, balers and other equipment as needed. The manual labor can sort out fibrous materials such as papers and cardboard and glass as required. The facility would be designed to handle waste at an infeed rate of approximately 500 tons per day (tpd). The capital cost is estimated to be approximately $25 to $50 million with the overall net tipping fee approximately (including amortization of the capital and netting out materials sales) $35 to $60 per ton.

Appendix A – Process Flow Diagrams

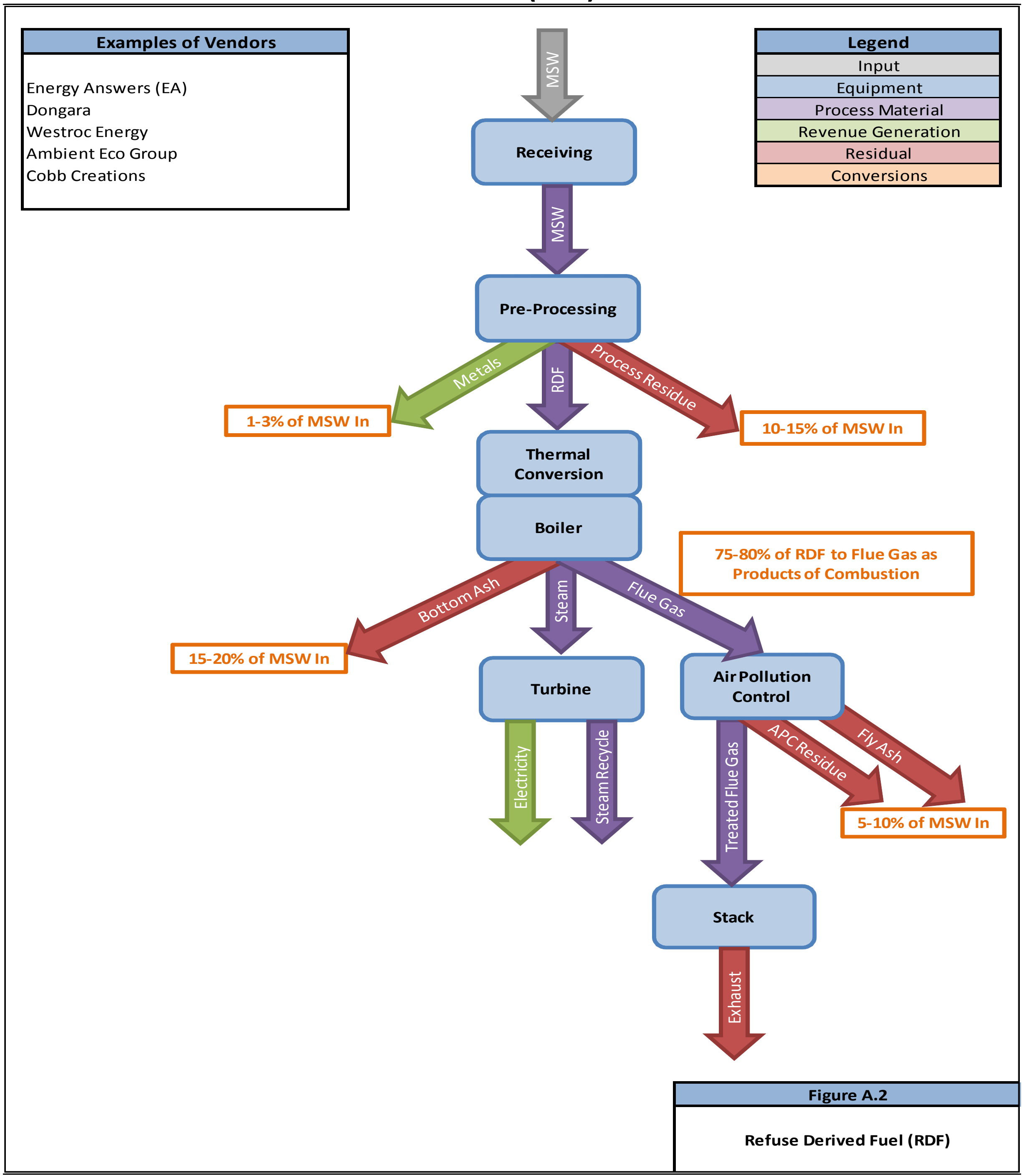
Anaerobic Digestion



Description:

Anaerobic digestion (or AD) is the process of decomposing the solid organic fraction of the MSW stream in an oxygen-deficient environment. It has been extensively used to digest and stabilize sewage sludge and animal manures, and has had recent application treating Sanitary Sewer Overflow (or SSO). The AD process may either be a wet or dry process depending on the total solids content being treated in the reaction vessel. Both types of AD processes involve the injection of the organic material into an enclosed vessel where microbes are used to decompose the waste to produce a liquid, a solid digestate material, and a biogas that consists mainly of methane, water, and carbon dioxide (CO_2). The resulting low- to mid-energy-content biogas can be utilized in a reciprocating engine or gas turbine to produce electricity, or can be compressed into a vehicle fuel. The remaining digestate material, which can be up to 50 % of the input depending on the type of AD process used, can be treated further (e.g. cured aerobically) to produce a compost that can be marketed as a soil amendment. The incoming mixed MSW or SSO will require a pre-treatment process that involves shredding, pulping and separation of the non-digestible fraction of the waste stream. In many cases, this technology can be used in conjunction with composting, mechanical biological treatment (MBT), or a refuse-derived fuel (RDF) process.

Refuse Derived Fuel (RDF) Combustion



Description:

This technology prepares MSW by shredding, screening, and removing non-combustible materials prior to additional processing. The goal of this technology is to derive a better, more homogenous, Refuse Derived Fuel (or RDF) that can be used in a more conventional solid-fuel boiler as compared to a mass-burn combustion waterwall boiler. The RDF process typically results in a fuel yield in the 80% to 90% range (i.e., 80 to 90 percent of the incoming MSW is converted to RDF). The remaining 10% to 20% of the incoming waste that is not converted to RDF is composed of either recovered ferrous metals (1-5%) which can be sold to market, or process residue (15% to 19%) that must be disposed of in a landfill. In most cases, the fuel is used at the same facility where it is processed, although this does not have to be the case. The RDF is blown or fed into a boiler for semi-suspension firing. Combustion is completed on a traveling grate. Thermal recovery occurs in an integral boiler. The APC equipment arrangement for an RDF facility would be similar to that of a mass-burn combustion system.

Traditional Mass Burn Combustion

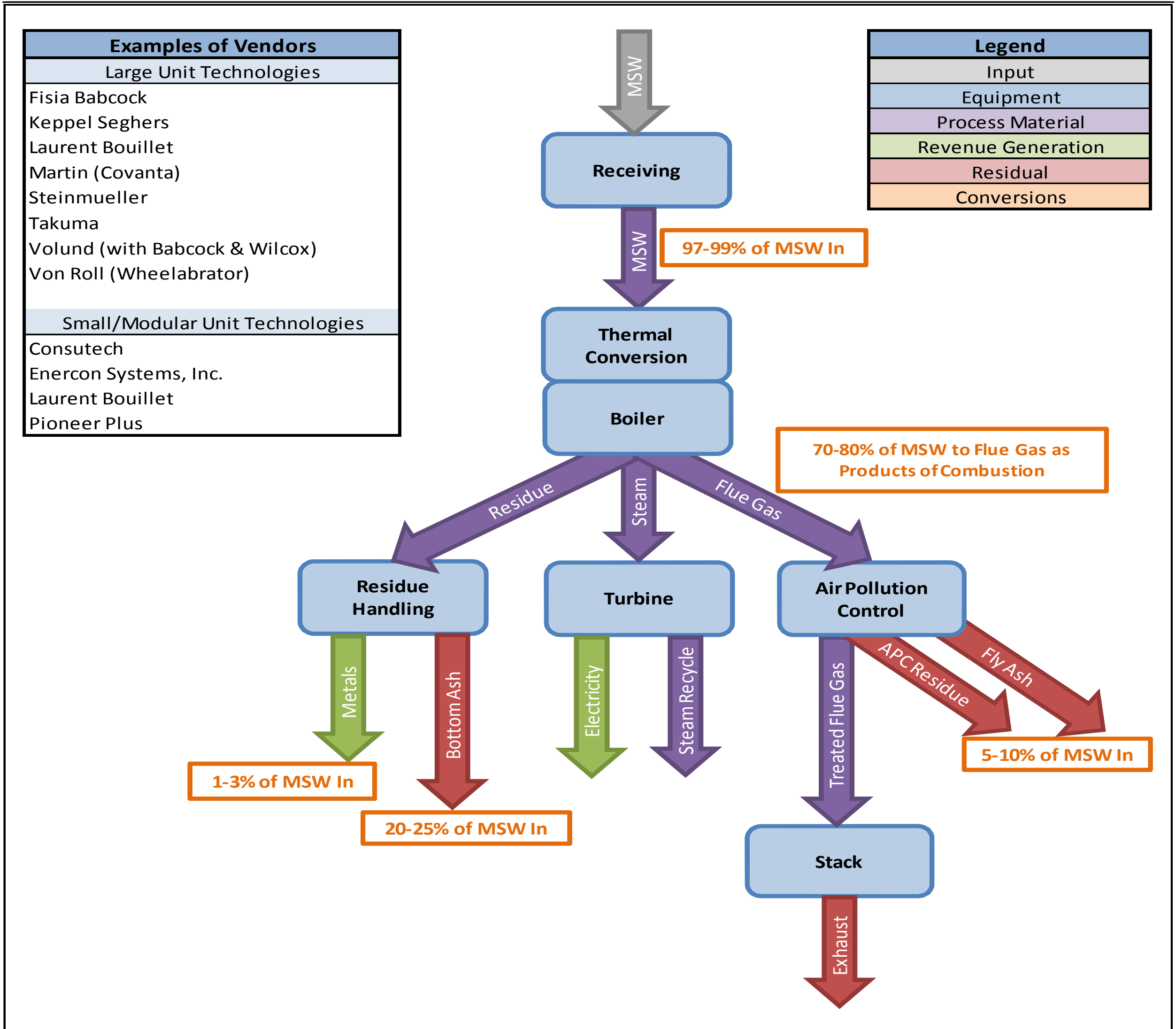


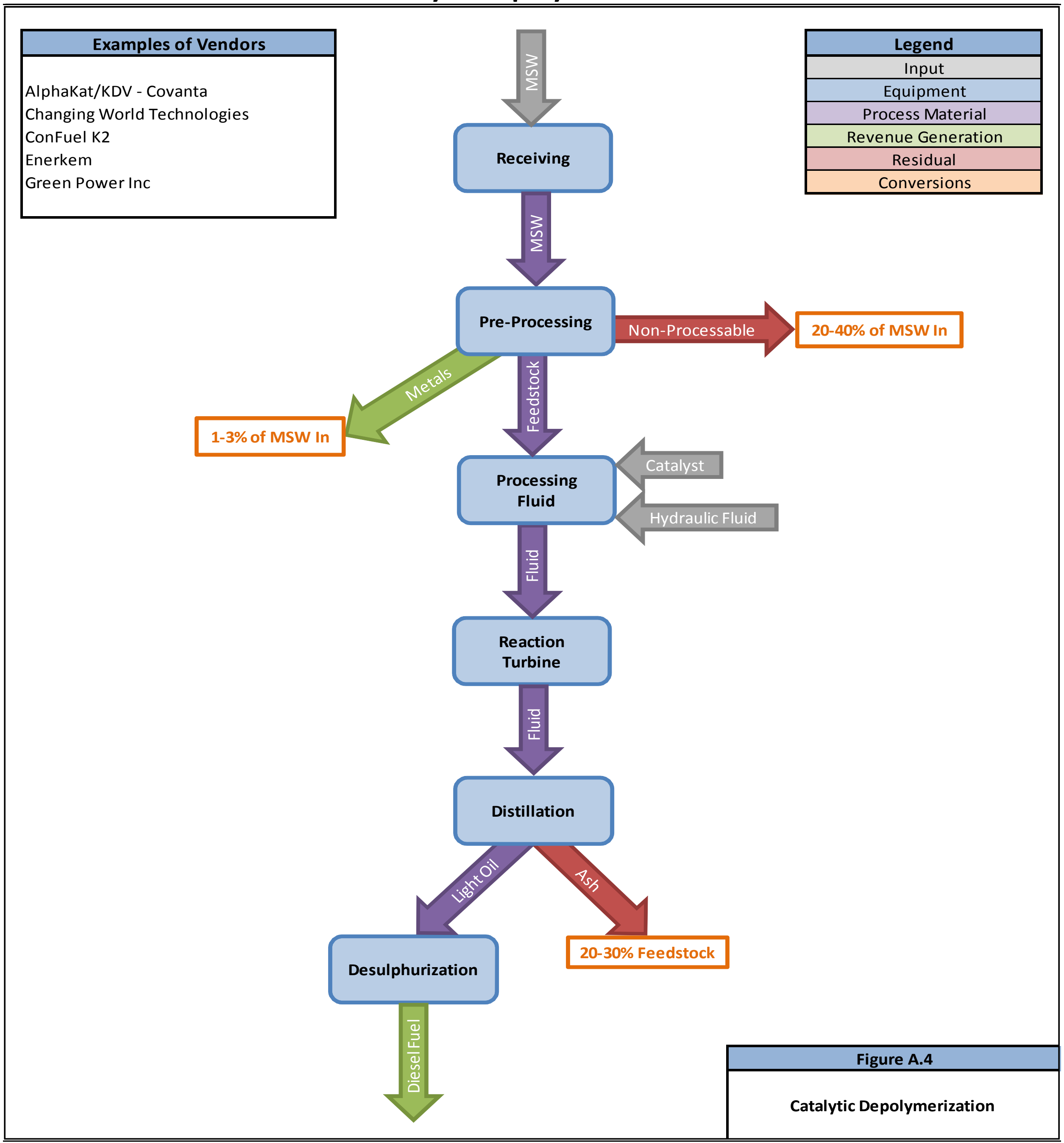
Figure A.3

Mass Burn Combustion

Description:

Mass Burn combustion technology can be divided into two main types: (a) grate based, waterwall boiler installations; and (b) modular, shop erected combustion units with shop fabricated waste heat recovery boilers. The modular units are typically limited to less than 200 tonnes per day and are historically used in facilities where the total throughput is under 500 tpd. In Mass Burn combustors, MSW is fed directly into a boiler system with no preprocessing other than the removal of large bulky items such as furniture and white goods. In the larger Mass Burn Combustion units, the MSW is typically pushed onto a grate by a ram connected to hydraulic cylinders. Air is admitted under the grates, into the bed of material, and additional air is supplied above the grates. The resulting flue gases pass through the boiler and the sensible heat energy is recovered in the boiler tubes to generate steam. In the smaller modular mass burn systems, MSW is fed into a refractory lined combustor where the waste is combusted on refractory lined hearths, or within a refractory lined oscillating combustor. The flue gases exit the combustors and enter a heat recovery steam generator, or waste heat boiler, where steam is generated by the sensible heat in the flue gas. In Mass Burn Combustion, four main streams are generated; steam, flue gas, bottom ash and fly ash. The steam is either sent to a steam turbine to generate electricity or it can be piped directly to an end user as process or district heating steam, or a combination of these uses. Mass burn technologies utilize an extensive set of air pollution control (APC) devices for flue gas clean-up. The typical APC equipment used include: either selective catalytic reduction (SCR) or non-catalytic reduction (SNCR) for NOx emissions reduction; spray dryer absorbers (SDA) or scrubbers for acid gas reduction; activated carbon injection (CI) for mercury and dioxins reduction; and a fabric filter baghouse (FF) for particulate and heavy metals removal.

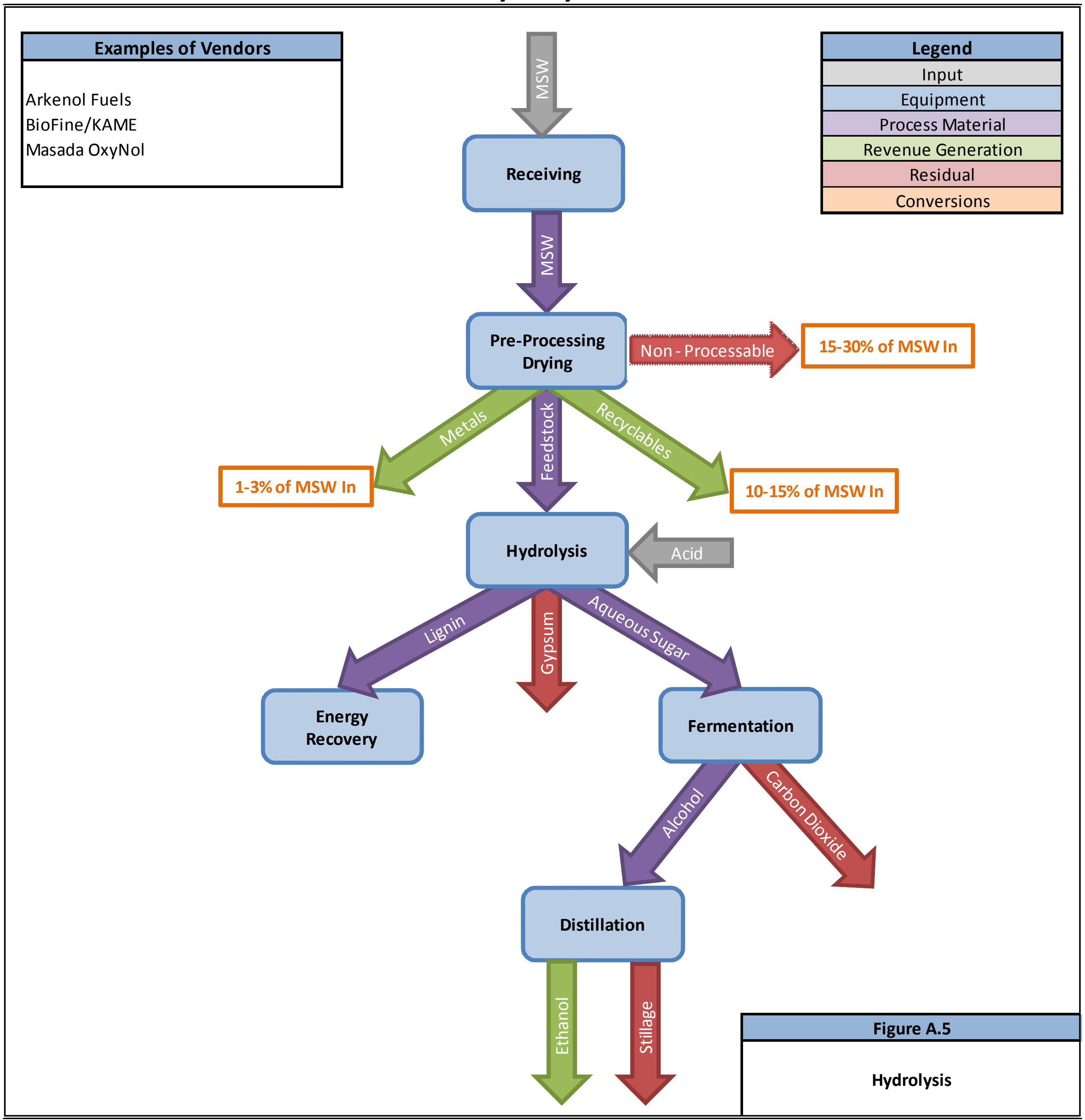
Catalytic Depolymerization



Description:

In a catalytic depolymerization process, the plastics, synthetic-fibre components and water in the MSW feedstock react with a catalyst under non-atmospheric pressure and temperatures to produce a crude oil. This crude oil can then be distilled to produce a synthetic gasoline or fuel-grade diesel. There are four major steps in a catalytic depolymerization process: Pre-processing, Process Fluid Upgrading, Catalytic Reaction, and Separation and Distillation. The Pre-processing step is very similar to the RDF process where the MSW feedstock is separated into process residue, metals and RDF. This process typically requires additional processing to produce a much smaller particle size with less contamination. The next step in the process is preparing this RDF. The RDF is mixed with water and a carrier oil (hydraulic oil) to create RDF sludge. This RDF sludge is sent through a catalytic turbine where the reaction under high temperature and pressure produces a light oil. The light oil is then distilled to separate the synthetic gasoline or diesel oil. This catalytic depolymerization process is somewhat similar to that used at an oil refinery to convert crude oil into usable products. This technology is most effective with processing a waste stream with a high plastics content and may not be suitable for a mixed MSW stream. The need for a high-plastics-content feedstock may also limit the size of the facility.

Hydrolysis



Description:
The hydrolysis process involves the reaction of the water and cellulose fractions in the MSW feedstock (e.g., paper, food waste, yard waste, etc.) with a strong acid (e.g., sulfuric acid) to produce sugars. In the next process step, these sugars are fermented to produce an organic alcohol. This alcohol is then distilled to produce a fuel-grade ethanol solution. Hydrolysis is a multi-step process that includes four major steps: Pre-treatment; Hydrolysis; Fermentation; and Distillation. Separation of the MSW stream is necessary to remove the inorganic/inert materials (glass, plastic, metal, etc.) from the organic materials (food waste, yard waste, paper, etc.). The organic material is shredded to reduce the size and to make the feedstock more homogenous. The shredded organic material is placed into a reactor where it is introduced to the acid catalyst. The cellulose in the organic material is converted into simple sugars. These sugars can then be fermented and converted into an alcohol which is distilled into fuel-grade ethanol. The byproducts from this process are carbon dioxide (from the fermentation step), gypsum (from the hydrolysis step) and lignin (non-cellulose material from the hydrolysis step). Since the acid acts only as a catalyst, it can be extracted and recycled back into the process.

Pyrolysis

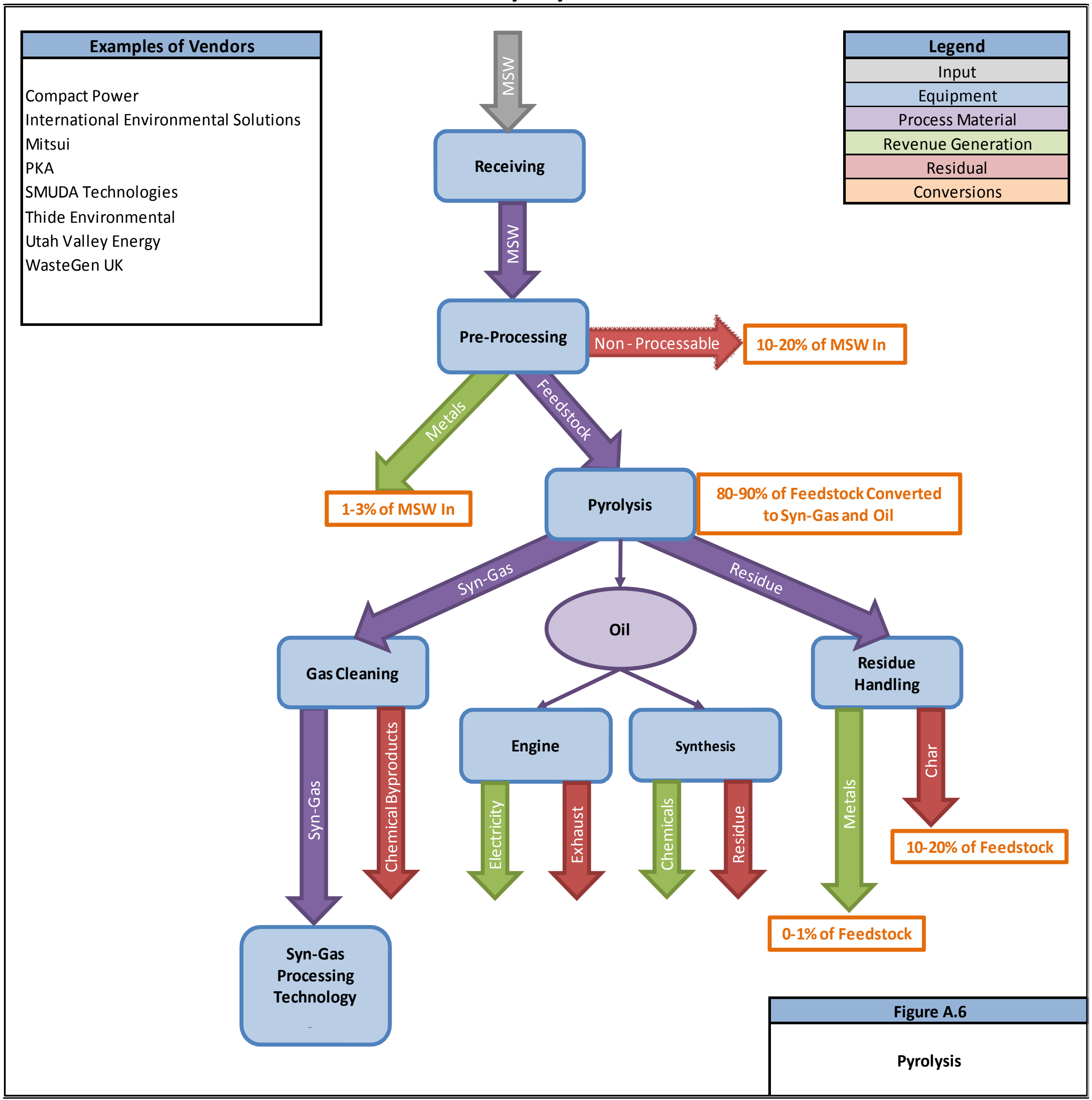


Figure A.6

Pyrolysis

Description:

Pyrolysis is generally defined as the process of heating MSW in an oxygen-deficient environment to produce a combustible gaseous or liquid product and a carbon-rich solid residue. This is similar to what is done to produce coke from coal or charcoal from wood. The feedstock can be the entire municipal waste stream, but, in some cases, pre-sorting or processing is used to obtain a refuse-derived fuel. Some modular combustors use a two-stage combustion process in which the first chamber operates in a low-oxygen environment and the combustion is completed in the second chamber. Similar to gasification, once contaminants have been removed the gas or liquid derived from the process can be used in an internal combustion engine or gas turbine or as a feedstock for chemical production. Generally, pyrolysis occurs at a lower temperature than gasification, although the basic processes are similar.

Gasification

Examples of Vendors

AdaptiveArc *
Alter NRG *
Compact Power
Ebara
Enerkem
Geoplasma *
Integrated Environmental Technologies *
New Planet Energy
PKA
Plasco Energy Group *
Primenery
PyroGenesis Canada, Inc. *
SilvaGas
Startech *
Taylor Biomass Energy
Technip
Thermoselect

Types of Gasification

Fixed Bed
Fluidized Bed
Moving Bed
Plasma Arc (indicated by a *)

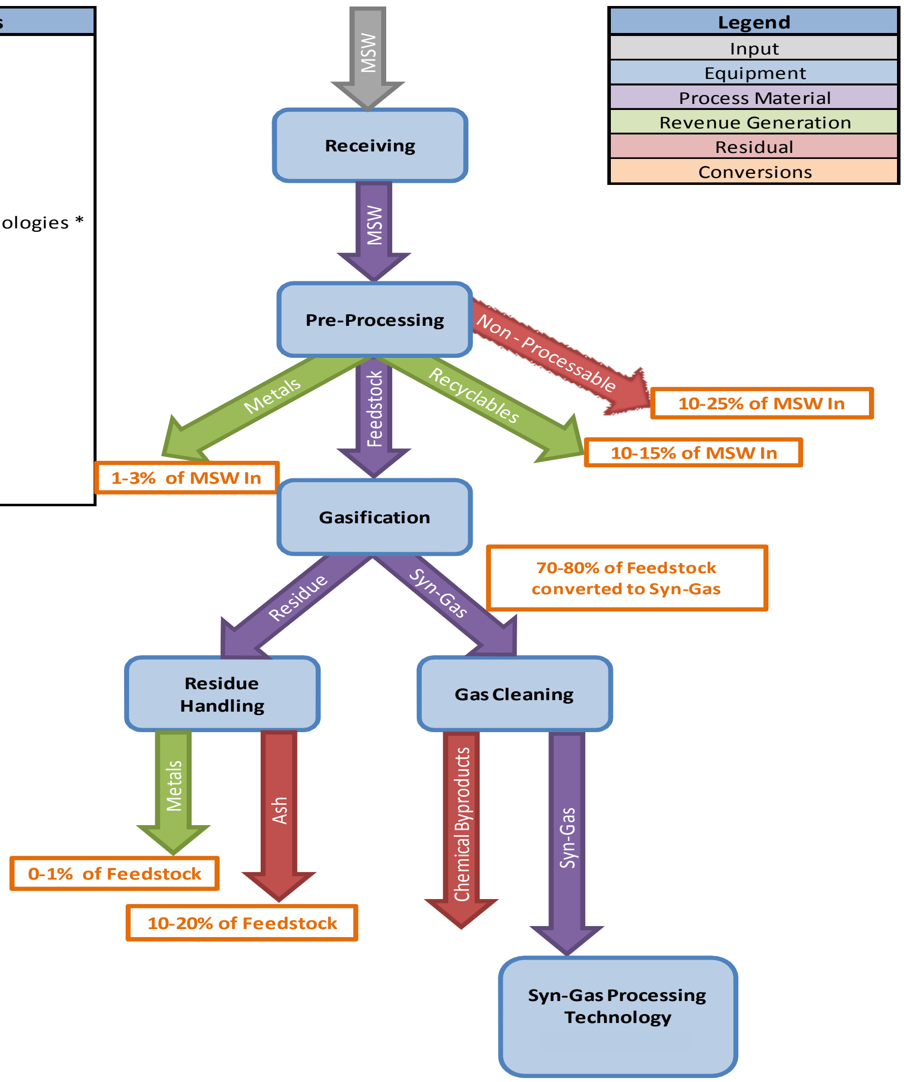


Figure A.7

Gasification

Description:
Gasification converts carbonaceous material into a synthesis gas or "syngas" composed primarily of carbon monoxide and hydrogen. Following a cleaning process to remove contaminants this syngas can be used as a fuel to generate electricity directly in a combustion turbine or engine, or the gas can be fired in a boiler to generate steam that can be used to generate electricity, for process uses or district heating, or a combination of both. The syngas generated can also be used as a chemical building block in the synthesis of gasoline or diesel fuel. The feedstock for most gasification technologies must be prepared into RDF developed from the incoming MSW, or the technology may only process a specific subset of waste materials such as wood waste, tires, carpet, scrap plastic, or other waste streams. Similar to Fluidized Bed Combustion, these processes typically require more front end separation and size reduction, and result in lower fuel yields (less fuel per tonne of MSW input). The feedstock reacts in the gasifier with steam and sometimes air or oxygen at high temperatures and pressures in a reducing (oxygen-starved) environment. The low- to mid-Megajoule syngas can be combusted in a boiler, or following a cleanup process a gas turbine, or engine or used in chemical refining. Of these alternatives, boiler combustion is the most common, but the cycle efficiency can be improved if the gas can be processed in an engine or gas turbine, particularly if the waste heat is then used to generate steam and additional electricity in a combined cycle facility. Industry experts generally expect that the flue gas will be lower in acid gases, combustion gases, organics, and metals, but APC equipment and syngas cleaning systems will still be required. The remaining ash and char produced by the syngas process may be marketed as a construction base, or disposed of in a landfill if a market does not exist.

THE CITY OF DALLAS, TEXAS

DEPARTMENT OF SANITATION SERVICES

LOCAL SOLID WASTE MANAGEMENT PLAN

TECHNOLOGY OPTIONS
Source Separated Organics

Task 5B

August 2011

Prepared for:
City of Dallas
Sanitation Services Department
1500 Marilla, Room 3FN
Dallas, Texas 75201

Prepared by:
Risa Weinberger & Associates, Inc.
5200 Keller Springs Road, Suite 927
Dallas, Texas 75248

Table of Contents

Technology Options

Source Separated Organics

The following information describes several available technologies for diverting organics from landfill disposal by various processes. They produce products for beneficial use, enable energy recovery, or both. The current condition, landfilling with recovery of methane for energy, is the baseline for relative comparison. Analysis and comparison of specific project parameters for these technologies is beyond the scope of this plan. Therefore, this analysis is intended to facilitate broad comparison on the basis of environmental protection; economics; regulatory requirements; potential for nuisance such as odor, dust and noise; and various operational concerns. Appendix 1 to this technical memo provides a synopsis of the comparison. As some of these technologies are relatively new and have not yet been proven in large-scale operation in the United States over time, it will be necessary to revisit this evaluation periodically. Note that this comparison is based on the assumption of source-segregated organic wastes.

Windrow Composting

Windrow Composting is an ancient technique for managing organic waste materials and improving soil characteristics for agriculture or horticulture. Short of using organics from the municipal solid waste stream directly as animal food, it is the most basic and direct method of converting waste organics into a usable product. Windrow composting is highly flexible in terms of variable feedstocks and market requirements for finished product. The process is generally accomplished outside, although indoor operations are sometimes more successful if particularly harsh weather conditions exist. The process generally includes preprocessing of organic material, typically grinding and mixing of various feedstocks, an aerobic decomposition phase in managed windrows, a curing phase, and product distribution.

Environmental benefits include not only those associated with the use of compost as a soil conditioner, as listed in Appendix 1, but also with diversion of organics from an anaerobic landfill environment to an aerobic composting environment. This shift from anaerobic to aerobic decomposition results in generation of less methane and more carbon dioxide. Even with recovery of methane for energy recovery, this diversion is considered an improvement in overall greenhouse gas generation.

This technology demands careful operational management using best management practices to avoid unacceptable nuisance conditions, and realizes revenue potential in the form of a tipping fee on the front end and product sales on the back end.

Aerated Static Pile Composting

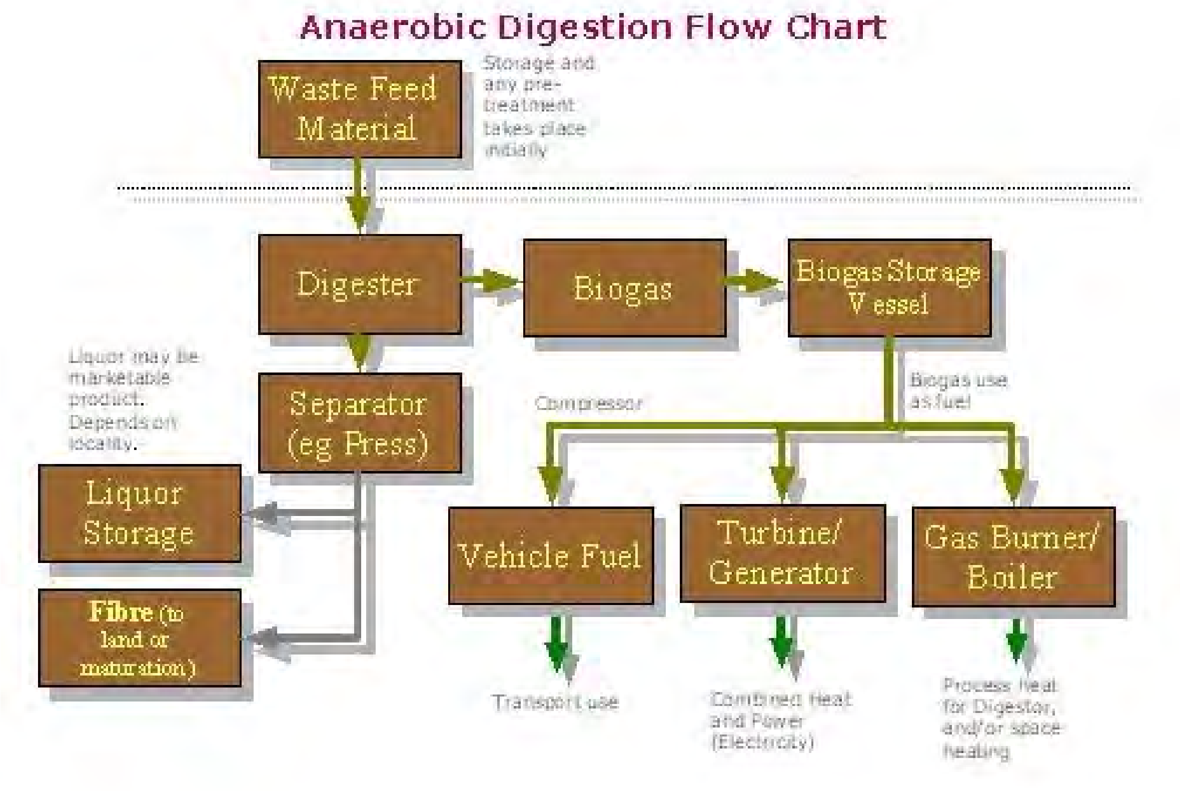
Aerated Static Pile (ASP) Composting uses the same principles as windrow composting, but it generally entails forcing air through piles using fans that either force air up through the piles into the enclosure, or pull air down through the piles and eventually exhaust to the atmosphere. The aerobic decomposition phase is somewhat accelerated compared to basic windrow composting. The piles are typically not turned, but remain static throughout the aerobic decomposition phase, although some systems involve mechanical mixing or turning as well. ASP operations are generally indoors, and use some sort of biofilter, scrubber, or another means of treating air for odors before it is emitted to the atmosphere. Some operations are outdoors. ASP processes involve higher capital expense than windrow composting, but may be more appropriate in settings where odor is a particular concern. They are more successful with consistent feedstocks so extensive pre-processing is often required. Occupational safety can be a concern due to the potential for hazardous environments in the enclosures. ASP facilities are less flexible in the sense that they are designed for a certain throughput, and growth beyond that design limit requires expansion of the building and equipment. One unique form of ASP composting employs long bags filled with organic material which are aerated using mechanical blowers. They are not in enclosed buildings and accommodate growth in throughput more easily than more traditional ASPs in buildings.

In-vessel Composting

There are a variety of in-vessel composters, ranging in size from very small ones designed to serve a single generator such as a prison or school, to quite large facilities that serve mixed MSW streams from entire communities. These units provide mechanical mixing and aeration in an enclosed vessel in order to further speed up the aerobic decomposition process and entirely contain odors within the vessel. In virtually all cases, the product of this type of system must undergo further processing in a windrow operation, followed by a curing process. These systems are extremely capital intensive on a large scale, and sometimes require significant pre-processing or carefully source-separated feedstocks. Because they reduce the total processing time, they can reduce the footprint of an operation as compared to a basic windrow operation alone.

Anaerobic Digestion

Whereas composting is an aerobic process, generating carbon dioxide, anaerobic digestion is the decomposition of organics without oxygen and generates methane. It is a common process with considerable operating history, particularly associated with municipal wastewater and agricultural wastes. Wastewater treatment plants anaerobically digest sludge in enclosed digesters, often collecting methane for energy recovery. Organic wastes can be anaerobically digested in dedicated facilities which produce residue that can be added to a compost process. This is a complex biochemical process which is costly to build and operate. The residue provides limited nutrient value to the composting process. An alternative, with even more limited experience is to process organic food waste prior to adding it to an existing sludge digester at a wastewater treatment plant. This has the benefit of using an existing facility rather than going to the considerable expense of building a new facility. But it does decrease the capacity of the digester to receive sludge. These processes require high moisture content and are generally not appropriate for large quantities of wood and brush, and better suited to food waste processing. Recovering methane from the anaerobic phase is analogous to recovering methane from a landfill.



Waste-to-Fuel Conversion

Anaerobic digestion can be one form of converting waste to energy, as can direct processing in a mass-burn unit or a refuse-derived-fuel process. However, the category of waste-to-fuel for this purpose addresses a number of much more complex biochemical processes. Typical products are ethanol or other fuel products sometimes referred to as syngas. There is very little operating history for these processes in the United States, particularly at full-scale. They are highly variable and must be evaluated on a case-by-case basis. Because of the lack of operating history, regulatory approvals for these processing facilities can be difficult. In Texas, a full permit-level authorization will be required for a municipal solid waste processing facility, even for a pilot-scale demonstration project.

Waste-to-Energy or Biomass-to Energy Processing

These techniques for diverting organics from landfills and recovering energy are well established in the United States. They include the recovery of energy in the form of steam heat or electric generation. Traditional waste-to-energy technologies such as mass burn facilities are large-scale facilities which process the entire mixed municipal solid waste stream; although, they are improved with pre-processing to remove inorganic recyclables before combustion. Refuse-Derived-Fuel facilities do require preprocessing to remove inorganic recyclables and process the combustible fraction into a more uniform fuel product which is typically burned in a dedicated furnace. Both produce rejects and residue that must be landfilled. These facilities are extremely capital intensive, operationally complex, and are not generally warranted when ample and affordable landfill capacity with energy recovery is available. Biomass-to-energy typically refers to burning or processing biomass, such as wood, in a facility for energy recovery. These facilities require a consistent and sustainable source of fuel to be successful.

Commercial Kitchen Pulpers

One way to capture some of the food waste from the municipal solid waste stream, such as for composting, is to encourage or require the installation of food waste pulpers in commercial or institutional kitchens. These machines process source-segregated food waste by pulping it, often followed by further processing to form pellets or material which is more easily handled and transported for composting. A variation on this technology is a machine that grinds, dewaters and disinfects food waste from kitchens, grocery stores, or food processors. This type of equipment is sometimes cost effective when hauling raw food waste with a high moisture content is not feasible. In both cases, the equipment is best installed at the generator, and is not applicable to residential applications. Because of the cost and the need to modify operations at the generator, any form of mandatory participation will likely be met with opposition.

Landfill Gas Recovery (ELR)

The current condition is landfilling of all organic waste currently under the control of the City, with the exception of some brush which is being diverted from the landfill as mulch. The McCommas Bluff Landfill is authorized for Enhanced Leachate Recirculation in future cells, which facilitates accelerated production and recovery of methane produced from anaerobic decomposition. The landfill currently recovers methane from landfill gas for electric generation. Any decreases in methane generation due to increased diversion of yard waste is likely to be offset by increased overall disposal rates over time, especially since the primary component of yard waste currently landfilled is wood. Wood produces less methane in an anaerobic landfill environment than grass and leaves, which are not currently collected for landfill disposal anyway. Organics in the landfill waste stream currently include organics in unsegregated residential, commercial, and industrial waste streams, and segregated portions of residential and commercial yard waste. Diversion of organics from the landfill will somewhat decrease gas generation per ton of material disposed. However, the primary organic component that is likely to be diverted is brush and wood, which is a relatively low source of methane generation compared to food waste. Most grass and leaves are already diverted through the City's effective "Don't Bag It" program. Because a large percentage of the organic material currently landfilled will not be diverted in the short- to mid-term, methane generation is not expected to decrease appreciably, especially if overall disposal rates at the landfill increase over time as projected.

Recommendation

In the short- to mid-term, windrow composting represents a proven technology of relatively low cost, with high potential for both front-end and back-end revenues. It is highly flexible over time as feedstocks change with changing waste stream characteristics. Windrow composting will preserve landfill life through diversion without significant decrease in methane generation over time, and it will realize other environmental benefits associated with the beneficial use of compost and mulch products.

APPENDIX
Organic Waste Management Technology Comparison Matrix

Criterion / Technology*	Environmental	Economic	Regulatory	Nuisance Potential	Operations
Windrow Composting	- decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	- low facility cost - moderate equipment cost -low operating cost -landfill diversion -decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks (registration or lower) - monitoring and reporting required	- minimal odor with careful operation and feedstock management - dust and noise potential	- highly flexible - BMPs essential to maintain product quality, marketability, and nuisance reduction -requires separate collection -contamination can be removed after processing
Aerated Static Pile Composting **(forced air or induced draft, enclosed or covered)**	- decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	- moderate facility cost -often requires building - moderate equipment cost -low operating cost -landfill diversion decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks (registration or lower) - monitoring and reporting required -OSHA concerns ref. hazardous indoor environment if applicable	-biofilter typically required for odor control -dust reduced if enclosed or covered	-accelerates aerobic decomposition -less flexible than windrow -typically covered piles, Ag-bag, or enclosed structure -biofilter or other odor control typically required -requires separate collection or extensive pre-

					processing
In-Vessel Composting	decreased GHG - decreases water demand - decreases fertilizer use/runoff - erosion control -landfill diversion	-high capital cost -electricity cost -high pre-processing cost -moderate operating cost -decreases methane generation and recovery at landfill -product revenue	- authorization type depends on feedstocks - monitoring and reporting required	-reduced nuisance potential	-typically requires windrow or ASP after in-vessel pre-processing -somewhat decreased processing time & decreased footprint -increased pre-processing -less flexible than windrow and ASP -requires separate collection
Anaerobic Digestion (Wastewater Digester or Dedicated)	-efficient GHG/energy recovery -low environmental risk associated with processing -decreases available wastewater digester capacity	-high capital cost for dedicated facility or expanded digester capacity -high capital cost for pre-processing and pipeline -methane revenue -increased financial risk with new technologies -decreases methane generation and recovery at landfill	-if in wastewater sludge digester, under wastewater permit -if in stand-alone digester, under solid waste permit and likely under research and development provisions	-low for enclosed systems	-increased operational risk with new technologies -requires separate collection and extensive pre-processing -end product can be composted - not appropriate for large yard trimmings/wood and brush
Waste-To-Fuel Conversion (ethanol, syngas,	-relatively unproven at full scale	-high capital cost -long-term financing	-permit required under Research and Development	-little operating experience in U.S.	-little full-scale operational experience

etc.)			provisions		demonstrated -typically requires separate collection or extensive pre-processing, or both -highly specialized operation
Waste-to-Energy or Biomass-to-Energy Processing	-low environmental risk with proper operation and controls -reject and residue disposal	high capital cost high O&M cost -long-term financing -decreases methane generation and recovery at landfill -reject and residue disposal	-permit required	-low with proper operation and controls	-typically mixed MSW for mass-burn and RDF -typically single fuel for biomass -highly specialized operation
Commercial Kitchen Pulpers Required by Ordinance (specialized machines for producing organic pulp form commercial food waste)	-low impact	-increased cost to generators -specialized hauling or on-site composting/digestion required	none	-high potential associated with storage and transportation of pulp	-facilitates all processes -requires separate collection -public opposition due to increased cost of installation
Landfill Gas Recovery (ELR) (CURRENT CONDITION)	-variable rates of GHG recovery	-preserves methane generation and recovery at landfill -decreases landfill capacity	-permit	-organics increase potential for odor	-brush and large wood may require special handling, increased compaction effort

GHG – Green House Gas, BMP – Best Management Practices, ASP – Aerated Static Pile, O&M – Operations and Maintenance, MSW – Municipal Solid Waste, RDF – Refuse Derived Fuel

* ASSUMPTION: Does not address mixed MSW grease/grit trap processing.

Appendix B: NCTCOG Closed Landfill Inventory List

This page is intentionally left blank.

SEE Less Trash Program

Closed and Abandoned Municipal Solid Waste Landfill Inventory Update

Dallas County
Permitted Landfill Sites

View Map

Click on the ID to view all available information for the site.

ID	SITE NAME	LOCATION
255	*CARROLLTON, CITY OF*	2.5M SW CITY HALL ON W SIDE WALLACE-CROSBY RD.,CARROLTON.
750	*Carrollton, City of*	5,000 FT.W OF IH-35E ON S SIDE OF SANDY LAKE RD.
1277	*City of Garland Castle Drive Landfill*	Intersection of Castle and Miles
61	*DALLAS, CITY OF*	S of I-30, W of Loop 12
146	*DALLAS, CITY OF/DAHLSTROM*	S of I-30 and W of Loop 12
87	*Dallas, City of/Leslie*	between Second and 175
88	*DALLAS, CITY OF/S LOOP*	6000 EAST SOUTH LOOP 12
63	*DALLAS, CITY OF/TM DYE*	between RR tracks and Newbery
89	*DALLAS, CITY OF/WALNUT HL*	2300 W. WALNUT HILL ROAD AT IH 35
447	*DUNCANVILLE, CITY OF*	Appears to be Estes Park per Mapsco
1261	*Duncanville, City of*	on Gifco Road, Midlothian
1049	*FARMERS BRANCH, CITY OF*	on Valley View Lane
601	*FRANK PRASIFKA*	west side of Dowdy Ferry Rd., disturbed
471	*GRAND PRAIRIE, CITY OF*	on Hardrock Rd
128	*HIGHLAND PARK, CITY OF*	at end of Conveyor Lane

1236	*Hutchins Landfill*	1.75M E-NE OF IH45&IH20 INTSCN,750'S OF IH20,E END LANGDON DR., 800'N CLEVELAND RD,S OF LANGDON RD,2M NE OF HUTCHINS CITY HALL
964	*IRBY LANE PROPERTIES*	location description is unclear, can't pinpoint exactly on map
264	*IRVING, CITY OF*	Twin Wells Park
974	*JAMES R. ALLEN*	E OF BALLWAG RD, 7.5M SW OF DUNCANVILLE CITY LIMITS
313	*KLEBERG, CITY OF*	1400 ALEXANDER RD 225FT SW OF OLD SEAGOVILLE & ALEXANDER INTSC
520	*LAS COLINAS CORPORATION*	Royal Lane
1379	*LAS COLINAS CORPORATION*	1200'S IH635,.6M N ROYAL LN,.6M E RASBERRY RD,.4M W TRINITY R.
799	*Mesquite Landfill*	1 mile W of Kleburg near Jordan Valley Road
2195	*PRASIFKA, BARBARA JOAN*	Post Oak at Fulgham Rd.
205	*SMITH LANDFILL COMPANY*	3333 FT WORTH AVE. DALLAS, TEXAS
556	*Trinity Oaks Landfill*	0.5 miles SE of US 175 at IH635 in Mesquite

Total Number of Dallas County Sites: 26

Go Back

North Central Texas Council of Governments | 616 Six Flags Drive P.O. Box 5888 Arlington, TX 76005-5888
Main Operator: (817) 640-3300 | Fax: (817) 640-7806

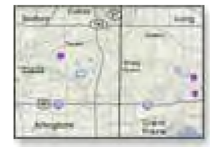
Home > Environment and Development > Disposal Options > Landfills
Print this page

SEE Less Trash Program

Closed and Abandoned Municipal Solid Waste Landfill Inventory Update

Dallas County
Unauthorized Landfill Sites

View Map



Click on the ID to view all available information for the site.

ID	SITE NAME	LOCATION
U1720	*183 Land Corporation*	NE quadrant of the HWY 183/International Place intersection
U2039	*A. L. Allen*	At entrance city of Mesquite Landfill P#556
U857	*Balch Springs*	3-way intersection
U1359	*Bob King*	Irving: S.E. Cornor of Story & Ruby Rd.
U2091	*Bob Lewis*	5625 & 5631 Parkdale Drive
U1543	*Brown Site*	S. of Vetch Rd. Vetch & Mars Rd.
U1339	*Bruton Rd. Site*	NE corner of 635 and Bruton Rd. (Cartwright Rd.)
U859	*California Crossing*	2100 California Crossing and Newkirk St
U861	*Carrolton Dump*	Carrollton, Beltline and Luna, SE quadrant
04T048	*Centennial Plaza Addition*	Southeast corner of IH35E and Lombardy
U1386	*Centerville at Nutler Rd.*	Garland: Centerville & Miller
U1387	*Centerville Rd. Landfill*	Garland: On either side of Mills Branch upstream of Rowlett.
04T046	*City of Farmers Branch - Keenan Bridge Rd*	1800 Valley View, Farmers Branch, TX
04T045	*City of Farmers Branch - Senlac Drive*	13333 Senlac Dr., Farmers Branch, TX
U924	*City of Mesquite*	NE corner of 635 and Bruton Rd. (Cartwright Rd.)
U863	*Coit Road Brush Site*	7700 Clodus Fields Dr and 12100 Coit Rd
U865	*Connell*	NW Hwy Frontage RD at Spangler, 200-300' W of Spangler Rd interchange
U1186	*Dabney/Cedar Hills*	Joe Wilson & Pleasant Run
U2036	*Dallas Demolition Co (Ray Lohden)*	Between Linfield & Felllows Rds at NE end of Stokes Rd
U2126	*Dal-Tile*	From I-45,E on Pleasant Run Rd, 2.1 mile on left
U869	*De Soto Landfill*	Wintergreen Rd
U1246	*Dempsey/Warrior Trail #3*	Great Southwest Parkway
U2129	*Don Poteet*	Immediately NW of 14830 Kleberg Rd

U872	*Duncanville (Ballweg)*	Ballweg Rd/Just N of Mansfield Rd
U2093	*E. J. Pickle*	S Beltline
U2094	*Earl Woody*	2300 Blk of Bowers
U1348	*East Garland Rd.*	Garland: Old St. Hwy west of Rowlett Creek
U1352	*East Miller Rd.*	Garland: East Miller Rd. SW intersection
U1171	*Forest/Greenville*	SW quadrant of Forest & Greenville
U875	*Forney*	4700 - 5200 Military Parkway
U2037	*Frank Presifka*	Intx of Fulghum & Post Oak Rds, Dallas Co.
U876	*Fulsom*	600 yds from Wintergreen and Old Hickory Rd
U907	*Garland Rd LF*	Garland Rd
U2040	*George Lucas*	3101 Beltline Rd
U2184	*Gramatan Co*	from I-45, E. Pleasant Run Rd, 2.1 mi on right
U908	*Grand Prairie*	Lion Country now Wildlife Pkwy
U1361	*Grand Prairie*	East of Grand Prairie clity limits: on Bear Creek E. of Belt Line.
U909	*Grapevine Disposal Site*	Hwy 121 in Dallas County
U2134	*Greg Nelson Salvage Yard*	2300 Moonlight
U1255	*Hague Financial Group*	S. Central Expressway (310) & I-20
U1327	*Hardrock Rd*	east of Hard Rock, south of Oakdale
U2138	*Herman Gibbons*	5003 S Lamar
U910	*Highland Rd Brush Site*	1800 Highland Rd at Ash Creek
04T049	*Holford Road Property*	Borders Holford Rd. and Lacewood in Garland
U1565	*Horseshoe Lake Rd.*	N of TrinityR., S of Lone Star Park
U911	*Hunter Ferrel @ Meyers Rd*	Hunter Ferrel & Meyers Rd
U912	*Hutchins*	Langdon Rd, 2 mi E of IH 45, S of IH 635
U1281	*IH 30 Corridor Land*	Hwy 30 & Beltline
U1360	*Illegal Site*	Irving: N. W. corner 700 ft. N. of county. Central & 183 Service Rd.
04T047	*Inspiration Dr. and IH35*	NW corner of Inspiration Dr. and IH35 in Dallas
U2132	*J.O. McPeters*	E Shady Grove (2400 blk) & E Irving Blvd intx
U2135	*James Currey*	3200 Stag Rd
04T044	*Jaycee Park*	North of Singleton and East of Bernal near U927
U2035	*Jessie Majors*	8500 Julius Schepps Hwy, N of Simpspn Stuart Rd, S of Loop 12
U914	*John Lomey Dump*	Same location as U1343
U925	*Karl Mirkes*	100 yds S Intx of Wintergreen & Old Hickory Rd in DeSoto
U915	*Kiest*	south side of Southerland
U916	*Killough Brush Site*	brush site was on S side of rd, N of creek
U917	*King Site*	SW corner of Glenwick St & Ruby Rd in Irving
U918	*Kleberg-Koontz*	Alexander is called Ravenview here
U919	*Lancaster*	Steinbeck Rd

U1358	*Lancaster Site*	Lancaster: N. side of Lavedner Rd. 0.9 miles E. of Ferris.
U920	*Lindamood Site*	2000 Blk of S. Nursery Rd
U921	*Linfield*	4800 Linfield Dr.
U2130	*Lloyd Miller*	7600 South Central Expressway (310) in Hutchins
U1206	*Luna Stemmons I & II*	"W & S of IH 35, E at Booth"
U922	*Merrifield*	Now part of Spur 408
U923	*Mesquite*	SE of Intx of 635 and 175
U1350	*Mesquite Sanitary Landfill*	North of Forney Rd at Forney and Town E. Blvd
U1532	*Mesquite Sanitary Landfill*	NE corner of 635 and Bruton Rd. (Cartwright Rd.)
U1349	*Miles Rd.*	Roulett: Between Castle & Pleasant Valley Rd.
U1225	*Mullins Warehouse*	SE corner Marsh & Simpson Ln
U1287	*Murff Annex*	10500 Spangler Road in Dallas
U926	*Murff Property*	1800 W Northwest Hwy
U2090	*Nabors & Whittle*	2725 Dowdy Ferry Rd.
U1570	*No Name*	Coppell-300 N. Lodge Rd.
U1571	*No Name*	Cedar View is a short road
U1572	*No name*	Cedar Hill-Duncanville Rd. 50yds. S. of Parkersville Rd.
U1563	*No Name*	Grand Praire-S. of I-20 at the bend of Mathew near Dallas Lane.
U1373	*No Name*	Grand Praire: 300 West of N. Beltline. South side of Hunter Ferrell.Hunter Ferrell.
U1375	*No Name*	south of the cemetary off of Cedar Hill Drive
U1376	*No Name*	Cedar Hill: Meadow Ridge & Jargeon Lane
U1377	*No Name*	Cedar Hill: 1382 FM Rd. 1/2 mile Wl of Rd. Straus
U1378	*No Name*	Cedar Hill: Straus Rd. S. of Sorcey Rd.
U1379	*No Name*	Cedar Hill: Joe Wilson Rd. 200 yds N or Hwy. 67.
U1380	*No Name*	Irving: E. of Texas Stadium. Into spur 482. Clover Leaf.
U1340	*No name*	Mesquite: Highway 67 at Motley Street
U1343	*No name*	Same location as U914
U1356	*No Name*	Cedar Hill: Mansfield Rd. 1/2 mi. W. of Robbin Rd.
U1357	*No Name*	Cedar Hill: Balway Rd. N. of Mansfield Rd.
U927	*Nomas*	3200 Claiborne Blvd at 5500 Nomas St
U1169	*Oak Cliff*	"E & adjacent to Coombs Creek, S of Kiest"
U1366	*Old City Dump*	Lion Country now called Wildlife Parkway, SW intx is part of P471
U873	*Old Farmers Branch LF*	2509 Royal Lane
U931	*Old Richardson Landfill*	near Sherrill Park G.C. and Owen's Spring Creek Farm
U2122	*Omega Financial*	3737 Middlefield Rd, E of and S of Middlefield Rd
U1245	*Overstreet/Warrior Trail #4*	Great Southwest Trafficway
U1344	*Pinnell*	Dallas: 2221 Lombardy Lane
U929	*Ray Talley*	at dead end of Deepwood; no entrance at Deepwood

U930	*Richardson LF*	.25 mi E of Intx of Plano Rd & Greenville Rd
U2125	*Ron Buckzlew*	Pin Oak Rd
U2139	*Sam Nabor*	5101 Youngblood ST
U1544	*Sand Branch Site*	E. side of Beltline Rd .at Bench St.
U1288	*Sargent Rd*	1240 Sargent Rd
U932	*Seagoville*	Bois D'Arc Rd, between Combine & Bilindsday
U1440	*Smith Site*	Approx. same location as P205
U2133	*T. E. Frossard*	6512 S Loop 12
U933	*Tanner Hutchins-Wilmer*	Vetch Rd
U2120	*Tim Canterbury*	W side of Gilbert Rd, 1/4 mi N of int w/ Shady Grove Rd
U934	*TX Industries*	Same location as P61
U936	*University Park/Garland*	Miller Rd at Centerville Rd
U1561	*Unknown*	Grand Praire: 300 ft north of Oakdale. Corner of Oakdale & County Line.
U1569	*Unknown*	Coppell-1400 Block of Sandy Lake Rd.
U937	*Unnamed*	On E side of Trinity River and S side of Martin Luther King Blvd at end of Lenway St
U878	*Unnamed (Garland)*	Intersection of MKT RR and Centerville Rd (approx 1200 Block)
U938	*Vilbig*	3300 Bill Harrod
U2038	*Warren Morean*	3837 Simpson Stuart Rd
U1248	*Warrior Trail*	1426 Southwest Parkway
U1242	*Warrior Trail #1*	E Southwest Pkwy
U1244	*Warrior Trail #8*	Warrior Trail
U1241	*Warror Trail #2*	SW Parkway
U2128	*Wesley Nunley*	Bird Rd. and extension of road,W of 310
U939	*West Dallas*	Joe Irwin Addition No. 5
U940	*West Davis*	700 N Walton Walker Fwy
U1351	*Westlake*	Mesquite: In Westlake Park under tennis courts.
U941	*Winnetka*	Possibly other owners to S of Blk 7110 (developed)
U942	*Yorktown*	300 Yorktown St

Total Number of Dallas County Sites: 127

Go Back

North Central Texas Council of Governments | 616 Six Flags Drive P.O. Box 5888 Arlington, TX 76005-5888
Main Operator: (817) 640-3300 | Fax: (817) 640-7806

Appendix C: Model Ordinances and Contracts

This page is intentionally left blank.

Summary of Selected U.S. Mandatory Commercial Recycling Ordinances (provided by Stopwaste.org)

Jurisdiction	Materials Covered	Thresholds: Business / MFD / Mobile	Enforcement/ Exemption	Performance Metric (goal, reporting)	Amount Spent on Enforcement/ Funding	Technical Assistance / Outreach
Sacramento, CA	All food / beverage establishments: aluminum & steel containers; glass bottles / containers; plastics; cardboard and boxes. All other businesses: paper; plastic; aluminum cans; scrap metal; wood pallets.	All business and non-residential properties that subscribe to 4 cubic yard or greater per week garbage service. Multifamily with five or more units per parcel.	Hazardous material and food inspectors check for compliance. Exemption: A self-hauling form is filled out that certifies all self-hauling activities. Exempt if space limitation or if compliance will result in zoning violation. Up to $1000/day fine for noncompliance	Businesses submit a detailed plan about on-site recycling. Haulers report quarterly on recycling tonnages and destination of recyclables. Waste haulers required to submit Recycling Plans; City staff review quarterly hauler reports, conduct on-site inspections, and can audit hauler records.	1st year enforcement = $400k. This covers 3,000 businesses per year of the 9,000 total targeted for enforcement. Enforcement on a 3 year cycle City spends approximately $100-$130 / business to enforce on approximately 40% of eligible businesses Franchise hauler fees ($500 per truck annually)	Each business has to provide containers for recycling, signage, and written recycling requirements site. SWA provides a handbook, sample signage, and other information; Over 10,000 Direct Mailers were mailed out.

Jurisdiction	Materials Covered	Thresholds: Business / MFD / Mobile	Enforcement/ Exemption	Performance Metric (goal, reporting)	Amount Spent on Enforcement/ Funding	Technical Assistance / Outreach
San Diego, CA	All papers, cardboard, plastic and glass bottles and jars, metal cans, and also other materials for which markets exist.	Residential / multifamily: Phased approach for commercial customers, by size: I. 20,000 square feet or more, II. 10,000 square feet or more and III all businesses. Phased approach: I. For multifamily 100 units or more, II. for 50 or more, III. for all complexes unless exempt.	Solid waste code enforcement officers work in concert with recycling staff. Exemptions for 6 cubic yards per week or less of generation of recyclables and refuse. A business may also apply for an exemption if they lack space to recycle, or if they generate no recyclables.	Haulers must provide an annual report. Staff targets those with low service levels of recycling, informs them of the ordinance, and offers assistance. If service levels don't increase, staff can take enforcement actions.	Approximately $221,000/year (estimated) Recycling enterprise fund fee A direct fee for multifamily complexes One code enforcement inspector, 2 recycling specialists, .5 admin aide	The party who sets up the recycling program is also responsible for educating tenants or occupants annually, upon occupancy, or when changes to the program occur. Technical assistance to businesses, events and venues is also provided by City staff. There are guidelines for appropriate containers and signage.
City and County of San Francisco	Almost all recyclables (i.e. paper, bottles, cans and plastic, etc.) and compostables.	All--applicable to everyone. No threshold. Multifamily is included.	Drivers will leave tags when they see the wrong material in trash, recycling or composting containers. Other hauler employees may look as can City/County staff, including SFE, DPW and DPH . Exemptions include a space waiver and small generator fines are capped at $100. Mixing of materials at multi-tenant buildings will not be enforced until July 1, 2011.	100% compliance is the goal. On-site inspection for reviewing compliance.	$185k per year Existing funding will be used, in addition to fines and fees that will provide funding.	City/County Agency will do broad outreach on the ordinance in an effort to make every person in SF aware of it. The City will send letters to businesses and apartment owners. Private hauler (Recology) will include info in bills and send letters to small property owners and hang flyers on containers as they re-label them.

Jurisdiction	Materials Covered	Thresholds: Business / MFD / Mobile	Enforcement/ Exemption	Performance Metric (goal, reporting)	Amount Spent on Enforcement/ Funding	Technical Assistance / Outreach
Seattle, WA	Prohibited from commercial trash: significant amount of paper, cardboard, yard	The ordinance (this is a landfill ban, not a mandatory recycling ordinance) is applicable to residential, multifamily, commercial, and self-haul customers. Free recycling for multifamily customers. Some flexibility for hotels.	The penalty phase started one year after the implementation of the program. Non-compliance is defined as more than 10% of such material in trash by visual inspection. Two warnings, then $50 surcharge to haul the material away. So far, 18 fines were collected. Exemption: space limitation for containers.	60% diversion goal.	One full-time commercial business inspector has been hired. Funded through solid waste rates.	The City contracts with Resource Venture, a program of the Greater Seattle Chamber of Commerce, to provide free waste reduction and recycling technical assistance to Seattle businesses.

Links to Sample Mandatory Recycling Ordinances

Sacramento Regional Solid Waste Authority Business and Multifamily Recycling Requirements
http://www.msa2.saccounty.net/swa/Documents/Title-IV.pdf (accessed October 15, 2009)
San Diego Recycling Ordinance
http://docs.sandiego.gov/municode/MuniCodeChapter06/Ch06Art06Division07.pdf (accessed October 15, 2009)
San Francisco Mandatory Recycling and Composting Ordinance
http://www.sfenvironment.org/downloads/library/sf_universal_recycling__composting_ordinance.pdf (accessed October 15, 2009)
Seattle Prohibition of Recyclables in Garbage
http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/cos_003964.pdf (accessed October 15, 2009)

Summary of C&D Ordinances in Alameda County, CA (provided by Stopwaste.org)

Jurisdiction	Diversion Requirement	Threshold	Who can haul
Alameda	50% of waste generated	Projects valued at $100,000 or more	Local franchise waste hauler - Alameda County Industries (ACI) or Permitee as approved by Public Works Department. Self-haul if materials are loaded onto fixed body vehicle and delivered directly to facilities.
Albany	100% of asphalt, concrete and similar material, at least 50%, by weight, of all other C&D Debris generated.	Projects valued at $75,000 or more. $25,000 for just demolition projects.	Local franchise waste hauler. Self haul for commodities, donated materials or materials hauled by owner or occupant, or its contractor.
Berkeley	100% of concrete and asphalt, 50% of remaining waste generated (Applicants shall make salvageable materials available for reuse prior to demolition)	All construction or renovation projects valued at $100,000 or greater. All demolition projects.	Mixed debris or source separated materials can be self-hauled to a qualifying mixed C&D facility *(identified in the builders guide).* Self-haul clean loads to Berkeley transfer station which sorts mixed C&D material, and has discount fee for clean compostable loads - *unpainted untreated wood, sheetrock, garden trimmings.* Contractor, self-haul, or local franchised haulers: *City of Berkeley, Biagini Refuse Services, Golden Gate Disposal, Richmond Sanitary, US Eagle, Waste Management & Bayview Refuse.*
Dublin	100% of concrete and Asphalt 50% of remaining waste Generated	Projects valued at $100,000 or more. Projects valued at $1,000,000 or more require a performance security deposit.	Debris boxes must be from a City of Dublin Pre-Approved Franchisee. Source separated recyclable materials may be removed by licensed transporters. Demolition debris may be removed by a licensed demolition/construction company. Request a list of approved haulers from the City.
Fremont	100% of concrete and asphalt 50% of remaining waste generated.	Construction and renovation projects valued $300,000 or greater (residential, commercial and civic). All demolition projects.	Anyone can haul. Recycling loads cannot contain more than 10% residual waste, otherwise Allied Waste must haul as Municipal Solid Waste (MSW). Strictly MSW boxes must go through Allied Waste.
Hayward	100% of asphalt, concrete and similar material (dirt, inerts) 50% of remaining waste generated (not inerts)	Projects valued at $75,000 or more and all City sponsored projects.	Debris boxes must be from franchise hauler-Waste Management of Alameda County (WMAC). Mixed debris or source separated materials can be self-hauled to a qualifying mixed C&D facility *(identified in the builders guide).* Weight tags are required to be turned in at the end of the project.
Livermore	50% of waste generated	Projects valued at $300,000 for construction or renovation. $40,000 for demolition. $1,000,000+ requires performance security deposit.	Open competition.

Jurisdiction	Diversion Requirement	Threshold	Who can haul
Newark	100% Asphalt and Concrete 50% of remaining waste Generated	All City or privately owned projects valued at $100,000 or greater. Structure demolition projects greater than $20,000	
Oakland	100% Asphalt and Concrete 65% of remaining waste Generated	All new construction, All demolition projects, Commercial projects valued at $50,000 or more.	Licensed franchised collector, Waste Management of Alameda County. Source separated C&D may be collected through private arrangements between generator and collector or licensed contractor as part of service or self-haul.
Piedmont	50% of waste generated	All construction, demolition or renovation valued at $50,000 or more	The City will provide one-half the cost of debris boxes used exclusively for the purpose of mixed C&D materials removed from the site by the City's franchised waste hauler for covered projects until funding is exhausted.
San Leandro	100% of asphalt, concrete, and similar material. 50% of remaining waste generated (not including inerts).	All construction projects valued at $100,000 or more.	The contractor/ subcontractors can self-haul; or local franchised waste hauler Alameda County Industries 510-357-7282 or Waste Management of Alameda County 510-613-8710; or A cleanup contractor (D63 classification) if doing cleanup work at the site.
Union City	50% of waste generated	Construction and demolition projects valued at $100,000 or more. Residential remodels increasing square footage by 50% or more	Allied Waste is the City's solid waste franchisee and provides collection and debris box services for construction sites. The City issues permits for others to collect and process construction and demolition debris. Permit holders shall only collect construction and demolition debris that has been separated from other solid waste and placed at a designated location for collection.
Alameda County	Traditional Public Works projects are required to divert 75% of asphalt, concrete, and similar materials and 50% for remaining C&D materials generated. County Projects must divert 50% of all C&D materials generated.	Construction – County projects and traditional public works projects valued at $100,000 or more. Demolition projects valued at $25,000 or more.	
Castro Valley Sanitary District	50% of waste generated	Construction and renovation projects valued at $75,000 or more. Demolition projects totaling an area of 1,000 square feet or more. Small projects do not fall under full enforcement of ordinance, but must still divert at least 50% and either use Waste Management of Alameda County or self-haul.	Franchised hauler, Waste Management of Alameda County or Self-haul by a fixed body vehicle to District-approved site. (sites approved as needed; no list available).

Jurisdiction	Diversion Requirement	Threshold	Who can haul
Oro Loma Sanitary District	100% of asphalt, concrete, and similar materials. 50% of remaining waste materials generated	Construction projects valued at $100,000 or more. Demolition projects valued at $40,000 or more.	Self-haul or use debris boxes from District's franchised waste hauler.

Links to Sample Non-Exclusive C&D Hauling Franchises and C&D Ordinances

City of Santa Rosa Non-Exclusive C&D Franchise Agreement
http://web1.ci.santa-rosa.ca.us/city_hall/pdf/City_Council/25494attA.pdf (accessed October 15, 2009)

City of Palo Alto C&D Ordinance
http://www.cityofpaloalto.org/civica/filebank/blobdload.asp?BlobID=15593 (accessed October 15, 2009)

City of Santa Clara Non-Exclusive Industrial Franchise Agreement
http://cityclerkdatabase.santaclaraca.gov/pdfCreator/Export.aspx?did=AAAAD051209051026389.DID&db=SCAGENDA (accessed October 15, 2009)

Appendix D: Acronyms and Definitions

This page is intentionally left blank.

Acronyms and Definitions

Acronyms

BOPA	Batteries, Oil, Paint and Antifreeze
BTU	British Thermal Unit
NCTCOG	North Central Texas Council of Governments
C&D	Construction and Demolition Debris
City	City of Dallas
DFW	Dallas-Fort Worth Metroplex
EPR	Extended Producer Responsibility
ETJ	Extra-Terrestrial Jurisdiction
FY	Fiscal Year (the City's fiscal year is October 1st to September 30th)
GHG	Greenhouse Gas
HHW	Household Hazardous Waste
MRF	Materials Recovery Facility
MTCE	Metric Tons of Carbon Equivalent
$MTCO_2E$	Metric Tons of Carbon Dioxide Equivalent
PAYT	Pay-As-You-Throw
SWAC	Solid Waste Advisory Committee
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality (formerly TNRCC)
TNRCC	Texas Natural Resource Conservation Commission (now TCEQ)
tpd	Tons per day
tpy	Tons per year
US or U.S.	United States
U.S. EPA	United States Environmental Protection Agency
WARM	Waste Reduction Model

Definitions

Community-based social marketing or social marketing[1]

Social marketing is the systematic application of marketing, along with other concepts and techniques, to achieve specific behavioral goals for a social good. A variation of social marketing has emerged as a systematic way to foster more sustainable behavior. Referred to as Community-Based Social Marketing by Canadian environmental psychologist Doug McKenzie-Mohr, Community-Based Social Marketing strives to change the behavior of communities to reduce their impact on the environment.[2] Realizing that simply providing information is usually not sufficient to initiate behavior change, Community-Based Social Marketing uses tools and findings from social psychology to discover the perceived barriers to behavior change and ways of overcoming these barriers. Among the tools and techniques used by Community-Based Social Marketing are focus groups and surveys (to discover barriers) and commitments, prompts, social norms, social diffusion, feedback and incentives (to change behavior). The tools of Community-Based Social Marketing have been used to foster sustainable behavior in many areas, including energy conservation, environmental regulation, and recycling.

Compostable Materials

Materials, such as yard trimmings, food scraps, and food-soiled paper, which can be aerobically composted and used as a soil amendment.

Diversion

Waste prevention, reuse, recycling and composting activities to divert discarded materials from landfills.

Eco-Depots

Drop-off facilities for reusable items, recyclables and hard-to-recycle materials, such as carpet, electronics, and batteries, oil, paint and anti-freeze (BOPA materials). Eco-Depots can be co-located with thrift stores, recycling centers, or landfills.

Eco-Industrial Park & Eco-Business Park

An industrial development where by-products from one manufacturing process can be used at another co-located remanufacturing facility. Can also include siting remanufacturing activities next to processors of recycled materials.

Generator

Single-family and multifamily residents, commercial and institutional businesses that discard materials for diversion or disposal. Entities that collect materials for diversion or disposal are not considered generators of the collected material.

---

[1] Definition excerpted from Wikipedia article on "Social Marketing" http://en.wikipedia.org/wiki/Social_marketing (accessed February 21, 2011).

[2] McKenzie-Mohr, D. (2000). Fostering sustainable behavior through community-based social marketing. American Psychologist, 55(5), 531-537.

Household Hazardous Waste

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste" or "HHW." Products such as paints, cleaners, oils, batteries, and pesticides that contain potentially hazardous ingredients and require special care when discarded.

Legacy Discards

Materials that cannot be recycled or composted and have been "designed for the dump." These materials were designed before Zero Waste systems were in place and will continue to need to be handled through municipal collection programs for many years to come.

Materials Recovery Facility

A "Materials Recovery Facility" or "MRF" is a facility specifically designed to accept mixed materials, such as recyclables or trash, and separate them into commodities to be sold or further processed. "Clean MRFs" are designed for clean materials, such as recyclables that have been collected from curbside recycling programs. "Dirty MRFs" or "Mixed Materials Processing Facilities" process trash or garbage collected from residential or commercial garbage collection programs.

Municipal Solid Waste

Municipal Solid Waste is defined at 30 TAC 330.3(88) as: "Solid waste resulting from or incidental to municipal, community, commercial, institutional, and recreational activities, including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial solid waste." For purposes of this plan, the term 'solid waste' shall mean municipal solid waste.

Organics

Materials such as yard trimmings, food scraps, and food-soiled paper, which can be aerobically composted and used as a soil amendment.

Planning Period

The "Planning Period" referenced in the local Solid Waste Management Plan covers the period from 2011through fiscal year 2060.

Recyclable Materials

Recyclable materials is defined at 30 TAC 330.3(122) as: "A material that has been recovered or diverted from the nonhazardous waste stream for purposes of reuse, recycling, or reclamation, a substantial portion of which is consistently used in the manufacture of products that may otherwise be produced using raw or virgin materials. Recyclable material is not solid waste. However, recyclable material may become solid waste at such time, if any, as it is abandoned or disposed of rather than recycled, whereupon it will be solid waste with respect only to the party actually abandoning or disposing of the material." Compostable materials are considered recyclable.

Resource Recovery Centers

Facilities, typically located at transfer stations and landfills where materials that are self-hauled by residents and businesses can be conveniently separated for reuse, recycling and composting. The most comprehensive Resource Recovery Centers have space available for diverting materials into the different Categories of Recyclable Materials.

Zero Waste

As defined by the Zero Waste International Alliance, Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.[3]

[3] Zero Waste International Alliance, Zero Waste Definition, http://www.zwia.org/ (accessed November 3, 2010)