



LBA ASSOCIATES

June 11, 2020

Charlotte Pitt, Interim Director
Solid Waste Management Division
PO Box
Denver, Colorado

RE: Denver Waste Reduction Strategy

Dear Charlotte:

LBA Associates, Inc. is pleased to present our recommendations for the Denver Waste Reduction Strategy. The strategy addresses city-wide policy, program and infrastructure improvements needed to achieve a landfill diversion rate of 50% by 2030. It represents an update to Denver's 2010 Solid Waste Management Plan.

The LBA Associates Team responsible for this work includes LBA Associates, Kessler Consulting and A² Solutions. We are privileged to have had this opportunity to continue our working relationship with DSWM and to establish the foundation for and implementation of a rigorous approach to diversion in the city's residential, commercial and construction sectors.

We would like to acknowledge and thank you and your staff for the assistance provided for data collection, research, analysis and ground-truthing – without this support our recommendations would not have been as far-reaching or as effective.

Sincerely,

A handwritten signature in black ink, which reads "Laurie Batchelder Adams". The signature is written in a cursive, flowing style.

Laurie Batchelder Adams,
LBA Associates, Inc. President & DWRS Project Manager

cc: Mitch Kessler, KCI
Peter Engel, KCI
Alicia Archibald, A²



DENVER WASTE REDUCTION STRATEGY 2020-2030

Prepared for Denver Solid Waste Management
June 2020

Prepared by LBA Associates, Inc.
with Kessler Consulting, Inc.
and A² Solutions, LLC

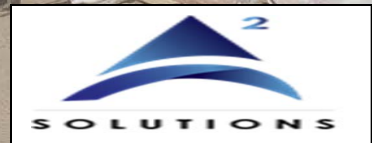


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List of Acronyms & Abbreviations

A1	A1 Organics
Admin	Administrator
Assist	Assistant
BLDGS	Buildings
BOH	Back-of-house
CCF	Clean community fee
C&D	Construction and demolition
CCTS	Cherry Creek Transfer Station
CDPHE	Colorado Department of Public Health & Environment
CGD	Certiifiably Green Denver
CP&D	Denver Community Planning & Development Department
CY	Cubic yard

DADS	Denver Arapahoe Disposal Site
DEDO	Denver Economic Development & Opportunity Department
DE&L	Denver Excise & Licensing Department
DIR	Director
DWRS	Denver Waste Reduction Strategy
DHA	Denver Housing Authority
DOC	Drop-off center
DOTI	Denver Department of Transportation & Infrastructure
DPHE	Denver Department of Public Health & Environment
DPR	Denver Parks & Recreation Department
DPS	Denver Public Schools
DRCOG	Denver Regional Council of Governments
EO	Executive Order
EPF	Environmental protection fee
Equip	Equipment
ETC	Extra trash collection
FAQ	Frequently asked question
FOH	Front-of-house
FTE	Full-time equivalent
FRWD	Front Range Waste Diversion (grant program)
GFL	Green for Life Environmental
GHG	Greenhouse gases
HHW	Household hazardous waste
ICI	Institutional, commercial & industrial
IGA	Intergovernmental agreement
Inc	Incorporated
IPM	Denver Infrastructure Project Management Division
K	Thousand
LBA	LBA Associates
LEED	Leadership in Energy & Environmental Design
LIP	Large item pick-up
LLC	Limited liability corporation
M	Million
MTCO ₂ E	Metric tons of carbon dioxide equivalents
MFU	Multi-family units
MRF	Materials recovery facility
O+M	Operations and maintenance
OCC	Old corrugated cardboard
OEDIT	Colorado Office of Economic Development & International Trade
Oper	Operator
PAYT	Pay-as-you-throw
Pgm	Program

PPP	Public private partnership
QRTLY	Quarterly
RREO	Recycling Resources Economic Opportunity Grant
SDO	Colorado State Demography Office
SRF	Special Revenue Fund
Super	Supervisor
SWM	Denver Solid Waste Management Division
SWMP	Solid Waste Management Plan
TPY	Tons per year
USCC	U.S. Composting Council
USEPA	U.S. Environmental Protection Agency
UWRO	Universal Waste Reduction Ordinance
WM	Waste Management

Section 1.0 INTRODUCTION

The City and County of Denver is the 19th largest city in the U.S. and has a thriving population. The city also generates a substantial waste stream that will continue to grow as individuals, businesses and industries move to and expand into the metropolitan area. This waste stream demands an aggressive strategy that minimizes the city's reliance on landfill disposal by maximizing cost-effective and practical alternatives.

The materials management systems that currently serve the city are a de-centralized mix of programs and facilities. At an estimated waste generation level of 2.3M tons/year and landfill diversion rate of only 20%, there is opportunity to coordinate efforts and objectives with a greater commitment to non-disposal solutions and emphasis on reuse, recycling and organics recovery practices.

The Denver Waste Reduction Strategy (DWRS) builds upon a facts-based and collaborative process that prioritizes a broad universe of waste reduction approaches to identify and evaluate those short- and long-term improvements best able to cause effective change in waste generation and management practices city-wide. It covers a 10-year planning period from 2021 to 2030 and considers phased implementation of sequential improvements that build on one another.

1.1 DWRS OBJECTIVES

The waste diversion goals that were established to initially drive the long-term agenda for this DWRS were developed by the Solid Waste Management Division (SWM):

- Divert 50% of all solid waste generated by 2025
- Divert 70% of all solid waste generated by 2030

To meet these goals, several critical objectives must be met:

- Identify policy, program and infrastructure improvements that will build on current successes to catalyze additional, substantive landfill diversion across all city sectors
- Build support for an integrated organizational structure, sustainable funding and public/private partnerships
- Leverage improvements made in Denver throughout the metropolitan area

Over the following pages, the LBA Team evaluates projected landfill diversion progress based on recommended DWRS policy, program and infrastructure improvements against SWM's city-wide diversion goals. In Section 6.0 the team suggests adjustments that more reasonably reflect what can be achieved by 2030.

1.2 DWRS DEVELOPMENT

The DWRS has been funded by a Recycling Resources Economic Opportunity (RREO) grant from the Colorado Department of Public Health and Environment (CDPHE). It addresses all waste generated across Denver. As such, it will provide some of the first strategic thinking - and action - around commercial and industrial materials management by local governments in Colorado.

This strategy has been developed for the Denver Solid Waste Management (SWM) division by Denver-based LBA Associates, Inc. and Kessler Consulting, Inc. of Tampa, FL. The LBA Team has worked with SWM for nearly 20 years on multiple research, assessment, planning and procurement projects. A² Solutions, LLC of Colorado Springs, CO, has also been a key contributor to the DWRS.

The DWRS is organized to include:

- Section 1 - Introduction
- Section 2 – Background
- Section 3 – Current Solid Waste Systems
- Section 4 – Short-Term Recommendations
- Section 5 – Long-Term Recommendations
- Section 6 – Conclusions

1.3 STRATEGY PARAMETERS

The DWRS is based on data provided by city departments and divisions, as well as on knowledge and information brought to the project by the LBA Team. There are several general parameters associated with its development.

Data

- 2018 is the base year for materials quantities, hauler reporting and population estimates (unless otherwise stated)
- All cost estimates are made in 2020 dollars - cost references for existing programs and budgets will be based on current year actuals wherever possible
- Rounding errors may occur in some tables and appendices

Short- & Long-Term Periods

For the purposes of the 10-year DWRS planning period, the short-term is generally used to reference the first five years extending through 2025. The long-term references 2026 through 2030.

Projected Quantities

The LBA Team developed projections of total waste generation, diversion and landfill quantities which serve as the basis for the DWRS strategies and recommendations. These projections are driven primarily by population growth and SWM's diversion goals. Appendix A provides quantity estimate details including

assumptions about sector growth and material capture levels. In some cases these projections differ slightly from estimates in other analyses due to assumptions and information that was revised over the several months during which the DWRS was developed.

Hauler-Reported Trash, Recyclables & Organics Quantities

Commercial and construction quantity data provided by private haulers for 2018 have not been confirmed by SWM. Instead, these quantities have been analyzed by the LBA Team and found to likely under-report actual sector quantities by approximately one-third. This under-reporting likely includes recyclables transferred directly to market by generators, materials not regulated and/or not measured, and quantities not reported by the private sector. Unless otherwise noted, an adjustment has been made throughout the DWRS to total commercial and construction tons to reflect an appropriate correction. Appendix B provides a basis for this adjustment based on industry housing and employment data.

Commercial and Construction References

As haulers typically classify any dumpster and compactor collection as “commercial”, this term is used in the DWRS to reference large residential, commercial, institutional and small industrial generators and materials (unless otherwise defined). Similarly, as haulers generally classify roll-off collection as industrial and roll-offs most commonly contain construction debris, the term “construction” will be used to connote the non-commercial, industrial construction sector waste stream going forward.

Disclaimer

Any recommendations made, perspectives shared, or conclusions reached in the development of this DWRS are solely those of the LBA Team, and not necessarily those of the City and County of Denver.

Section 2.0 BACKGROUND

This section provides an overview of existing SWM and private waste management operations, progress to date and the need for more effective landfill diversion. There are three distinct sectors within Denver for which waste generation and management vary widely:

- Small residential – homes ranging from single-family to 7-unit complexes (served by SWM)
- Commercial – large residences of 8 or more, businesses, institutions and small industrial (served primarily by private haulers)
- Construction – served by private haulers

Table 2.1 shows population and waste stream expectations over the DWRS period.

	Population	Small Residential Tons (collected by SWM)	All Other Tons (collected by private haulers)	Total
2018	718,100	223,100	2,145,000	2,368,100
2020 (estimate)	738,600	224,700	2,206,200	2,431,000
2025 (estimate)	783,500	228,200	2,340,300	2,568,500
2030 (estimate)	827,700	231,700	2,472,200	2,703,900

Denver is the cornerstone of the greater metropolitan region, which is generally defined by the Denver Colorado Council of Governments (DRCOG) membership. This group will have a population of about 3.8M by 2030. Less than a third of these communities currently provide public collection (like Denver) or contract for residential collection; the rest have limited control over services in their jurisdictions. While some DRCOG members have begun discussion around the need for regional partnerships, there has been no substantive collaboration in terms of landfill diversion to date. With an effective DWRS, Denver will be in a position to provide leadership by establishing policies that other DRCOG members can duplicate and by facilitating partnerships around future regional infrastructure improvements.

2.1 CITY-WIDE SOLID WASTE SYSTEM OVERVIEW

Denver's solid waste services are jointly managed by SWM (with core collection service to small residences) and the Denver Department of Public Health and Environment (DPHE), which oversees contract operation of the city-owned Denver Arapahoe Disposal Site (DADS). These functions are not formally coordinated. The Denver Excise and Licensing Department (DE&L) also has a role in private hauler licensing.

SWM DIVISION

The commitment to and follow through on all current and future landfill diversion activities resides primarily with SWM, which is housed within the Department of Transportation and Infrastructure's (DOTI) Utilities Department. This division has significant assets and programs that include:

- Trash and recyclables collection for approximately 180,000 households – compost subscription to about 18,000 homes
- Service to city facilities – including Denver Public Schools (DPS), Denver Housing Authority (DHA), Denver Parks and Recreation (DPR) and other government buildings
- 105 small residential collection routes including weekly trash, monthly trash overflow/bulky waste, every-other-week recyclables and organics, and seasonal waste streams
- More than 180 full-time staff – supervisors, program managers, administrators, drivers, inspectors and maintenance staff
- Four fleet maintenance centers, one in each city quadrant – Cherry Creek, Osage, Platte & Roslyn
- Cherry Creek Transfer Station (CCTS) in southeast quadrant – with transfer of trash, recyclables and seasonal yard waste
- Public drop-off center (DOC) for residential recycling and seasonal debris collection (located at CCTS)
- Contract processing of single-stream recyclables and organics
- Contract collection for electronics, appliances and household hazardous waste
- Residential education and outreach
- Graffiti, Keep Denver Beautiful and Homelessness programs
- \$27M (2020) - does not include capital improvements, new programs or infrastructure (such as PAYT, transfer station, others identified in the DWRS) or fleet maintenance

DPHE DEPARTMENT

DPHE is responsible for the operation of DADS, which is operated under contract to Waste Management (WM) for the foreseeable life of the facility (estimated at about 130 years). DADS is the largest landfill in Colorado and serves the greater metropolitan area including both public and private haulers. Key attributes of this facility include:

- Permitted area of nearly 1,300 acres
- Accepted over 1.5 million tons/year of non-hazardous solid waste, biosolids, asbestos and other waste (2019)
- Includes a landfill gas-to-energy system (power is exported to Xcel)

DPHE will earn an estimated \$3M in annual royalty payments from WM in 2020.

DPHE staff also conduct several sustainability activities separate from DADS including Certifiably Green Denver (CGD) which provides technical assistance to and recognizes businesses and neighborhoods for environmental activities including landfill diversion practices.

DE&L DEPARTMENT

DE&L manages the private hauler licensing process, collects hauler data for SWM tracking and is responsible for enforcement of hauler regulations. Since these requirements became effective in 2016, DE&L and SWM have been working to move to on-line registration, streamline reporting and improve database capabilities; these changes have not yet been made.

DENVER DIVERSION-RELATED POLICIES AND REGULATIONS

In addition to the hauler ordinance described above, Denver has very few policies that incentivize or require waste diversion and most have only recently been promulgated:

- Requirement for new residential complexes with more than 5 units to provide space for recycling and organics separation and containment (2019)
- Requirement for retail stores to charge \$0.10 for disposable bags provided to customers (effective July 2021)

Other policies impacting the sustainability of city operations includes several executive orders (EOs):

- EO 115 – requires waste generated by city operations to be disposed at DADS
- EO 123 – includes requirements for green city fleets; at least LEED Gold certification for new city buildings greater than 5,000 square feet and major renovations; environmentally-preferable purchasing and waste reduction practices in city operations; use of recycled material in construction of city projects; and building maintenance per LEED for all facilities

A final relevant policy is Denver’s 80 X 50 Climate Action Plan, which recognizes improved landfill diversion as a key method for reducing greenhouse gases (GHGs). In support of this policy, DPHE applied a life cycle-based methodology to estimate that approximately 842,700 metric tons of carbon dioxide equivalents (mtCO₂e) are avoided by current waste reduction practices in Denver^{1,2}.

2.2 PRIVATE SOLID WASTE SYSTEM OVERVIEW

Over 80 private haulers provided collection services in Denver in 2018. Their customers include all residential, commercial and industrial generators not served by SWM. Private haulers also own and operate transfer stations, DOCs, material recovery and compost facilities, and landfills in the region. Some of these accept portions of Denver’s waste stream and most charge tip fees.

While haulers are required to be licensed and report annual quantities, there are currently no city requirements for haulers or their customers to separate or divert recyclables or organics.

¹ This reduction is equivalent to the annual emissions generated by about 32,400 U.S. citizens or by 183,200 passenger cars.

² “Final Updated Denver LCA Memo,” Lotus Engineering & Sustainability, April 2020.

2.3 PREVIOUS DENVER SOLID WASTE PLANNING EFFORTS

The SWM division developed a Solid Waste Master Plan in 2010 (SWMP) that considered some policies for large residential and commercial landfill diversion, but primarily focused on small residential materials management. The 2010 SWMP planning period extended through 2020; Denver's DWRS is both a timely update of that plan and a necessary expansion to a city-wide landfill diversion approach.

Table 2.2 (on the next page) summarizes progress made to date on the 2010 SWMP recommendations to current status. As shown, most of the 2010 SWMP recommendations have yet to be implemented. Reasons include lack of dedicated funding, increasing recycling costs, operations and programs supported by the General Fund and other dynamics not directly associated to solid waste but still constraining resource allocation to SWM programs and infrastructure.

The most telling indicator of success in Table 2.2 is the last row which compares the potential small residential landfill diversion if the 2010 SWMP recommendations were implemented (147,600 tons) versus the diversion actually achieved through the end of 2019 (only 51,600). This finding underscores the missed opportunity represented by the 2010 planning effort.

2.4 NEED FOR MORE AGGRESSIVE WASTE REDUCTION

Denver currently ranks in the bottom third of the 30 largest U.S. cities with respect to aggressive landfill diversion planning (Appendix C shows that most of these cities have strategies for short-term goals of 80% or greater). Denver is also far from the top performer in Colorado, with several Front Range cities whose residential diversion ranges from 27% to 60%³. Based on the city-wide progress to date and the lack of 2010 SWMP implementation, it is clear that a more aggressive materials management approach is needed to address the city's:

- Continued reliance on landfills – 80% of the city's wastes are currently disposed
- Increasing cost to haul and process diverted materials
- Lack of regional landfill diversion policy and leadership

This DWRS will identify those short- and long-term strategies needed to set Denver on a path to achieve substantial increases in sustainable materials management.

³ "The State of Recycling in Colorado," EcoCycle, 2019 (top performing cities include Boulder, Fort Collins, Golden, Greenwood Village, Lafayette, Longmont, Louisville, Loveland and Superior).

Table 2.2 2010 SOLID WASTE MASTER PLAN STATUS

Plan Recommendation	Status	Date Completed
Short-Term (2011-2015)		
Standardize refuse collection & expand collection of diverted materials	Small residential trash transitioned to roll carts	Completed 2017
	Recycling provided to all 1-7 units	Completed 2019
	Subscription organics collection added	Full scale in 2013
Reduce large item pick-up (LIP) & refuse overflow collections	LIP collections have been increased from every 5 weeks prior to 2010 SWMP to every 4 weeks currently	Not completed
Add two new drop sites	One drop site developed at Cherry Creek transfer station property	Cherry Creek completed 2014
Implement hauler licensing/data reporting & collection policy	New hauler licensing/reporting policy	Completed 2016
	Require haulers to collect diverted materials	Not completed
Require large restaurants to divert organics		Not completed
Implement MFU refuse collection verification program		Not completed
Add paint collection to HHW program	Paint was included in third-party collections; city supports CO Paint Care	Completed 2010
Long-Term (2016-2020)		
Add third drop site		Not completed
Implement variable trash rates	Pay-as-you-throw program has been developed but implementation expected 2021 or later	Not completed
Improve the Cherry Creek Transfer Station (increase trash capacity)	New, larger trash bay added & existing bay transitioned to recyclables transfer (plans for third compost bay underway in 2020)	Completed 2015
Add new transfer station in northeast quadrant of city		Not completed
Implement new construction diversion requirements city-wide		Not completed
Adopt diversion goal for small residents of at least 50% by 2030	City-wide goals set by SWM 50% by 2025, 70% by 2030	Completed 2019
Expand public education to address other recommendations	Efforts associated with improvements (above) that were completed	Completed 2017
Overall 2010 SWMP Planning Period		
Goal – reduce disposal of residential waste to 178,100 tons/year by 2020	Disposed of only 171,500 tons in 2018 (179,300 tons in 2017)	Completed 2018
Divert 147,600 tons from small residential sector by 2020	As of December 2019 only 54,200 tons have been diverted	Not completed

Section 3.0 CURRENT SOLID WASTE SYSTEMS

This section presents a more detailed description of the waste generation sectors and materials across the city. It also quantifies landfill diversion successes to date and estimates quantities that will require management over the 10-year planning period.

3.1 SMALL RESIDENTIAL SECTOR

This sector includes about 180,000 households eligible for SWM service that are between one and seven units in size; the largest category of these are single-family homes at about 75% of total small residences. Ninety-two percent of eligible households participated in the city's curbside recycling program in 2018, while 10% subscribed to curbside organics collection. Core solid waste services (namely curbside trash and recyclables collection) are provided at no cost, while composting is a fee-based program. Residential carts are collected primarily with automated side-loading equipment. Table 3.1 summarizes the material metrics for this sector, including estimated future quantities based on SWM diversion goals (see Appendix A).

	2008	2013	2018	2020 (estimate)	2025 (estimate)	2030 (estimate)
Population	593,100	649,500	718,100	738,600	783,500	827,700
Total Waste Generation	247,700	242,400	223,100	224,700	228,200	231,700
Per-Person Generation (pounds/person-day)	2.3	2.0	1.7	1.7	1.6	1.5
Trash	219,700	206,000	171,500	171,800	114,200	69,200
Curbside Recyclables	28,100	33,200	40,600	41,000	52,000	57,000
Curbside Organics	0	1,200	8,100	9,000	46,000	80,000
Other Diverted Materials⁴	0	2,000	2,900	2,900	16,000	25,500
Landfill Diversion Rate	11%	15%	23%	24%	50% (goal)	70% (goal)

HISTORICAL SUCCESSES

Despite an increasing population, the total tons of waste generated (and per-person generation rate) decreased between 2008 and 2013. These decreases were significant and can in part be attributed to seasonal precipitation (periodic droughts decreased green waste generation), changes in waste materials (less paper and lighter packaging reduced weights) and program changes (moving from a dumpster to a cart-based system likely reduced waste generation).

⁴ These include plastic film, Styrofoam, batteries, paint and other hard-to-recycle materials not collected by SWM.

Landfill diversion rates more than doubled through 2018 and reflect continued education and program efforts by SWM as well as providing recycling to all eligible households, offering subscription organics collection and adding the CCTS DOC. The current 23% rate, however, remains significantly below the national average of 35% reported by the USEPA for municipal solid waste sectors in 2017, and is less than half of SWM’s goal for 2025.

FUTURE PROJECTIONS

For the purpose of the DWRS, SWM’s diversion goals have been used to estimate waste generation and landfill diversion. These goals were based largely upon expected implementation of a pay-as-you-throw (PAYT) fee system for small residential trash, recyclables and organics collection in 2021. PAYT will represent a sharp contrast to the current system (which assesses no user fees for trash and recycling collection). SWM anticipates that residential recycling and composting will increase significantly, and customers will generate less trash overall as they are offered the ability to control their trash costs. These assumptions lead to high estimates for diverted materials; they could under-estimate trash quantities if PAYT is implemented later than expected.

DIVERSION POTENTIAL

Figure 3.1 identifies the potential for further diversion of small residential trash. Table 3.2 (next page) lists the top divertible materials in that stream (both were measured by the LBA Team during a 2016/2017 composition study of representative trash samples – see Appendix D for additional detail). This study estimated that trash samples analyzed had a potential diversion of 69%.

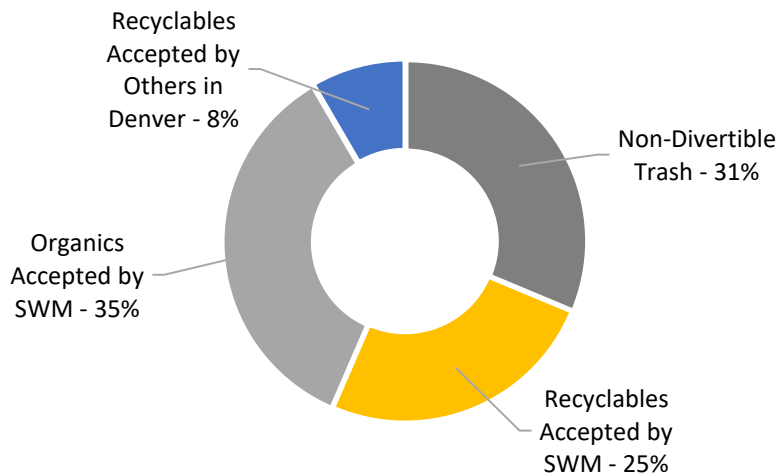


Figure 3.1 POTENTIAL FOR DIVERSION OF SMALL RESIDENTIAL TRASH (percent by weight)

Table 3.2 TOP TEN DIVERTIBLE MATERIALS IN SMALL RESIDENTIAL TRASH

Material	% By Weight
Food Waste	18.6%
Yard Waste	16.5%
Glass Containers	4.2%
Film, Bags, Wrap	4.2%
Cardboard	3.5%
Mixed Paper/Junk Mail	3.1%
Paperboard/Chipboard	2.4%
Office Paper	1.7%
PET Bottles	1.6%
Newspaper	1.5%

DIVERSION CHALLENGES

Current challenges SWM faces with small residential customers include:

- What residents perceive as “free” trash service (no user fee) is a disincentive to diversion
- Extra trash (ETC) and large-item (LIP) collections allow for virtually unlimited trash overflow and bulky items
- Only 10% of eligible households subscribe to the fee-based compost program
- Significant seasonal waste (leaves) is not collected curbside – residents are required to drive to a temporary collection point
- Away-from-home diversion practices differ from small residential programs – which causes confusion and misses an opportunity for reinforcement

Additional implementation challenges SWM faces include:

- Low landfill disposal costs and limited economic incentive to increase landfill diversion
- Historical lack of support for waste reduction policy at local, regional and state level
- Increasing cost of processing single-stream recyclables at the city’s contract material recovery facility (MRF)
- Cost of transporting organics to the city’s contract compost facility (located 43 one-way miles from center of Denver)
- Lack of MRF and compost facility capacity for significant increases in diverted quantities
- Reliance on the city’s General Fund restriction of resources for new and expanded programs

3.2 COMMERCIAL SECTOR

The commercial sector includes primarily dumpster collection of large residential or multi-family units (MFU), commercial, institutional and small industrial waste (excluding construction). SWM provides some dumpster collection in this sector (limited to DPS, DHA, DPR and government buildings).

QUANTITIES

Table 3.3 summarizes commercial material metrics (these have only been collected by SWM since 2016). Interestingly, the commercial sector capture rate in 2018 was not dissimilar to the small residential rate (also 23%), despite vastly different programs and incentives for diversion.

Table 3.3 COMMERCIAL MATERIAL STREAMS (tons/year unless otherwise noted)					
	2018 (as reported)	2018 (adjusted)	2020 (estimate)	2025 (estimate)	2030 (estimate)
Total Waste Generation	608,000	938,000	964,800	1,023,400	1,081,100
Trash	468,000	722,300	742,900	511,700	324,300
Recyclables⁵	112,900	215,700	221,900	341,100	504,500
Organics	27,100			170,600	252,300
Landfill Diversion Rate	23%	23%	23%	50% (goal)	70% (goal)

DIVERSION POTENTIAL

Figure 3.2 and Table 3.4 (on the next page) show the potential for further diversion and the top divertible commercial materials, respectively (as measured by the LBA Team in a 2019 composition study – see Appendix E for additional detail). This study estimated that trash samples analyzed had a diversion potential of 74%.

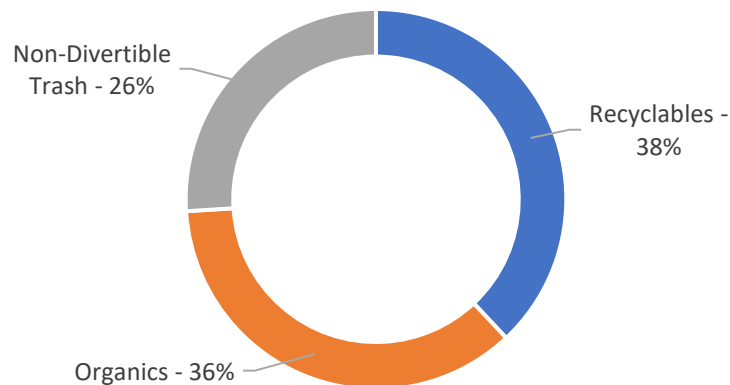


Figure 3.2 POTENTIAL FOR DIVERSION OF COMMERCIAL TRASH (percent by weight)

⁵ Based on hauler reports and waste audit findings, a 2:1 ratio has been assumed for the relative amount of recyclables and organics diverted by this sector.

Material	% By Weight
Food Waste	24.5%
Cardboard	8.3%
Compostable Paper	7.3%
Film, Bags, Wrap	6.0%
Paperboard/Chipboard	2.2%
Clean Wood	2.2%
Yard Waste	1.7%
Mixed Paper/Junk Mail	1.6%
Plastic Non-Bottle Containers #1-#7	1.4%
Bulky Rigid Plastics	1.4%

DIVERSION CHALLENGES

Achieving SWM's diversion goals in this sector will require a level of influence by the city that incentivizes and/or requires effective waste reduction practices. This control is expected to include solid short-term policy and infrastructure improvements, followed by substantive programming in the long-term. Current challenges include:

- Low disposal costs
- Lack of incentives and diversion mandates (and lack of similar policy in other communities, at regional or state level)
- Multiple waste generators in most buildings and inconsistent messaging
- Frequent disconnect between property managers and owner/tenant generators
- Only one available no-cost drop site (operated by SWM, available to residents only)
- Lack of space for recyclable and organics containers
- Limited recyclables and organics processing capacity
- Increasing cost of processing single-stream recyclables at local MRFs
- High cost of transporting organics to processing facilities
- High recyclables and organics contamination levels (minimal education about material quality)
- Incomplete data – including commercial generators who self-haul (e.g. landscapers) and those who ship recyclables directly to processors/markets (e.g., large grocers)

As part of DWRS development, SWM solicited input from private haulers, MFU owners/managers (including homeowners associations) and numerous businesses and business organizations concerning approaches for increasing landfill diversion from the commercial sector. Haulers generally felt that local government needs to standardize accepted recyclables, require property owners to provide more space for material containers and work to decrease contamination levels. Waste generators themselves identified several obstacles (see Table 3.5 on the next page).

Table 3.5 DIVERSION OBSTACLES FOR COMMERCIAL GENERATORS	
<p><u>Restaurants</u></p> <ul style="list-style-type: none"> ✚ Lack of diversion mandates ✚ Logistical challenges with front of house operations ✚ High cost of alternative products & packaging ✚ Lack of space 	<p><u>Businesses</u></p> <ul style="list-style-type: none"> ✚ Many different types of businesses in multi-company properties - messaging cannot be one-size-fits-all ✚ Older buildings with less common & storage space often need more training and incentives
<p><u>Groceries</u></p> <ul style="list-style-type: none"> ✚ Need to “de-package” food ✚ High contamination ✚ Food donation organizations cannot accommodate significantly more food waste 	<p><u>Merchant Associations</u></p> <ul style="list-style-type: none"> ✚ Numerous waste generators within same block, all with discrete contracts & different services/terms ✚ Inability to provide materials management assistance to members
<p><u>MFU Generators</u></p> <ul style="list-style-type: none"> ✚ Owners cannot increase rents for new services for foreseeable future ✚ Some buildings use valet/many do not – not all services include recycling ✚ Lack of consistency in programs & messaging (confusion decreases diversion/increases contamination) 	<p><u>All Generators</u></p> <ul style="list-style-type: none"> ✚ Lack of space for extra recycling/compost containers ✚ Not all haulers provide recyclable & organics collection service ✚ Diversion costs are too high ✚ Dissatisfaction with hauler service (some recyclables landfilled, evergreen clauses in hauler contracts lead to unwanted renewals)

3.3 CONSTRUCTION SECTOR

This sector includes materials generated during construction and demolition (C&D). The sector encompasses both public projects (typically with contract builders) and private projects. Construction projects vary dramatically in terms of number and size - both have been on the upswing during the last few years (this may change in the future as the economy shifts in response to dramatic events such as coronavirus and other factors). There are numerous project types including road and bridge, building, roofing and environmental projects; demolition and land-clearing can be part of larger projects or stand-alone. The waste generated at each also varies widely throughout the course of the project.

QUANTITIES

Table 3.6 (next page) summarizes the material metrics for this sector (as with the commercial sector, construction metrics have only been collected by SWM for two annual cycles). It is probable that this sector currently achieves the highest diversion city-wide. However, the inability to track haulers moving debris, the lack of city incentives/disincentives, the difficulty measuring recyclables and the lack of processing options for mixed materials notably increase the obstacles associated with recycling in this sector.

	2018 (as reported)	2018 (adjusted)	2020 (estimate)	2025 (estimate)	2030 (estimate)
Total Waste Generation	804,600	1,207,000	1,241,500	1,316,900	1,391,100
Trash	665,400	998,200	1,026,700	658,500	417,300
Recyclables	139,200	208,800	214,800	658,500	973,800
Landfill Diversion Rate	17%	17%	17%	50% (goal)	70% (goal)

DIVERSION POTENTIAL

A visual audit of construction loads generated from projects throughout Denver was conducted in 2019. These loads represented mixed construction debris from renovated and new construction building projects, and some demolition (see Table 3.7 for the most prevalent materials).

Aggregate products, untreated wood, and yard waste could have been diverted through existing programs. Metal and cardboard (measured in lower quantities than those shown in the table below) could also have been diverted.

Material	% By Weight
Aggregate Products (from concrete, asphalt also rock & grit)	10% -27%
Treated Wood	10% - 19%
Drywall	6% - 21%
Roofing Shingles	<1% - 25%
Untreated Wood	7% - 11%
Mixed Materials	3% - 14%
Yard Waste	3%- 8%

DIVERSION CHALLENGES







Current challenges to materials management in the construction sector include:

- Difficulty separating out divertible materials (especially from demolition debris)
- Lack of project space to containerize sorted materials
- Low landfill disposal costs and lack of incentives and diversion mandates
- Lack of mixed construction and demolition debris processing facilities in Colorado
- Lack of end-markets

⁶ Quantity projections are based on the current economy which may not be sustained over the DWRS planning period. For the purpose of early planning in the DWRS, it is expected that most diverted materials will be recyclable.

- Lack of quantity information – some C&D haulers are not licensed nor reporting quantities to DE&L; other haulers (including those transporting materials from Denver-owned projects) bypass facility scales which results in less accurate quantity tracking
- Lack of regional or state policy
- Lack of representative data – especially materials which are recycled on-site and exempt from reporting (primarily aggregate products)

SWM also conducted stakeholder meetings with contractors active in Denver, who expressed additional diversion challenges (see Table 3.8).

Table 3.8 DIVERSION OBSTACLES FOR CONTRACTORS	
	Small projects do not generate enough divertible material to warrant the space and cost
	Requirements for any project beyond aggregate recycling would be a hardship until cost-effective mixed waste processing is available locally
	End-market solutions are needed at a regional/state scale (especially drywall & asphalt shingles)
	City-owned projects need to be subject to diversion requirements (and could be used as pilot study for private projects)
	LEED projects do not necessarily result in diversion (recycling points are optional as long as minimum totals are earned)
	SWM reporting needs to be stream-lined and track soils

3.4 OVERALL DENVER WASTE STREAM

Using commercial and construction tons as reported by haulers for 2018 (without adjustment), SWM has previously considered the size of each waste generating sector in the city to be as shown in Figure 3.3 (on the next page). When the hauler-reported tons are adjusted to account for incomplete data, however, the relative weight of each sector changes, and the small residential sector drops to 9% of the total waste generated and managed in the city (see Figure 3.4 on the next page).

This finding emphasizes the necessity for Denver to prioritize policy, programs and infrastructure that supports landfill diversion by the commercial and construction sectors. Without this priority, the city will continue to make progress but in such a small portion of the city waste stream that achievement of SWM’s diversion goals may not be possible.

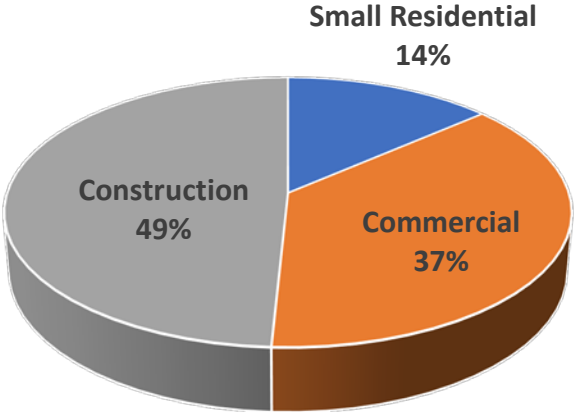


Figure 3.3 WASTE GENERATION BY SECTOR - UNADJUSTED

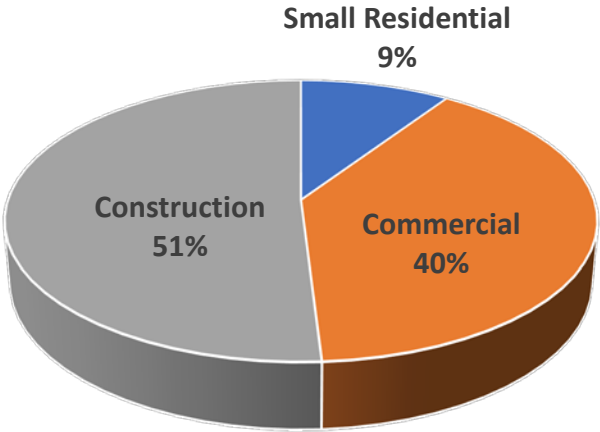


Figure 3.4 WASTE GENERATION BY SECTOR - ADJUSTED

Section 4.0 SHORT-TERM RECOMMENDATIONS

Short-term recommendations are deemed to be time-critical for the purpose of the DWRS based on one or more of the following criteria:

- A necessary foundational step to support the implementation of other critical waste reduction improvements
- Impactful in terms of ability to increase landfill diversion, improve cost-effectiveness and/or raise public awareness
- Pivotal in controlling city costs that are currently set by the private sector
- Improvement already in progress by 2020

Top priority recommendations should be undertaken and completed during the five-year period between 2021 and 2025. Some recommendations will not likely be completed until later in the DWRS period.

4.1 UNIVERSAL WASTE REDUCTION ORDINANCE

Denver's commercial and construction sectors collectively account for more than 90% of Denver's total waste stream and represent a sizeable potential for landfill diversion. There are multiple obstacles, however, including the lack of SWM's influence in terms of incentive and mandates. Development of a universal waste reduction ordinance (UWRO) can create the opportunity to better engage generators and haulers with improved program access, clearer management structure and technical assistance services.

CURRENT POLICY & NEED FOR IMPROVEMENTS

Denver implemented a hauler licensing policy (Chapter 48 Article V) in 2016. It requires private solid waste haulers operating in the city to be licensed through DE&L. Haulers are also required to report annual quantities of collected trash, recyclables, organics and other materials⁷. Estimates are allowed for hauler loads with a mix of Denver and non-Denver materials and for loads without access to truck scales. In 2018, over 80 haulers were issued operating licenses.


⁷ Defined as junk/cleanouts, landscape debris, scrap tires, scrap metal, electronic waste, etc.

The ability to track generation and diversion in the commercial and construction sectors has been critical to understanding future diversion opportunities on a city-wide basis⁸. However, the current policy leaves room for improvement on several levels (see Table 4.1).

Table 4.1 POTENTIAL AREAS FOR IMPROVING HAULER ORDINANCE
<p><u>License/Renewal Applications & Quantity Reporting</u></p> <ul style="list-style-type: none"> ✚ Hauler application/reporting is cumbersome – hard copy applications are required ✚ Staff estimate that a few commercial and many construction haulers are operating without a license – these may include small companies whose primary businesses is not hauling ✚ Quantity tracking requires double manual data entries and reliance on spreadsheet analysis ✚ Annual data is not timely – due to both slow analysis and need for tracking and correcting errors
<p><u>Accuracy of Reported Data</u></p> <ul style="list-style-type: none"> ✚ Reported commercial & construction quantities may be underestimated by one-third with materials generated by large business like some grocery stores, landscapers, contractors and others not captured (see Appendix B) ✚ Data does not allow insight to MFU quantities versus other commercial tons
<p><u>No Requirement for Trash Haulers to Provide Recyclables or Organics Collection</u></p> <ul style="list-style-type: none"> ✚ Some haulers collect one or both materials, but service is not universally available which limits the provision of diversion to tenants/owners

PROPOSED IMPROVEMENTS





Changes to Hauler Licensing & Reporting

 **Adopt a Database Program Designed for Waste Hauler Reporting** – The city’s current subscription software is not customized to track hauler or quantity data and is cumbersome. Ideally, new industry-configured software⁹ will:

- Have cloud-based, intelligent reporting forms that are fully customizable to Denver’s solid waste system
- Automatically track hauler compliance while maintaining confidentiality
- Automatically download application and quantity data to provide SWM with real-time access, minimal errors and the ability to query and export easily
- Allow comparison to key metrics in other municipalities
- Link to accounting software for billing, payment tracking and issuance of late notices
- In the future, facility reporting software could be added to this platform to facilitate tracking and reporting metrics at DADS, contract and city facilities




⁸ The State of Colorado tracks diverted material managed by processing facilities; this data is not specific to municipalities, counties or even regions.

⁹ ReTRAC Connect is one platform that allows comparisons with 200 U.S. municipalities; Colorado customers include Arvada, Breckenridge, Boulder County and Fort Collins, CO. Green Hale and Starlight software are alternative platforms used for tracking construction waste metrics.

-  **Require Haulers to Differentiate Between Commingled and Source-Separated Materials** – Adding these materials to the annual reporting form should be a simple adjustment and will increase information available for evaluating program successes and opportunities in the future.
-  **Require Haulers of Commercial Materials to Provide Recyclables & Organics Collection Services Upon Customer Request** – Haulers should be allowed to subcontract material collection, as long as customer service contracts remain with the primary hauler and have consistent term, standard of care and contract components as those used for trash collections.
-  **Implement Compliance Fees for Missed Renewal/Reporting Dates** – These fees should be separate from penalties established for municipal code violations and apply to late license renewals and late quantity reporting. They should be automatically added to the cost of the next license renewal.
-  **Encourage Material Weights for All Trash, Commingled and Source-Separated Recyclables** – Most transfer, landfill and MRF facilities in the metropolitan area have truck scales with the ability to measure or track vehicle tare weights. Actual enforcement is impractical but if SWM can investigate repeat offenders who rely on volume conversion, it may decrease the number of times drivers skip facility scales to save time and thereby increase data quality.

New Commercial Generator Requirements

These policy recommendations will be the basis for a UWRO that also applies to generators (or property managers/owners). At the present time there are approximately 170,000 MFUs and 180,000 businesses operating in Denver¹⁰. A recycling mandate is not recommended at this time – nor is a requirement for source-separation of food waste or other organics. It is recommended, however, that commercial diversion be required in the long-term, when processing capacity is expanded.


-  **Develop Database of Commercial Generators & Responsible Parties** – City records, residential and business organizations¹¹ will be needed to develop a database to track compliance and assess technical assistance needs.
-  **Require Commercial Generators to Subscribe to Trash Collection Service from a Licensed Private Hauler** – This requirement will help to ensure that only licensed haulers are used, to minimize illegal dumping of commercial waste and to establish a hauler relationship for future recycling activities. Compliance can be verified by including a copy of the hauler service contract in the generator's annual recycling plan.
-  **Require Commercial Generators to Develop/Update an Annual Recycling Plan** – This should be an on-line form prepared by SWM that allows commercial generators to identify and quantify materials

¹⁰ Per SWM staff and NAICS, January 2019.

¹¹ For example, the Apartment Association of Metro Denver, the Denver Building Owners and Managers Association, the Denver Business Improvement District.

that are diverted (either as reported by hauler or based on collection capacity). Applicability should be phased in with larger generator compliance required first. Reporting waivers should be available for parties with shared collection, home-based businesses and similar.


Construction Contractor Requirements

 **Develop Outreach to Contractors for Hauling Licenses and Data Collection** – Outreach efforts will likely require coordination with Denver’s Division of Infrastructure Project Management (IPM, which manages most of the city’s construction) and the Colorado Contractors Association (whose members work frequently on Denver road and bridge projects). Communications should work to:

- Increase licensure of C&D haulers
- Encourage measurement of materials reused/recycled on site (primarily clean soil and aggregate¹²) - volume-to-weight conversion factors may be needed
- Encourage use of facility truck scales to improve quantity data

While construction diversion activities are not expected to be required in the short-term, it is conceivable that they will be part of the city’s long-term DWRS. Information collected through this task will help inform future policy development and program planning.

Future Policy Expansion

 The short-term UWRO recommendations described above should be revisited for expanding generator requirements over the long-term planning period. These expansions may include:

- Require haulers to provide recycling collection to all commercial accounts – and organics collection to food establishments
- Require commercial generators to recycle – and food establishments to source-separate food waste (this would likely start with large businesses as described in the 2010 SWMP)
- Require construction projects to divert additional recyclables (see Section 5.3)

The ability to implement diversion requirements for these sectors will in large part be dependent upon development of additional processing capacity in the region (see Sections 4.5 and 5.1).

Table 4.2 (next page) identifies similar universal diversion policy components used by other municipalities.

¹² Colorado regulations exempt on-site industrial recycling operations from most requirements including reporting (6 CCR 1007-2, Part 1, Section 8.5).

Table 4.2 UNIVERSAL WASTE REDUCTION EXAMPLES						
City	Software Used	Hauler Reporting	Hauler Diversion Services	Commercial Generator Requirements	Construction Diversion Requirements	Other
Austin, TX (city serves <5 units)	ReTRAC	Bi-annual	Provide 3-stream collection	Provide recycling to commercial (MFUs>4), BOH organics, diversion plan	50% diversion mandate, cannot dispose of >2.5 pounds/square foot of project	Provide FOH/BOH recycling & organics, annual diversion plan
Aspen, CO	Only 5-6 haulers	Bi-annual	Provide recycling to all generators with bundled PAYT pricing	Yard waste disposal ban & recycling space for commercial	County requires 25% diversion & landfill fees up to \$151/ton	Commercial can share hauler service with written contract
Boulder, CO¹³	ReTRAC	Annual	Provide 3-stream collection (recycling 1/2 of trash), bundled PAYT	Subscribe to 3-stream collection, provide annual training, annual report		FOH/BOH recycling & organics, in-room hotel recycling, city trash tax
Portland, OR	ReTRAC (Portland Metro)	Qrtly	Provide 3-stream & glass upon request, cannot charge more for recycling	Provide recycling & glass collection, divert 75%	75% diversion mandate, deconstruction required for older homes	De minimis- 4 cubic yards/week recycling & 250 pounds food waste
Seattle WA (2-hauler franchise)		Contract reporting	Provide 3-stream (1 hauler also collect construction debris)	Contract with franchise hauler, no recycling/organics allowed in trash	Salvage assessment for demolition & major renovations, diversion reporting	Recyclable/org anics disposal bans; also aggregate, gypsum, clean wood, etc.
Sioux Falls, SD		Hauler reports by landfill & MRFs	Recycling with bundled PAYT; no visible recycling; must achieve 80% diversion	Properties provide recycling containers & education; mandatory materials list		Hauler license renewal may be withheld for failure to meet 80% requirement

Appendix F includes additional information on these programs

¹³ Boulder's municipal recycling rate increased from 17% to 40% between 2016 and 2018 and composting rate increased about 125% during the same period (EcoCycle's 2019 "State of Recycling in Colorado Report").

IMPLEMENTATION CONSIDERATIONS

Logistics of Expanding Existing Hauler Policy into UWRO

This should involve a stakeholder-centric process (similar to that conducted for SWM by the LBA Team on both the hauler licensing policy in 2016 and for DWRS preparation). In terms of phased implementation, it is recommended that effective dates for commercial generators begin with large MFUs and businesses, move on to medium generators and finish with the smallest category of generators. Differentiating between these categories can consider number of units, type or size of business and level of service¹⁴.

Technical Assistance

Technical assistance for the commercial sector should include initial assistance with program logistics, resources, tools and guidance for such activities as completing annual recycling reports. These services will grow as more generators participate (see Appendix G includes more specific recommendations). The 2019/2020 MFU recycling pilot study being conducted by Recycle Colorado and SWM may provide further technical assistance suggestions.

Enforcement

It is recommended that enforcement of commercial generator reporting be “soft” and include only notices and SWM staff follow-up over the short-term, but that fines be assessed beyond that point. The revised policy should include a new schedule of fines for generator non-compliance established to offset the estimated SWM and any legal staff cost of addressing.

The accuracy and completeness of hauler-reported data should improve over time and will ideally be within plus or minus 10% of actual tons. Periodic checks by SWM (similar to the analysis included in Appendix B) is recommended in the future.

Increase Hauler Licensing Fees

This option could increase SWM revenue generation needed for commercial and construction waste reduction programs. If based on trash volumes, it could also create an incentive for both increased landfill diversion (by both haulers and their customers) and better hauler reporting. Section 4.10 discusses this in more detail.

4.2 RESIDENTIAL PAY-AS-YOU-THROW

SWM is poised to directly influence significant improvements in the level of landfill diversion achieved by the small residential sector. Without appropriate incentives, however, successes beyond the current 23% rate is unlikely. A PAYT system will not only change how residents consume goods and manage discards at home but will also impact behavior at work and in public. To maximize system success, changes to SWM’s ETC/LIP collections should be considered at the same time.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

The 2010 SWMP included a recommendation to move small residential collection to a PAYT system to give residents some control over their service level and cost, establish equitable pay for size of service, create an incentive to recycle and compost, and reduce the sector's reliance on landfill disposal.

As of 2020, this change has not been implemented. Currently, the cost of most SWM's services remain supported by the city's General Fund; trash, recyclable and ETC/LIP collections are provided for \$0 fee and are instead funded by sales and property taxes. As a result, there is no direct link between how much small residents generate and how much they pay and therefore no incentive to recycle more and trash less. As compost service is currently a fee-based subscription program, there is actually a disincentive to source-separate organics.

SWM has evaluated a PAYT concept that will hopefully be approved for implementation in 2021 (Table 4.3 includes proposed rates for the first year of implementation). The concept would establish tiered user fees for key services that would accrue to a dedicated special revenue fund (SRF) managed by SWM and be used to directly fund the following parameters:

- Bundle materials collection as one service
 - Continued regular collections – weekly trash, every-other-week recycling and every-four-week ETC/LIP
 - New every-other-week compost collections for a \$0 fee subscription (customers would still need to request service, but current fees would be eliminated)
- Assess a single fee for bundled collections based on trash container size
- Allow unlimited recyclable and composting set outs
- Include a robust outreach and education system

Rates by Trash Size	Year 1	Notes
95 Gallons	\$29.00	<ul style="list-style-type: none"> • Proposed rates include flat base fee (\$11.84/household-month) plus variable rate tied to trash container size • Proposed rates include operating costs, non-recurring expense, capital improvements and 2% annual inflation
65 Gallons	\$21.50	
35 Gallons	\$14.00	






A new PAYT system means new fees for small residential, but it also means new compost service accessible to all customers as well as a new sustainability program that encourages landfill diversion over landfill disposal. Table 3.1 previously illustrated the significant increase in recycling and composting expected as a direct result of PAYT through 2030. Organics diversion increases are expected to be especially significant (the

¹⁵ "Draft Solid Waste Cost of Service and Rate Design Study," Burns & McDonnell, November 2019 (proposed rates include just of \$2/household-year for outreach efforts, \$22M for new transfer station land/construction and additional funds for collection fleet replacement).

approximately 18,000 households with subscription service in 2018 will rise towards 180,000 as PAYT is rolled out).

PROPOSED IMPROVEMENTS

Recommendations regarding a future PAYT system for the small residential sector include:

- 
Include an Affordability Option – This should allow homes living below the poverty level to obtain bundled collection services for variable rate portion (flat base fee would be waived¹⁶)
- 
Roll Out Program in Single Phase – This will focus dedicated resources over the shortest period to minimize both transition and public concerns about equality (i.e., why one neighborhood must comply earlier than another). At most, this transition should be broken into two geographical roll outs.
- 
Support PAYT Diversion Incentive by Modifying ETC/LIP Service – Continuing the current level of ETC service eliminates the customer need for a larger to trash cart (and higher fee). Section 4.3. provides further discussion of options to adjust the current ETC/LIP service to support (instead of under-mine) the PAYT system.
- 
Adjust Proposed PAYT Rate Structure to Create Stronger Diversion Incentive – The differential between the rates for each cart size shown in Table 4.3 may reflect actual collection costs but does not create a strong diversion incentive (e.g., 95-gallon cart provides 2.7 times the volume of a 35-gallon cart yet it costs just 2.1 times more). An alternative rate structure could be directly calibrated to cart volume (e.g., a 95-gallon cart costs 2.7 times more than a 35-gallon cart) or even charge relatively more for the larger cart sizes.
- 
Develop Outreach to Residents – A public outreach and education campaign will need to be wide-ranging, multi-media-based and deployed on an on-going basis. SWM will need to communicate need, directions and options, and clear information to control material quality.

IMPLEMENTATION CONSIDERATIONS

Program logistics

- Identify subtotal cost of each material collection on customer bills to provide transparency and debunk myths about “free” recycling and composting (still maintaining bundled rates)
- Default trash cart size at 65 gallons – unless residents select otherwise
- Anticipate short-term illegal dumping and placement of trash in recycling and organics containers with temporary litter inspection/enforcement and public outreach
- Integrate potential changes in ETC/LIP services with PAYT implementation (see Section 4.3)

¹⁶ The affordability option is expected to reduce SWM revenues and has been considered in the proposed rates shown in Table 4.3.

- Evaluate costs for years 2 through 10

Cost of Service Evaluation

- If capital improvements change – such as development of a new city MRF before or instead of a new transfer station
- If more customers move to smaller cart sizes than estimated – which can reduce the level of cost recovery
- If affordability program requests/waivers exceed than estimated
- If operating costs, non-recurring expenses or capital improvement expenses exceed those estimated or if expenditures occur earlier than modeled

4.3 REDUCE EXTRA TRASH & LARGE ITEM PICK-UPS

Denver's small residential sector generated over 18,000 tons of trash overflow/bulky item trash which represented nearly 10% of total waste generation in 2018. These collections - which have only limited restrictions on quantities accepted - create a disincentive for waste reduction and will undermine SWM's new PAYT system. Adjustments can easily be made to ETC/LIP that best support PAYT diversion incentives, eliminate loopholes, reduce SWM net costs and continue to maintain appropriate customer service.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

SWM currently provides ETC and LIP collections on a four-week cycle to small residences¹⁷. Each collection allows up to ten 32-gallon bags of trash, grass clippings and/or bundled branches and up to five bulky items such as furniture, large toys, carpeting and exercise equipment. This service is provided at no cost. ETC/LIP crews make about 580,000 collections per year, which translates to approximately 25% of all small residences setting out materials for collection.

The proposed rates for new PAYT system (Table 4.3) are based on a cost analysis that includes the existing every-four-week ETC/LIP collection as part of the bundled package of services (estimated at \$1.18 per customer per month).

ETC


Current service allows up to 80 gallons per week of service. Continuing to provide this service without charging an extra fee creates a loophole for customers to use a smaller cart but not reduce waste that does not fit in the cart. If SWM converts to the PAYT system without a reduction in ETC service, a significant uptick in ETC tonnage can be expected as well as a cost increase of more than the estimated \$1.18 per customer per month.

¹⁷ SWM is currently evaluating changing this frequency to once every eight weeks as early as 2020.


LIP


Current service allows smaller residential customers to dispose of five items per collection. While this may accommodate significant (but occasional) home projects in any given month, the total allowance is excessive (and equates to about 60 large items/year for once-every-four-week collection). This level of service is vulnerable to abuse.


PROPOSED IMPROVEMENTS

-  **Establish a Separate Fee for ETC Collection** – This fee should be calibrated to the rate differential between trash cart sizes. As a frame of reference, the proposed first year PAYT rate (see Table 4.3) for 35-gallon cart service is \$14 per month for weekly service, which translates to approximately \$2.95 per 32-gallon bag¹⁸.

Establishing a separate fee is not contingent on PAYT. If PAYT implementation is delayed beyond 2021, SWM could still proceed with implementing an ETC fee that would be calibrated to the PAYT fees once that conversion occurs.

-  **Continue to Provide LIP as a Bundle Service** – LIP service should continue to be offered and bundled in the PAYT rates. The primary rationale for this is that automated cart service cannot handle large items.

-  **Reduce the LIP Set Out Allowance** – Providing a service that allows customers to discard more than the equivalent of one large item per week can be difficult to justify in a program oriented toward promoting waste diversion. Setting a limit on the number of items is relatively easy to monitor. However, the size of items can vary greatly (e.g. a sofa or mattress can be much larger than a discarded toy). So in addition to limiting the number of items, SWM should consider limiting the number of items allowed and/or limiting the overall volume per set out. If small residential customers generate more LIP waste than a reduced allowance, they could be directed to pay for a private collection service.

-  **Maintain the Existing Every-Fourth-Week Collection Frequency (or every-eighth week as appropriate)** – Small residential customers will be experiencing significant change in their services with the conversion to PAYT and addition of organics collection. Likewise, an ETC collection fee will alter incentives and behavior. Additionally, as ETC and LIP collection is integrated, splitting them onto different schedules does not make economic or operational sense.

¹⁸ The LBA Team estimates that at \$1.18/household-month for the existing ETC/LIP service and SWM's reported 25% set out rate the cost per ETC/LIP pick-up is currently \$4.72/month. If the average ETC/LIP set out includes only two 32-gallon bags at a fee of \$2.95, more than enough revenue would be generated to cover ETC/LIP costs.

IMPLEMENTATION CONSIDERATIONS

Separate Billing System for ETC

SWM would need to develop a new tracking, payment and/or billing system if it implements a fee for ETC. Alternatives include:

- Recording by ETC/LIP drivers of addresses and the number of bags collected - would require mobile technology and administration (e.g., on board computers and separate components in customer billing software)
- Require residents to pre-purchase bag tags to be displayed on all ETC bags – would require administration and management of a system for printing, distribution and tag sale
- Enable residents to pre-purchase tags through an online system, print them at home and affix them to bags – would require both administration and management of the on-line sales platform and integration with mobile technology such as quick response code readers (some tags would still be required for those without computer/printer access)

Enforcement

SWM learned with the move from residential dumpsters to carts several years ago that limiting the ability for trash overflows is effective in reducing waste generation, but that residents require time to adjust to service changes. Implementing a fee for ETC and limiting LIP collection may increase illegal dumping and litter during initial implementation, which may require additional monitoring and code enforcement work.

4.4 RESIDENTIAL CARDBOARD DISPOSAL BAN

Cardboard is a widely recognized recyclable and is acceptable in all curbside and drop-off center collections. Despite wide-spread access, however, LBA Associates estimated that only 53% of this material was diverted by the small residential sector. As SWM looks at ways to help its customers reduce future PAYT costs through recycling – and eyes programs that can be expanded to the commercial sector in the future – cardboard diversion policy can be a relatively easy and effective mechanism for raising public awareness around landfill diversion.

CURRENT OPPORTUNITY

Cardboard is collected curbside and at DOCs by SWM and private haulers from all sectors across the city. Some is source-separated by commercial generators; other material is collected as part of a commingled stream. SWM collects cardboard in the residential single stream, which is processed by GFL at its MRF in north Denver.

There are several characteristics of cardboard that make it a target for diversion programs. It is a significant portion of the waste stream that will only increase with e-commerce, it is voluminous and takes up space in trash containers and it is a material that the public generally recognizes as recyclable.

City-Wide Generation

Quantity estimates for 2018 indicate that cardboard is the largest recyclable by weight discarded by both small residential and commercial generators (Appendices D and E provide sector-specific waste composition results). Table 4.4 summarizes existing disposal, while Table 4.5 estimates diversion rates. Together they confirm the future opportunity for targeted cardboard recycling.

Table 4.4 LANDFILLED CARDBOARD (2018)					
Small Residential		Commercial		Total	
% by weight	tons/year	% by weight	tons/year	% by weight	tons/year
3.6%	6,200	8.3%	66,500	7.5%	72,700

Table 4.5 ACTUAL & POTENTIAL CARDBOARD CAPTURE RATES (2018)				
	Actual		With Additional Diversion	
	Small Residential	Commercial	Small Residential	Commercial
Landfilled	6,200	66,500	2,500 (if 60% diverted)	26,600 (if 60% diverted)
Recycled	7,000	49,800	10,700	89,700
Total	13,200	116,300	13,200	116,300
Landfill Diversion (% by weight)	53%	43%	81%	77%

Appendix H provides an assessment of 2018 capture rates

The diversion assumptions in Table 4.5 consider additional cardboard diversion resulting from a disposal ban implemented in tandem with the new PAYT system that are generally consistent with findings in other cities.

Cardboard Markets

Material markets are widely available and all the MRFs in the Front Range accept cardboard for processing. Market conditions are volatile, and prices dropped significantly in 2018 and 2019 due to the lack of overseas markets and the glut of supply. However, cardboard recycling typically remains economically viable. Figure 4.1 (on the next page) reflects an analysis of cardboard prices in the southcentral U.S. region (including Colorado). Month to month prices have fluctuated broadly over the past 10 years but have averaged \$108/ton.

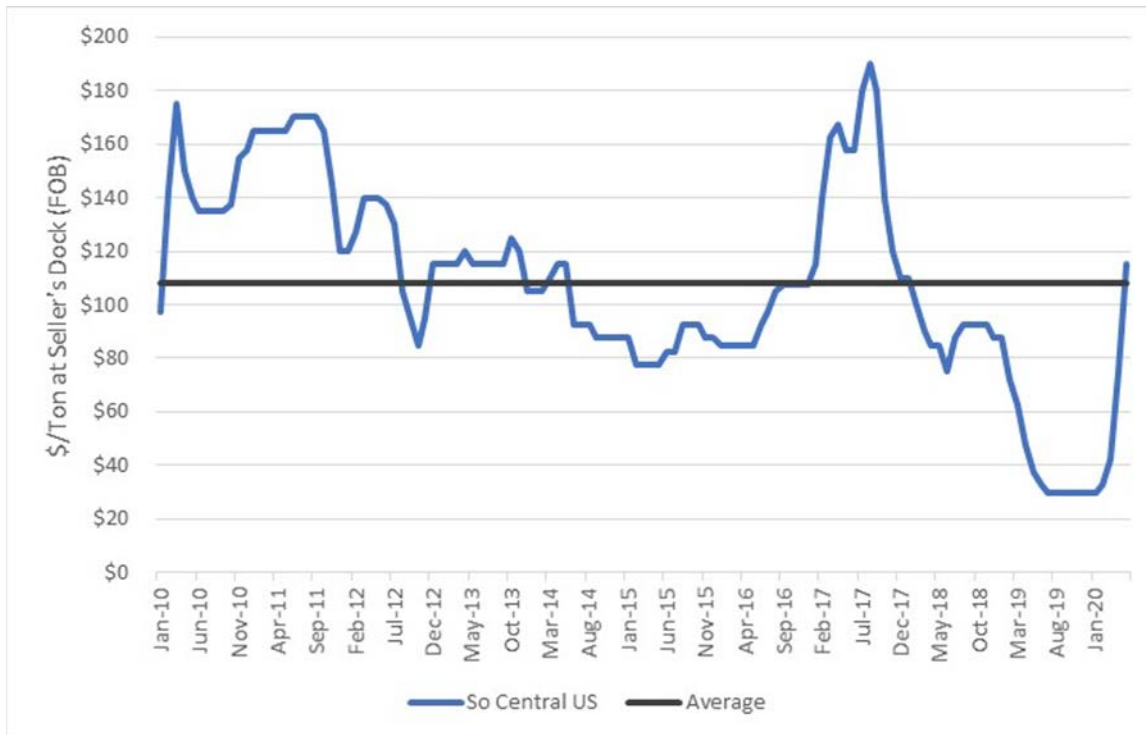


Figure 4.1 AVERAGE CARDBOARD PRICING¹⁹ (\$/ton)

Successes in Other Cities

Table 4.6 (next page) summarizes old corrugated cardboard (OCC) ban policies in other U.S. cities. These cities have measured impressive results; both Fort Collins and Iowa City show the measurable impacts a cardboard ban can have on the diversion of other recyclables.

A disposal ban like that practiced by Fort Collins - instead of a landfill ban as used by the other cities in Table 4.6 - is recommended because of its:


- Focus on the point of generation
- Ability for tracking by SWM drivers and staff - to identify opportunities for education and correction
- Ability to create a balance between capturing more material and raising public awareness about the need and ease for diverting this material

¹⁹ Prices are freight on board per RecyclingMarkets.net.

Table 4.6 MUNICIPAL CARDBOARD BAN EXAMPLES				
Municipality	Applicability	Hauling	Outreach	Enforcement
Fort Collins, CO (disposal ban)	Saw 19% increase in DOC OCC first year (residential & commercial recyclers)	Private licensed haulers required to offer recycling collection at no additional fee	Annual hauler notification of accepted materials & guidelines	Penalty up to \$3000, lien against the property, jail (no citations issued)
Iowa City, IA (landfill ban)	All Sectors – attributes 45% curbside increase over 2 years to OCC ban	City collection of residential refuse and recycling up to 4 units PAYT, private licensed haulers for others	City education through website and other distribution	Misdemeanor or municipal infraction (never enforced)
Lincoln, NE (landfill ban)	All Sectors – tripled OCC diversion first year	Licensed haulers must provide recycling (may charge additional fees if OCC in trash carts)	Bi-annual hauler notification of availability of recycling services	Penalties up to \$500 or misdemeanor punishable by jail (no tickets issued)
Linn County, IA (landfill ban)	All Sectors	Both public and private haulers provide curbside recycling		Penalties increase from infraction to fines & contempt


Appendix F includes additional information on these programs

PROPOSED POLICY


 **Implement New Cardboard Disposal Ban** – The ban would ideally be implemented at the same time as the PAYT system is rolled out. Residents would be required to separate boxes and other corrugated material from trash:

- Maximum threshold of 25% cardboard should be allowed in trash carts – this margin will address the difficulty in determining compliance in carts and to account for material this is unacceptable for either recycling or composting
- Cardboard can be reused, placed in curbside recycling carts (if dry and clean), placed in curbside organics carts (if clean except for food contamination) or delivered to drop sites
- Cardboard should not be stored outside of recycling or compost carts – residents must request larger/multiple containers (reused or taken to a city drop-off center)

A residential cardboard ban could either be new policy or an amendment to the city’s existing municipal code (Chapter 48).

 **Develop Outreach to Residents** – It is expected that messaging will build on PAYT messaging and methods, will encourage compliance and will provide information to control material quality²⁰.

²⁰ Fort Collins observed that their success was proportional to the amount of staff education and follow up (and is especially important for disposal versus landfill bans).

 **Future Policy Expansion** - This policy is intended to lay the foundation for policy expansion to other sectors in which private instead of city haulers interact with generators at the collection point. To improve the success of expansion, SWM should track and monitor metrics and qualitative observations from the small residential sector that could help address future commercial challenges:

- Ability to identify non-compliance
- Issues with overflowing recycling carts
- Success working with non-compliant generators to divert more cardboard and minimize contamination
- Success raising generator awareness about reuse and DOC opportunities
- Ability for generators to down-size trash carts or decrease frequency of dumpster collection

IMPLEMENTATION CONSIDERATIONS

Enforcement

It is expected that compliance will be observed by SWM drivers who see gross amounts of cardboard in or overflowing trash carts and by SWM staff who perform “alley audits” (or periodic trash cart inspections). An “Oops!” tag or similar notice should be used to alert residents to excessive discarded material.

Where violations occur, enforcement is expected to be “soft” given the program’s balance between diversion and education. Like the example cities tabulated above, the issuance of non-compliance notices is likely to replace fee assessment (except for heavy repeat offenders and egregious circumstances) and it is not expected that city code enforcement personnel will be required on a regular basis.

Other Considerations

- Short-term issues may include overflowing recycling carts and diversion of contaminated materials (which were not identified as significant problems for the example cities after early implementation)
- Will likely be homeowner need for larger recycling carts (95 gallon) to minimize cardboard overflows
- Ability to decrease the 25% threshold over time – although a smaller value may be hard to quantify and may not be valuable
- Additional DOCs needed for small and large residential generators only
- Cost/benefit of a dedicated SWM cardboard collection route should be evaluated – in terms of diversion levels, cart overflows, ability to bundle/protect cardboard outside of carts in Denver weather, etc.
- Potential for new costs associated with cost of recycling instead of landfilling cardboard should be estimated

4.5 NEW CITY MATERIALS RECOVERY FACILITY

SWM’s ability to achieve its waste reduction goals is threatened by a projected shortfall of processing capacity given Denver’s growth over the next ten years, the upcoming implementation of residential PAYT and the expectation of other city-wide waste reductions program. Reliance on private MRFs plus declining

commodity pricing are also a pressing concern. A new publicly owned Denver MRF could address all of these issues and provide affordable processing capacity for tons collected beyond the small residential sector.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

Processing Capacity

Two private MRFs located in Denver process most of the recyclables generated in Denver (both SWM residential and privately collected commercial recyclables as well as materials collected outside the city). These facilities are owned by Green for Life Environmental (GFL) and WM. The LBA Team estimated that the combined operating capacity is 273,000 tons per year and the current tonnage being processed uses over 80% of that capacity²¹ (see Table 4.7).

	Operating Capacity	Current Tonnage	Available Capacity
Existing Private MRFs	273,000	221,000	52,000

Table 4.8 identifies the estimated recyclables diversion for the DWRS planning period for both the small residential and commercial sectors, both of which are expected to grow. The available capacity at the two private Denver MRFs is less than 10% of quantities estimated for 2030; Denver recovery is projected to exceed available capacity early in the planning period. This dynamic may make it difficult for SWM to secure sufficient capacity for its residential tons.

	2020	2030
Small Residential	41,000	56,000
Commercial	>140,000	504,500
Total	>181,000	560,500

Three additional MRFs exist outside of Denver; however, their locations range from 30 to 75 miles from downtown Denver and transferring recyclables to them would cost approximately \$15 to \$27/ton in addition to tip fees that would be charged if those facilities were willing to accept Denver recyclables (see Appendix I for cost details).

Recycling Economics

Recovered materials commodity pricing is currently very low making recycling processing economics less favorable than in the past. Additionally, quality standards have become more stringent. The result for SWM and other recycling programs has been higher processing costs, less or no revenue share and more costly

²¹ "Assessment of Options for Securing Denver's Future Recycling Processing Needs," Kessler Consulting, February 2020.


²² Based on the tons reported by facilities for two shifts/day, seven operating hours/shift, five days/week (facility capacity not independently verified).

contamination management. Cities and counties that own MRF facilities are better positioned than those reliant on the private sector which have limited ability to negotiate more favorable financial terms, upgrade technologies and establish operating standards to support their waste reduction goals.


Similar to a number of other major U.S. cities, Denver has the opportunity to secure greater control of its recycling infrastructure and costs by developing a publicly controlled MRF. This will allow Denver to better address changes in the recycling marketplace and earn greater financial benefits than available through continued negotiations/contracting with private MRFs.

The financial benefits of a city MRF would likely be further enhanced through collaboration with other local governments in a regional solution that would provide more tons and improve the unit cost of operations.

PROPOSED IMPROVEMENTS

 **Feasibility Study** – This study should be conducted by an outside consultant with applicable expertise and should consider financing and funding options, future market circumstances, potential private sector partners and various procurement approaches. Siting options need to consider anticipated growth, proximity to collection routes and transfer stations, distance and travel routes to DADS and processing facilities.

It is recommended that the MRF be developed and operated using a public private partnership (or PPP). The study should evaluate various partnership options. It is expected that the most advantageous scenario will be city ownership of the site and facility, and contracts with a private development team and private operator²³. This approach has been used to develop most of the PPP MRFs in the U.S. due to the flexibility it provides and ability to leverage competition in both development and operations.

 **Design/Construct New Facility** - The MRF should be designed to have ample capacity to process SWM's small residential recyclables in addition to tonnage from the commercial sector, which could be attracted to the facility by the private operator and improve the economies of scale.

Facility Concept - The facility would have a design capacity of 30 tons/hour which would provide capacity to handle in a single shift all of SWM's small residential recyclables plus recyclables that may be brought to the facility by private haulers serving the commercial sector. The MRF building would require 75,000 square feet for receiving, processing and storage areas, and additional square footage for offices and employee facilities. The facility would utilize state-of-the-art processing equipment to accommodate capacity demands and achieve quality standards. In addition, the facility would have space for public meeting and tours. Other features would include fuel pumps and parking for city collection vehicles, tractor trailers, employee vehicles, visitors and tour buses. The facility will also ideally include a DOC for residential recyclables, organics and seasonal items.

²³ PPP options, pros and cons were described in "Assessment of Options for Securing Denver's Future Recycling Processing Needs," Kessler, February 2020.

Estimated Costs - The capital costs for a city owned MRF capable of processing SWM tons are estimated to be \$27M to \$28M with annualized capital costs ranging from \$1.8M to \$1.9M (see Table 4.9 and Appendix I for additional detail). This estimate includes site work, MRF building, processing system equipment, rolling stock and scales but excludes land purchase.

Table 4.9 COST ESTIMATE FOR CITY PROCESSING FACILITY²⁴ (2020\$)		
Item	Cost Range	
Total Capital Cost	\$26,547,200	\$28,464,300
Annualized Capital Cost @2.5%	\$1,763,300	\$1,894,800
Annual Operating Cost	\$2,282,400	\$2,486,600
Total Annual Cost	\$4,045,700	\$4,381,400
Annual Tons (estimated 2030)	56,000	
Per Inbound Ton	\$73	\$79
Annual Commodity Cost (Revenue) at 50% Revenue Share	(\$2,692,600)	(\$2,692,600)
Per Inbound Ton	(\$48)	(\$48)
Net Annual Cost (Revenue)	\$1,353,100	\$1,688,900
Per Inbound Ton	\$24	\$30

The annual operating cost is estimated to range between \$2.3M and \$2.5M. The estimated total annual cost is \$73 to \$79 per ton, which is less than the \$85/ton processing fee currently paid to GFL. The estimated net annual cost is \$1.4M to \$1.7M or \$24 to \$30 per ton (including annualized development cost, operating costs, private operator profit and an assumed 50% revenue share with the contract operator).

Regional MRF Option - A second option would be to develop and operate the MRF to handle more than just small residential recyclables collected by SWM, but also process materials from other local government programs and commercial recyclables brought in by the contracted private operator. This can be accomplished with the same size and design capacity as a MRF processing small residential tons only, but instead operating two shifts per day. Most private sector MRFs in fact operate this way because it increases the return on capital investment. The annual operating costs for a regional MRF are estimated to range between \$4.5M and 4.9M (see Table 4.10 on the next page and Appendix I). The estimated net annual cost is \$0.9M to \$1.4M or \$8 to \$13 per ton, which is a notable decrease from single-shift operations (shown in Table 4-9).

²⁴ Commodity revenue is based on historical 10-year average prices (see “Task 2C & 2D – Market & Commodity Analysis”).

Table 4.10 COST ESTIMATE FOR REGIONAL PROCESSING FACILITY (2020\$)		
Item	Cost Range	
Total Capital Cost	\$26,547,200	\$28,464,300
Annualized Capital Cost @2.5%	\$1,763,300	\$1,894,800
Annual Operating Cost	\$4,453,500	\$4,848,200
Total Annual Cost	\$6,216,800	\$6,743,000
Annual Tons (doubled estimated 2030 small residential tons)	110,100	
Per Inbound Ton	\$56	\$61
Annual Commodity Cost (Revenue) at 50% Revenue Share	(\$5,312,800)	(\$5,312,800)
Per Inbound Ton	(\$48)	(\$48)
Net Annual Cost (Revenue)	\$904,000	\$1,430,200
Per Inbound Ton	\$8	\$13

The regional approach is expected to increase private sector interest in a PPP and competitiveness in pricing. It will also improve the economic stability of the facility for the city, as half of the tons estimated in Table 4.10 would be generated by non-SWM customers, and half of the tip fees would be paid by others essentially reducing SWM's net annual operating costs by 50%.

Funding for Capital Improvements – Potential funding sources include:

- Proposed PAYT rates (see Table 4.3) includes \$22M for a new transfer station - depending on SWM decisions regarding prioritization of capital projects, these monies may be available in part or whole for a new MRF
- State and regional grant funding – the CDPHE RREO and Front Range Waste Diversion (FRWD) grant programs will have up to \$2M and \$2M-\$15M/year available, respectively, for infrastructure projects such as a regional Denver MRF²⁵
- Other new sources of city funding – see Section 4.10

Recyclables Market Impacts - MRFs represent a long-term investment, therefore revenue projections in Table 4.9 and 4.10 are based on 10-year historical commodity prices from 2010 through 2019. During that time commodity prices cycled through both up- and down-markets. While historical prices are not a guarantee of future prices, it is expected that over a MRF's lifespan the aggregate commodity price will be comparable to historical long-term averages. Nevertheless, to provide a low market scenario for comparison, the LBA Team estimated costs based on three-year historical commodity prices from 2017 through 2019 when pricing was especially volatile. For the city MRF option, the estimated net annual cost of the MRF increases from \$1.4-\$1.7M to \$1.7-\$2.1M or from \$24-\$30/ton to \$31-\$37 per ton. For the regional MRF option, the estimated net annual cost increases from \$0.9-\$1.4M to \$1.6-\$2.2M or from \$8-\$13/ton to \$15-\$20 per ton.

²⁵ The coronavirus pandemic, however, may reduce the availability of both programs in the near future.

Savings from Existing Contractor Fees – Table 4.11 compares the financial impact of contracting with a private MRF versus a new Denver PPP MRF. Based on the 2020 estimate of 41,000 tons of small residential recyclables (see Table 3-1), a Denver PPP MRF has the potential to reduce the cost to process small residential recyclables by \$0.4M to \$1.8M/year, depending on the tip fees that would be charged under a new processing services contract (and not including revenue share). Under the regional PPP MRF scenario, the cost reduction for Denver would be \$1.1M to \$2.5M/year (see Table 4.12).

TABLE 4.11: COST SAVINGS FOR CITY PROCESSING FACILITY (2020\$)

TABLE 4.11: COST SAVINGS FOR CITY PROCESSING FACILITY (2020\$)			
Private MRF Contract Annual Cost			
<i>Expected Range of Processing Fees Cost/Ton</i>	\$85	\$100	\$120
<i>Cost/Year</i>	\$3,485,000	\$4,100,000	\$4,920,000
PPP MRF Annual Cost			
<i>Cost/Ton (Average of \$73 - \$79/ton from Table 4.9)</i>	\$76	\$76	\$76
<i>Cost/Year</i>	\$3,116,000	\$3,116,000	\$3,116,000
Net Annual Savings	\$369,000	\$984,000	\$1,804,000

TABLE 4.12: COST SAVINGS FOR REGIONAL PROCESSING FACILITY (2020\$)

TABLE 4.12: COST SAVINGS FOR REGIONAL PROCESSING FACILITY (2020\$)			
Private MRF Contract Annual Cost			
<i>Expected Range of Processing Fees Cost/Ton</i>	\$85	\$100	\$120
<i>Cost/Year</i>	\$3,485,000	\$4,100,000	\$4,920,000
PPP MRF Annual Cost			
<i>Cost/Ton (Average of \$56 - \$61/ton from Table 4.10)</i>	\$59	\$59	\$59
<i>Cost/Year</i>	\$2,398,500	\$2,398,500	\$2,398,500
Net Annual Savings	\$1,086,500	\$1,701,500	\$2,521,500

IMPLEMENTATION CONSIDERATIONS

Schedule Urgency

Because SWM's current processing contract with GFL expires in April 2021 and a processing price of \$100 per ton or higher is expected to result from a new recycling processing services procurement, Denver should evaluate opportunities for a new city-MRF as soon as possible. It is recommended that key evaluation steps be conducted with the help of an outside consultant with applicable expertise and would include:

- For a regional MRF approach, outreach and engagement with other DRCOG governments will be needed to identify potential partners and assess frameworks for interlocal agreements
- Evaluate the potential alternative sources of financing capital such as grants and subsidized loans from organizations like the Closed Loop Fund²⁶ and material trade associations

²⁶ See "Assessment of Options for Securing Denver's Future Recycling Processing Needs," Kessler Consulting, February 2020. This document considers cost savings including the city's revenue share.

Opportunities for Co-Locating MRF

SWM has been planning for a new transfer station to improve the operational and economic efficiency of collection services. Potential exists to co-locate and develop the MRF and transfer station as a single project. This would have financial benefits and eliminate the need to select and acquire separate sites.

However, the optimal locations for the two facilities may be challenging to align (such as a regional MRF serving other communities versus a city-only transfer station). Another option is to co-locate the MRF with the DADS Landfill on property already owned by the city, and to locate the transfer station in an area of the city where hauling costs are minimized.

Other Challenges

- Economic risk is inherent with infrastructure of this magnitude - PPP's can reduce front-end public financing or funding required depending on which partnership is selected
- Economic risk with developing a MRF with capacity to handle more than small residential recyclables (which is the only stream SWM has direct control over) – the new City MRF will need to offer competitive tip fees to receive recycling tonnage that would otherwise go to a private MRF

4.6 NEW CITY TRANSFER STATION

SWM currently uses a combination of transfer stations and direct haul to move small residential trash to DADS. This system leaves SWM reliant on private operators to transfer nearly two-thirds of its collected trash. Only one station transfers recyclables and – until SWM expanded the CCTS in 2020 – none transfer organics (especially problematic as composting facilities are located well outside of the metropolitan area). The addition of a new three-stream SWM transfer station will provide more complete transfer coverage in areas of the city with significant growth and more sustainable economics for hauling recyclables and organics to processors.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

SWM currently owns and operates the CCTS in southeast Denver, which is used to transfer small residential trash and recyclables. By the end of 2020, SWM also expects to transfer sector organics from this site as well. Having the ability to transfer organics is a prerequisite for PAYT because the operational impacts of direct hauling organics once compost collection is provided to SWM customers will be significant.

The City transfers 33% of small residential trash through this facility and hauls 8% directly to DADS. The rest of the stream is transferred through two private stations owned by WM. Table 4.13 (next page) summarizes their usage and SWM fees. Given WM's current footprint in Denver's transfer and disposal system, the company can achieve economies of scale efficiencies and potentially charge discounted rates for transfer services that do not reflect the full cost of their infrastructure and operation.


Table 4.13 WASTE MANAGEMENT TRASH TRANSFER FACILITIES		
	Disposal & Recycling	South Metro
SWM's Small Residential Collections	32%	27%
Facility Fees (\$/ton)		
Operations & Hauling	\$17.47	\$19.14
DADS Tip Fee	\$17.65	\$17.65
Total	\$35.12	\$36.79


Even though the City is experienced in efficient transfer operations at CCTS, it may be challenging to compete with WM's rates at a second, city-owned transfer station. New transfer infrastructure, however, would provide SWM with:

- Better control over trash collection and transfer
- Another location for transferring recyclables and organics from SWM routes that do not use CCTS
- Ability to serve rapidly growing areas of the city (especially the northeast)
- Potential to reduce collection costs by reducing the distance and time lost by recycling and organics collection trucks travelling to processing facilities

SWM recognizes the need for expanding its transfer capacity and included \$22M for development of a new facility (\$12M for land and \$10M for construction) as a future capital project in the proposed PAYT rates (see Table 4.3).

PROPOSED IMPROVEMENTS

 **Conduct Feasibility Study** - In order to better determine the viability of a new transfer station, an evaluation should be conducted regarding the opportunities for siting; more specific scenarios regarding facility sizing and conceptual design; and more detailed cost analysis, financing and funding options. The study may also consider the cost and benefits of various facility locations (in terms of transfer operations). Siting options need to consider anticipated growth, proximity to collection routes, distance and travel routes to DADS and processing facilities. The study should be done by an outside consultant with applicable expertise.

 **Design & Construct New Facility** - A new Denver transfer station would mimic the CCTS (as expanded in 2020) with bays for trash, recycling and organics.

Facility Concept - The facility would be designed with a minimum 20-year life and a suggested capacity of 400 tons per day of trash and 200 tons per day of recyclables and organics. The transfer station operation is estimated to require a 16,500-square foot building. The facility would also include collection fleet facilities comparable to those at CCTS, including employee facilities, offices, maintenance facility, fuel pumps, truck wash and parking for tractor trailers, collection vehicles and

employee vehicles. Depending on its proximity to other DOCs, the transfer station will ideally include a new DOC for residential collection of recyclables, organics and seasonal items.

Costs - The capital costs for a new city-owned transfer station are estimated to be \$8.2M to \$9.3M with annualized capital costs ranging from \$576,400 to \$651,500 (see Table 4.14 and Appendix J for additional details). These costs include facility site work, buildings, rolling stock and scales but exclude land purchase.

Item	Cost Range	
Total Capital Cost	\$8,203,200	\$9,296,200
Annualized Capital Cost @2.5%	\$576,400	\$651,500
Annual Operating Cost	\$1,092,000	\$1,248,000
Total Annual Cost	\$1,668,400	\$1,899,500
Annual Tons	156,000	
Per Inbound Ton	\$11	\$12

The annual operating cost for the facility is estimated to range between \$1.1M and \$1.2M. The estimated net annual capital cost and operating cost ranges from \$1.7M to \$1.9M. The cost per ton for operations only (exclusive of hauling to end-use facilities) would range from \$11 to \$12/ton. The cost for hauling from the transfer station to the MRF, compost and landfill facilities depends to a large extent on the haul distance and tons per transfer load. The location of a new transfer station is unknown; Table 4.15 includes an evaluation of haul costs from CCTS (including annualized capital cost of transfer trucks and operating costs). It also indicates the total cost per ton (a combination of the total annual transfer station cost and the hauling costs). These values will vary depending on the new facility location.

	Cost Range	
Hauling (based on CCTS location)		
<i>Trash to DADS (15-20 one-way miles)</i>	\$10	\$13
<i>Recyclables to MRF (10-15 one-way miles)</i>	\$11	\$16
<i>Organics to Composting Facility (40-50 one-way miles)</i>	\$13	\$16
Total Facility Operations (Table 4.14) & Hauling		
<i>Trash to DADS</i>	\$22	\$25
<i>Recyclables to MRF</i>	\$22	\$28
<i>Organics to Composting Facility</i>	\$24	\$28

²⁷ The approximate one-way distances from CCTS to DADS is 20 miles, to GFL or WM MRFs is 15 miles, to A1 is 50 miles.

The estimated total facility and hauling cost for trash is higher than the same costs charged by WM (see Table 4.13). The LBA Team estimated that if only the facility operating and hauling costs are considered (i.e., the annualized capital costs are excluded), the range for trash would be \$17 to \$21 per ton and competitive with WM.

IMPLEMENTATION CONSIDERATIONS

- Despite the benefits, trash transfer and hauling may be more expensive than current privately provided services - this could potentially be offset if the transfer station is
 - Co-located with a new city MRF (reducing capital costs)
 - Located to decrease haul costs lower than shown above
- SWM may need to evaluate the relative net benefits of using city PAYT funds for a transfer station versus MRF especially if the development of one precludes the other in the short-term
- If SWM pursues both a new MRF and transfer station - they should be integrated and ideally co-located to maximize efficiencies (and possibly total land requirements)

4.7 NEW CITY DROP-OFF CENTERS


SWM currently operates the only free DOC for the collection of recyclables, organics and seasonal items. Located in the southeast quadrant, however, access is not convenient for users in other parts of the city. Additional DOCs will provide access to more small residential homes and to MFUs who may not have any other affordable or convenient recycling and composting opportunities.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

SWM currently operates only one recycling DOC at the CCTS. It is a well-used facility that accommodated over 60,000 customer visits in 2018 and collected over 400 tons of recyclables and organics. While the tonnage is small compared to what is collected curbside, the additional opportunities for waste reduction efforts is valuable; many MFUs have no other access to diversion programs and all residents only have access to seasonal debris collections (such as leaves and holiday lights) at the CCTS DOC. However, given the facility's location in southeast Denver, it is not convenient to all potential users.

PROPOSED IMPROVEMENTS

New DOCs located in different parts of Denver are important to provide equal opportunity to other residents. The CCTS DOC has proven to be convenient and efficient to operate, so it provides a reasonable basis of design for new sites.

-  **Develop New DOCs** – Up to three new DOCs (to ideally provide one in each quadrant of the city) will ultimately be developed. It is expected that at least one new DOC would be co-located at the new city MRF and transfer station facilities (if not two). Other locations should be based on proximity and convenience to residential customers (especially MFUs). The DOCs may be developed over multiple

years but should occur early in the planning period. It is expected that the DOCs would be staffed and have similar hours of operations as the CCTS facility. Each would be sized to contain:

- Minimum of six 8-cubic yard dumpsters and additional 95-gallon roll carts for recyclables
- Minimum of 25 35- or 65- gallon roll carts for food waste
- An 8-cubic yard dumpster for holiday lights and other miscellaneous items
- Yard waste storage area and space for rear-load collection vehicle
- Shed or small office for workers
- Ample space for traffic flow and for collection vehicles to service the containers and yard waste area

IMPLEMENTATION CONSIDERATIONS

- Finding available land – ideally new DOCs will be co-located with other city operations to minimize the need to site and procure new property (including existing fleet operations)
- Minor capital costs – the DOCs are expected to be co-located on property that is already fenced and gated with available staff amenities
- New operating costs – these are limited to dedicated FTEs and minimal supplies

4.8 OTHER SHORT-TERM RECOMMENDATIONS

WASTE REDUCTION AT CITY FACILITIES

Solid waste collection service to city facilities is widely inconsistent, as shown in Table 4.16 on the next page. With the exception of DPS service (which is governed by an intergovernmental agreement or IGA), collections provided by SWM collections are not fee-based.

Issues associated with the inconsistencies and inefficiencies shown in Table 4.16 include:

- Poor quantity data – as SWM collections are typically part of residential tons and are approximated or unavailable (SWM fleet does not have truck scales – staff must estimate quantities based on containers and collection frequencies)
- Many missed opportunities for SWM service - due to lack of equipment to service dumpsters and/or access small downtown spaces (SWM's fleet includes only four front-load vehicles which are primarily dedicated to DPS collections)
- SWM fleet is only dedicated to DPS service – and lacks flexibility for multiple, on-call collections
- Lack of recycling at DHA housing complexes with dumpsters
Most facilities other than DPS must provide their own recycling/organics containers and compostable liners – resulting in inconsistent color/shape cues (SWM does have standard signage available)
- Potential for confusion and lack of engagement by some facilities

Table 4.16 CITY FACILITY SOLID WASTE COLLECTIONS			
Facilities	Trash Collection	Recyclables Collection	Organics Collection
Denver Government Buildings (200 buildings)			
<i>Those with container, quantity, access issues (Webb Building, Arts & Venue facilities, Denver Central Library, etc.)</i>	By private haulers	Some by private haulers (especially Arts & Venue)	Some by private haulers (especially Arts & Venues), some by SWM; only ~50 facilities compost (including all fire stations)
<i>Others</i>	By SWM	By SWM	
Denver Public Schools (170 schools)	By SWM (through IGA)	By SWM (through IGA)	By SWM (extra fee, ~40 schools compost)
Denver Housing Authority (4,800 units)			
<i>Housing complexes</i>	By SWM	None	none
<i>Housing in SWM routes</i>	By SWM	By SWM (not all units recycle)	By SWM (as part of small residential subscription compost program)
Denver Parks & Recreation			
<i>Major regional parks (17) & recreation centers</i>	By SWM	By SWM	none
<i>Other parks & centers</i>	By DPR	By SWM	none

Other improvements could include:

- Establish collection for facilities currently serviced through an IGA or similar mechanism with set fees to fully cover collection costs – use IGA’s to require recycling both internally and in public areas
- Review DPS IGA and revise to reflect accurate costs²⁸
- Develop a plan to expand organics recovery to facilities with kitchens, cafeterias, etc.
- Require compost for new sod/plantings are areas where soil is disturbed (apply to city construction projects & on-going maintenance - especially IPM and DPR)
- Require green waste from landscaping to be composted
- Evaluate universal SWM collections and the ability to provide pricing competitive with the private sector (would likely be phased in as current service contracts expire and would require the addition of front-load vehicles and truck scales for non-compactor service)
- Help city facilities improve purchasing practices
 - Through compliance with LEED-EB O+M requirements for developing environmentally preferable purchasing practices²⁹
 - Through compliance with EO 123 source reduction practices

²⁸ SWM has anecdotally observed that DPS fees covered by the IGA underestimate actual costs by as much as two-thirds.

²⁹ See Denver Purchasing guidelines (“March 2020 Standard Purchase Order Terms and Conditions - Procurement of Recovered Materials”).

- Increased awareness about the myriad products in the marketplace which are reusable, recyclable or compostable
- Specify single-use plastics (SUP) reduction practices³⁰ that provide recyclable/compostable alternatives – also prohibit the purchase of pre-packaged water in favor of hydration stations

REVISE EQUAL SPACE ORDINANCE

One of the key obstacles to commercial diversion is the lack of space for adding recycling and organics containers in crowded alleys, parking lots and other areas that haulers can access³¹. Implementing solutions for new construction or major renovations is critical in the very short-term to catch as much of the current building boom as possible and begin to correct a physical constraint that is otherwise challenging to overcome.

In late 2019 an amendment was made to the Building and Fire Code for the City and County of Denver (Section 420.11.5) requiring new MFUs with more than five residences³² to have recycling container space equal to trash space, organics space equal to one-half trash space, equal generator access for all materials and appropriate signage. This amendment failed to consider:

- Non-residential commercial properties – these can include properties with significant potential for diversion of both recyclables and organics (especially food waste)
- Existing code requires a minimum vehicular access of 14 feet (vertical clearance) and 10 feet (width) – which are inadequate for some collection vehicles

Many municipalities have promulgated policy to require space for additional containers as part of building permit approval (see Table 4.17 on the next page includes Colorado examples).

Priority should be placed on amending the existing code by:

- Adding code section for same applicability to commercial buildings – exemptions can include curbside pickup for individual businesses
- Adding applicability to major renovations for both MFUs and commercial – potentially defined as the addition of two or more units or more than 250 square feet of commercial space that is a food establishment

³⁰ This policy could provide a “lead by example” opportunity for a future expansion of the 2021 disposal bag policy. Carbondale, Telluride, Fort Collins and other Colorado communities are currently evaluating single-use plastics reduction policies.

³¹ This was a common complaint from commercial generators during the DWRS stakeholder meetings in August and September 2019.

³² Specifically addresses Group R-2 residents (defined as two or more units) but with applicability to building groups of at least five units.

- Adding requirement that trash, recyclable and organics containers are co-located in the same storage location – to maximize convenience for generators
- Adding collection service access that is as convenient for recycling and organics containers as trash
- Increasing vehicular access to minimum 20 feet (vertical clearance) and 12 feet (width)

Table 4.17 RECYCLING SPACE REQUIREMENTS – COLORADO EXAMPLES					
	Type of Generator		Type of Construction		
	Residential	Com-mercial	New Construction	Renovations	Other
Aspen	3 or more units	Yes	Yes	Whenever 2 or more residential/ lodge units OR 250 sf commercial space are added	40% demolition
Boulder	Any attached unit	Yes	Yes	Whenever 50% of external walls removed	No
Broomfield	Any units with centralized collection	Yes	Yes	Whenever renovation equals 50% of more of fair market value	No
Fort Collins	Any units with centralized collection	Yes	Yes	Whenever structure size increased by 50% or more	Any zoning change
Lafayette	Any attached unit	Yes	Any development that is man-made change or improvement		
Longmont	3 or more units	Yes	Yes	No	No
Superior	3 or more units	Yes	Yes	Generally implemented as >500sf	Any development application or building permit

Appendix F includes additional information on these programs

This work will require close coordination with the Denver Development Service Division and Building Inspections staff within the Denver Community Planning and Development Department (CP&D). This coordination can either be dedicated SWM staff available to CP&D or partial SWM funding for staff attached directly to the Building Inspections group³³. As amendments to the city’s Building and Fire Code are considered regularly, it is possible that the proposed improvements could be considered in the next two to three years. Regardless, the impact of these code requirements will not likely be realized for several years.

³³ Fort Collins uses the latter approach to provide expertise to its Planning & Development staff.

4.9 SWM DIVISION ADMINISTRATIVE IMPROVEMENTS

One recommendation that can be an especially important foundational improvement to solid waste management in Denver is an alternative financial structure that will more clearly separate SWM services from other city functions that compete for General Fund support. This improvement will require relevant revenues (such as residential PAYT rates and other sources) to fund SWM services. Parallel consideration for further efficiencies should be the integration of all solid waste functions within SWM.

CURRENT SYSTEM & NEED FOR IMPROVEMENTS

Administrative responsibility for Denver’s solid waste management system is split between SWM and DPHE. SWM is responsible for most of the system, while DPHE is responsible for the oversight of DADS.

Current Funding

SWM currently relies primarily on the General Fund plus a small amount from a SRF for organics collection (see Figure 4.2). The SWM budget has historically covered operating expenses while capital expenses (e.g., facilities and equipment) have been covered by the General Fund separately.

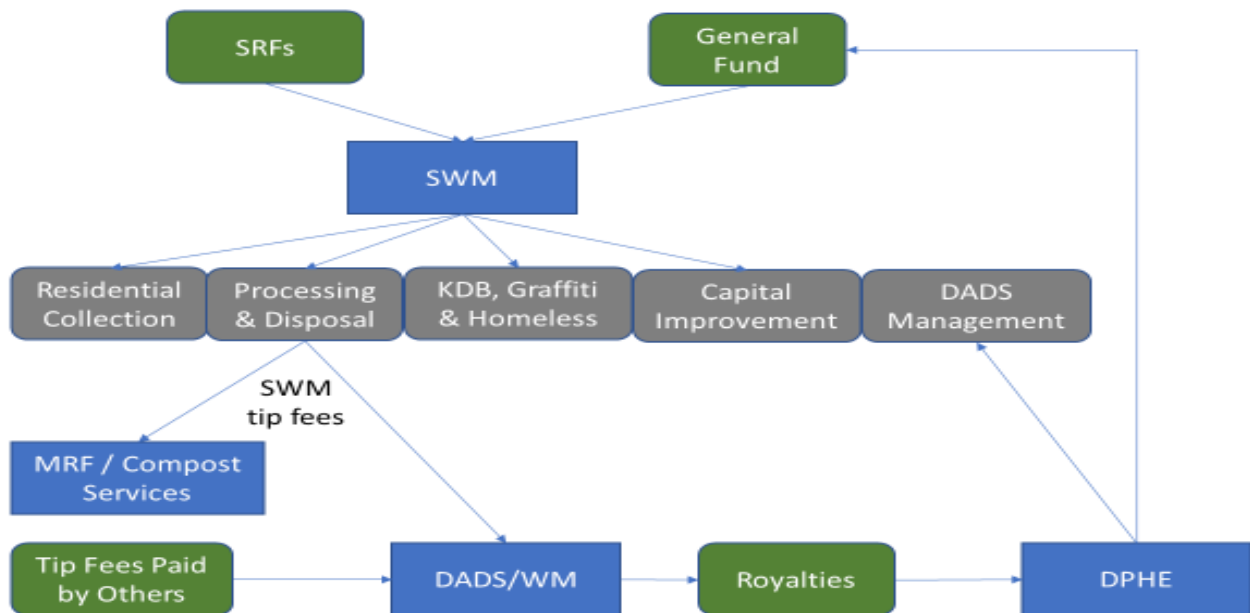


Figure 4.2 CURRENT SWM FUNDING

Operational expenses include DADS tip fees³⁴. Per EO 115, all city-controlled non-hazardous waste must be disposed at DADS. SWM and WM negotiate the tip fee annually (\$17.65 in 2020) and WM guarantees it is the lowest rate charged at DADS.

³⁴ WM is responsible for all day-to-day operations, permitting, construction, closure and post-closure care.

WM pays DPHE a royalty equal to a percentage of gross disposal revenue to DPHE and is expected to be approximately \$3M in 2020. DPHE utilizes a portion of the royalties for DADS contract management and broader sustainability programs while remainder is deposited to the General Fund. The primary source of General Fund revenue is local sales tax and, to a lesser extent, property tax. DADS royalties represents a small fraction of the overall fund.

PAYT

SWM estimates that PAYT will be implemented in 2021 and will need to generate approximately \$52.5M during the first year³⁵. Proposed rates for the initial year (see Table 4.3) were accordingly estimated to cover the cost of residential services (i.e., trash, recyclables, organics and ETC/LIP collections) including the core functions of administration, customer service operations, infrastructure operations, residential programming, fleet replacement, transfers to the General Fund and the land/construction for a new city transfer station. The proposed rates will not cover:

- New improvements such as those recommended in the DWRS (estimated in Table 4.19 and 5.5)
- Unknown cyclical increases in recyclables processing costs due to declining commodity revenues
- Costs associated with recovery from the 2020 coronavirus pandemic (whose impact on current and future budgets will not be fully known for several months)

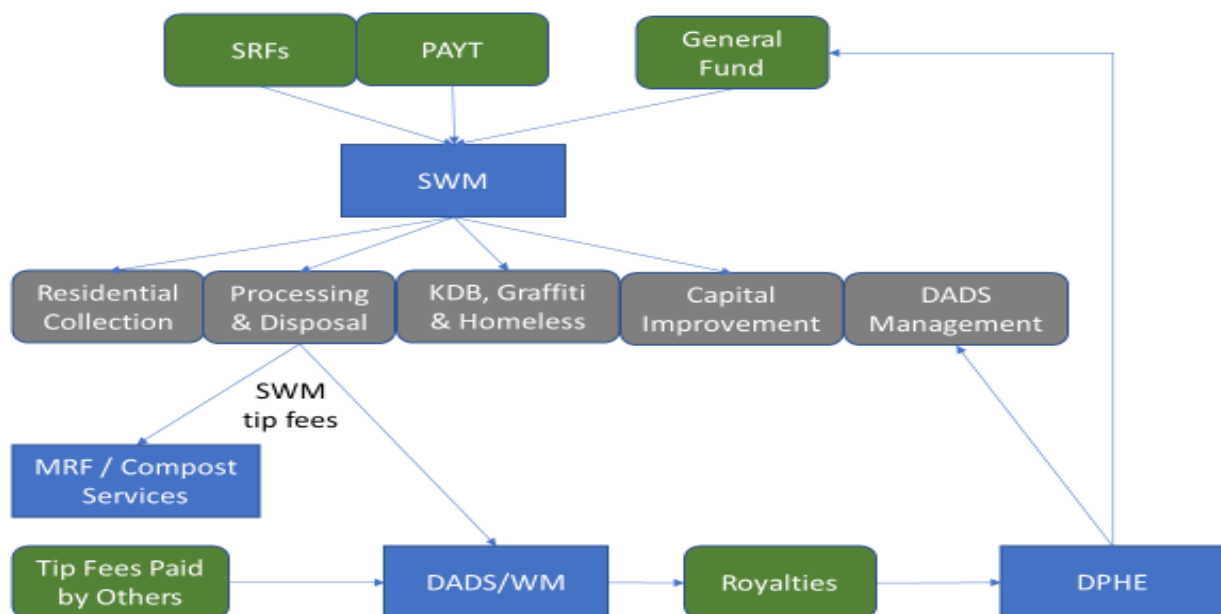



Figure 4.3 SWM FUNDING WITH PAYT

³⁵ “Draft Solid Waste Cost of Service and Rate Design Study,” Burns & McDonnell, November 2019 - costs for non-residential programs (i.e., Keep Denver Beautiful, Graffiti and Homeless) are estimated to be an additional \$2.5M and are funded through the General Fund. This funding approach is not expected to change in the future regardless of new residential programming and revenue generation.

As a result, SWM will need to continue to rely in part on the General Fund for a portion of its needs (see Figure 4.3 on the previous page). While the current SRF for subscription compost collections will no longer be needed, a PAYT SRF will be necessary.

PROPOSED IMPROVEMENTS


 **Conduct Organizational Management & Financial Analysis** – This analysis should build on the 2019 PAYT cost of service analysis and update expense projections, identify gaps between revenues and expenses, identify potential funding sources (see Section 4.10) and plan for organizational realignment of services and infrastructure under SWM.

 **Transition to Solid Waste Enterprise Fund** – The benefits of enterprise funds include:

- Reduced competition with other municipal services for funding
- Reduced burden on the General Fund
- Transparency and management based on full cost accounting
- Focus on planning a strong foundation for sustainable program management
- Improved management information systems and tracking

Municipal solid waste programs that generate substantial revenue from collection services and disposal facilities are often administered as enterprise funds similarly to a public utility, where service fees, assessments and/or tipping fees cover most or all of their expenses.

From a funding perspective, it is recommended that SWM move from a General Fund division with small SRFs to an enterprise whereby revenue from services (small residential PAYT, ETC and municipal properties) and royalties from DADS are combined to fund SWM’s portfolio of infrastructure and services. For example, DADS royalties could be used to help fund the recommendations in this DWRS and reduce future burden on the General Fund. The exception would be major capital improvement project investments that would still be financed through the General Fund or municipal bonding (see Figure 4.4 on the next page).

 **Consolidate All Solid Waste Functions Within One Division** – The administrative structure and funding mechanisms for Denver’s solid waste services are unique. Most municipal solid waste programs with a full system of collection, processing, transfer and disposal are managed by a single department or division. DPHE’s primary mission and activities are broadly focused on environmental quality and public health but not infrastructure and operations like DADS and the WM contract. DADS is a critical component of Denver’s solid waste infrastructure and services; as such its development, operations and management are more directly aligned with the mission and responsibilities of SWM and DOTI. It is recommended that all solid waste functions and responsibilities be consolidated under one division, so the city’s overall solid waste system is managed in a more integrated manner.

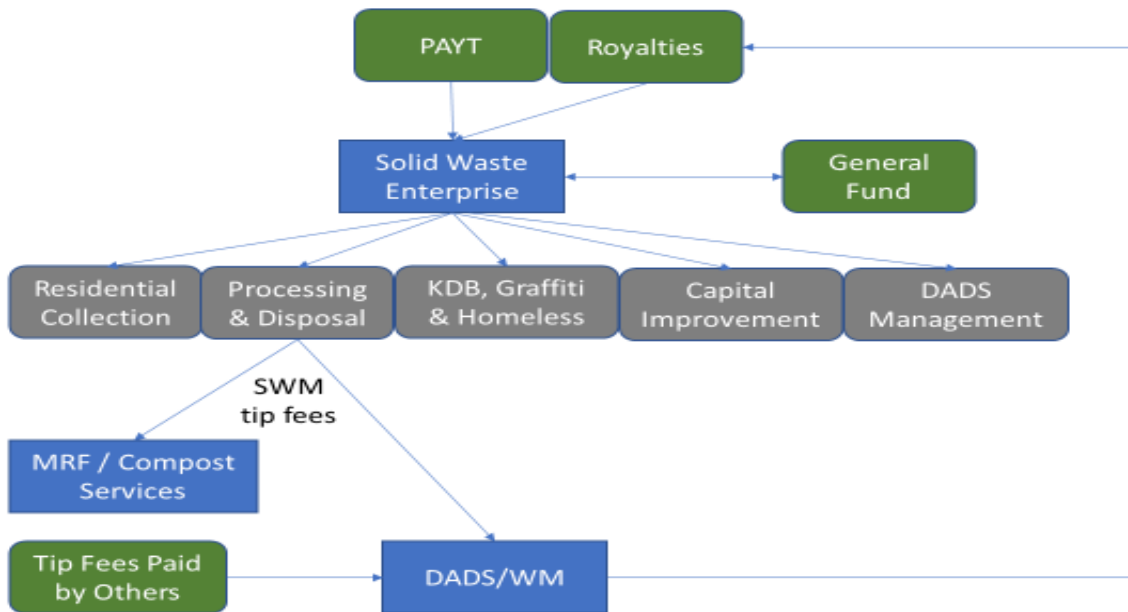


Figure 4.4 SOLID WASTE ENTERPRISE FUNDING

IMPLEMENTATION CONSIDERATIONS

SWM Reorganization

Currently SWM has two primary lines of management focused on recycling/composting operations and programs, and trash/transfer facility operations. There are overlapping responsibilities for the different collection services. With an expanded portfolio, SWM may consider increasing and more clearly delineating the lines of management based on function, for example:

- Administration and future DWRS visioning/planning
- Customer services
- Collection operations (all three streams)
- Infrastructure operations (SWM and contracted facilities - transfer stations, DOCs, MRF and potentially landfill)
- Residential & commercial programs (quantity/annual report tracking, education/outreach, technical assistance, hauler licensing, etc.)
- Inspection and enforcement (expanded to manage new initiatives recommended in this DWRS)

Consolidate Solid Waste Staff

Consolidating SWM staff and DPHE landfill contract and regulatory compliance staff will help to ensure continuity and further streamline overall system management.

Integration of Enterprise Funds

Enterprise funds are often viewed as source of money that can be “raided” to fill general funding gaps without impacting taxpayers. However, given the relatively small size of the SWM revenue requirements versus the magnitude of revenue Denver generates from sales taxes, this may be less of an issue.

Cost Distribution

Cost of services should equitably distribute costs amongst program beneficiaries so that one sector is not significantly subsidizing programs and services for others (for example, SWM should evaluate options for generating revenues from the commercial sector to support waste reduction programs aimed at those sectors).

4.10 NEW CITY FUNDING SOURCES

Fully funding a SWM enterprise and the DWRS improvements recommended in this document will require more revenue than what is projected to be generated from PAYT and DADS royalties. Opportunities for generating revenues for services provided to all sectors through modest fees can build on existing fee structures. The evaluation of new funding sources should be conducted at the same time as any SWM administrative improvements.

The following funding options are in addition to funding mechanisms discussed elsewhere (i.e., PAYT, General Fund and the compost SRF). Options range from general community-wide fees to fees that target specific components of the solid waste system and/or sectors to create incentives for increased waste reduction successes.

It is important to note that funding based on the amount of trash collected and disposed (such as PAYT and landfill surcharges) can decrease over time if reduction and recycling programs are successful. So a comprehensive funding strategy should incorporate a diversity of funding sources and options for adjusting fees over time to ensure financial sustainability for all aspects of the system.

Equity and burden-sharing are also important criteria to consider when developing a sustainable funding base. It is necessary to determine the appropriate balance between charging customers the actual cost of services and creating incentives and disincentives for desired behaviors. The DWRS presents a number of opportunities in the commercial and construction sectors which are not directly served by SWM. Equity and burden-sharing will need to reflect local political preferences and practices to ensure that various stakeholder groups support the recommended funding strategies.

POTENTIAL FUNDING OPTIONS

Environmental Protection Fee / Clean Community Fee for Residential Generators

An environmental protection fee (EPF) or clean community fee (CCF) is a community-wide fee that can be levied to raise money for environmental programs including those related to materials management, waste reduction and recovery (see Table 4.18 on the next page for national examples).

Program	Fee	Uses
Austin, TX	Clean Community Fee - \$8.95/household-month	DOCs, zero waste program development, reuse centers, street sweeping, graffiti removal, etc.
Boulder, CO	Trash Tax (revenues \$1.8M/year) \$3.50/household-month \$0.85/cubic yard commercial	Waste reduction initiatives, public education/outreach
Fort Worth, TX	Environmental Protection Fee Applicable to all sectors	Disposal services, environmental programs & services

An EPF or CCF applied to all residents can provide a substantial and stable source of funding. For example, if a fee of \$1 to \$2/household/month would generate between \$4.2 and \$8.4M/year (350,000 small residential homes and MFUs). While generating adequate revenue to cover projected budget shortfalls and being a stable source of funding independent of waste generation and actual services provided, this kind of fee:

- Would be difficult to justify for small residences unless/until SWM provides services in addition to those included in the PAYT system
- Would be challenging to assess on MFUs until a reporting and monitoring system is implemented to track and verify the level of collection service provided by licensed haulers
- Would require adding a non-ad valorem assessment on residential property tax bills based on the number of dwelling units per tax bill
- May not be a financial driver of behavior – even if tied specifically to waste reduction
- Some community members will perceive it to be inequitable because - although it can be dedicated to broad community benefits - some generators may derive greater benefit than others (e.g., DOCs may be of greater value to MFUs than others)

Volume-Based Hauler Licensing Fee for Commercial & Construction Sectors

Denver's current private hauler licensing process requires an annual licensing fee that is based on the number of vehicles owned. This fee is not a significant source of revenue and does not reflect the impact of haulers on Denver infrastructure or their critical role in the city's materials management system. One option is to increase the existing fee structure; however, this would still not be likely to generate significant funds.

An alternative approach is to base the fee on the volume of trash service that haulers provide (Boulder's trash tax is effectively a volume-based fee that increases customers' waste management cost and encourages them to reduce waste). A similar volume-based fee would target the generators not served by the SWM and thus be a potential source of funding for waste reduction activities targeting commercial and construction generators in an equitable manner that does not use funds from small residential as a subsidization. For example, applying a \$0.85/cubic yard fee (comparable to Boulder's fee) to \$1/cubic yard fee to trash

quantities hauled by private haulers would generate \$4.8M to \$5.7M/year³⁶. As Denver’s waste reduction successes increase, this revenue could drop to roughly \$3M/year (i.e., 50% diversion levels).

Implementation of such a fee would build on the existing licensing and tonnage reporting process but would:

- Require increased SWM monitoring – as haulers would have an economic incentive to under-report
- Require clear justification in terms of fair and tangible benefits (this sensitivity may be reduced as PAYT is implemented) – for example, MFUs and businesses have long been sensitive to the inequity between their sector (which receives no SWM services currently)

Landfill Tip Fee Surcharge for Non-SWM DADS Tons

Solid waste facility fees are a widely used method to incentivize and fund waste reduction efforts. Fees are typically added on top of standard facility tip fees and apply to trash generated by all sectors. Landfill disposal fees in the metropolitan area are low relative to other parts of the U.S. Regional tip fees in the Mountains/Plains region averaged \$44/ton in 2018³⁷.

In Denver, a system of disposal surcharge at DADS could be imposed on all trash and C&D debris from non-city sources in addition to the royalties which would continue to be paid by WM. Being applied only to non-city waste, the funds generated could be a transparent and equitable way to fund commercial and construction sector waste reduction efforts. The fee would also apply to tons generated outside of Denver and would support activities that would offset the environmental impacts of hosting a regional disposal site.

Such a fee would be relatively easy to implement and monitor as WM already weighs and charges tip fees at DADS. Assuming DADS inbound tons are approximately 1.5M/year and that non-city tons are about 1.2M³⁸, a \$3/ton to \$5/ton surcharge could yield between \$3.6M and \$6.0M/year. Adding this fee would not require new billing efforts by SWM and would be simple for DADS to implement (requiring only an adjustment in tracking and transferring funds to SWM on a quarterly basis)³⁹.

Funding Summary

Whether implemented individually or in aggregate, the options described above offer the potential to raise substantial funding to meet future revenue requirements associated with recommendations in the DWRS:

- EPF/CCF at \$1 to \$2/household-month - \$4.2M to \$8.4M/year
- Volume-based licensing fee at \$2.85 to \$3.33/ton - \$4.8M to \$5.7M/year
- Non-SWM landfill tip fee surcharge at \$3 to \$5/ton - \$3.6M to \$6.0M/year

³⁶ Based on 1.7M adjusted hauler trash tons in 2018 and a conversion factor of 3.333 cubic yards/ton.

³⁷ “Analysis of MSW Landfill Tipping Fees,” Environmental Research & Education Foundation, April 2019.

³⁸ SWM and DIA tons were about 171,000 and 13,000 in 2018, respectively. Other quantities not available for analysis include contract tons from city facilities and construction projects.

³⁹ Colorado landfills are already subject to tip fee surcharges that are passed on to CDPHE quarterly. For reference, the CDPHE-mandated surcharge is \$1.67/ton in 2020 and a new FRWD enterprise adds \$0.50/ton (both of these programs will escalate annually through 2029).

In the aggregate, these sources could generate between \$12.6M and \$20.1M annually.

These three funding options would impact stakeholders differently. For example, an EPF/CCF would impact, and be perceived by, small and large residential households differently. Small residential would be paying the fee in addition to PAYT, so those customers would need to understand the additional services being funded, such as additional DOCs and a MRF not included in the PAYT rates. Large residential households would be benefitting from additional DOCs and improved access to diversion services through a UWRO and MRF. Commercial generators would see higher collection costs as haulers pass through volume-based license and landfill surcharge fees but would benefit from improved diversion access and SWM technical assistance.

Lastly, it is important to consider that over time as Denver's landfill diversion levels increase, funds from licensing fees and landfill tip fee surcharges based on trash tons will decrease (funds generated by an EPF/CCF would remain stable or grow slightly with population increases). To retain sustainable funding for diversion in the long term, the city should establish a multi-component revenue generating strategy that address all sectors with reasonable stability over time. Utilizing all three options is one way to accomplish this. Alternatively, the city could consider a more broad-based EPF/CCF that applies to all of the commercial and construction sectors.

4.11 IMPLEMENTATION OF SHORT-TERM RECOMMENDATIONS

COSTS FOR SHORT-TERM RECOMMENDATIONS

Table 4.19 (on the next page) includes an estimate of city costs for implementing short-term recommendations (costs are expressed as 2020\$). These estimates are based on several assumptions:

- Costs begin with implementation and do not include policy development
- Labor costs are based on average 2020 burdened salaries for each category
- Costs are those additional expenses expected to be incurred by SWM staff – they do not include costs for city staff/activities that are not expected to exceed current workloads or consulting fees other than those needed for MRF and transfer station feasibility and siting work
- Estimated capital and operating costs for infrastructure is detailed previously in this section and in appendices as noted

[Labor Requirements](#) – It is expected that labor needs associated with short-term improvements will be staggered between 2021 and 2025 and will have less impact on staffing levels than on-going operations. As noted in Table 4.19, the long-term labor requirements are estimated to include about 0.5 FTEs at the Program Administrator level (to assist with most new programs and policies), just under 4 FTEs at the Equipment Operator level (for DOC operations) and a new Administrative Assistant position to provide customer service and billing related to ETC/LIP service improvements.

IMPLEMENTATION SCHEDULE FOR SHORT-TERM RECOMMENDATIONS

Figure 4.5 (at the end of this section) provides a suggested sequencing of improvements recommended for the short-term period through 2025.

Table 4.19 CITY COSTS ESTIMATED FOR SHORT-TERM IMPROVEMENTS (2020\$)

Improve- ment	Start-Up Year Costs				Subsequent Annual Costs		
	Capital	Labor ^a	Other	Notes	Labor ^a	Other	Notes
UWRO	\$0	\$31,000	\$8,000	0.5 FTE Pgm Admin Software	\$15,500	\$8,000	0.25 FTE Pgm Admin Software
PAYT	\$0	\$0	\$0		\$0	\$0	Included in proposed Table 4.3 rates
ETC Fee & Reduced LIP	\$0	\$35,000	\$25,000	1.0 FTE Admin Asst Supplies	\$35,000	\$25,000	1.0 FTE Admin Asst – assumes some bag tag on-line purchasing
Residential OCC Disposal Ban	\$0	\$15,500	\$0	0.25 FTE Pgm Admin	\$6,200	\$0	0.1 FTE Pgm Admin
New City MRF (regional option)	(\$26.5M- \$28.5M ^c)	\$29,800	\$200K- \$250K	0.25 FTE Super/Dir Feasibility study	\$0	\$0.5M- \$0.7M	Facility operations costs (includes labor)
New City Transfer Station	(\$8.2M- \$9.3M ^c)	\$17,900	\$150K- \$200K	0.15 FTE Super/Dir Feasibility study	\$0	\$1.7M- \$1.9M	Facility operations costs (includes labor)
DOCs (1 DOC) (3 DOCs)	\$0 excludes land	\$56,300 (\$168,900)	\$25,000 (\$75,000)	1.25 FTE Equip Operator Supplies	\$56,300 (\$168,900)	\$25,000 (\$75,000)	1.25 FTE Equip Operator Supplies
City Facility Diversion	\$0 excludes fleet costs	\$24,300	\$0	0.1 FTE Super/Dir 0.2 FTE Pgm Admin	\$0	\$0	
Equal Space	\$0	\$3,100	\$0	0.05 FTE Pgm Admin	\$6,200	\$0	0.1 FTE Pgm Admin
Administrative & Funding	\$0	\$45,300	\$0	0.25 FTE Super/Dir, 0.25 FTE Pgm Admin	\$0	\$0	
Total without PAYT Capital	(\$34.7M- \$37.8M ^b)	\$370,800K	\$458K- \$558K	Excludes land purchases & fleet for additional city facility services	\$231,800	\$2.3M- \$2.7M	Includes 3 new DOCs
Total with PAYT Capital^d	(\$12.7M- \$15.8M ^b)						

^a Average burdened salaries: Supervisor/Director (Super/Dir) \$119,000; Program Administrator (Pgm Admin) \$62,000; Equipment Operator (Equip Oper) \$45,000; Administrative Assistant (Admin Asst) \$35,000

^b Regional recyclables processing option includes 50/50 revenue split city/operator, 50% tip fee payment by non-city haulers

^c Capital costs provided for reference only – see annual facility operations for amortized design and construction (land purchase excluded)

^d PAYT capital (\$22M) included in Table 4.3 rates

Section 5.0 LONG-TERM RECOMMENDATIONS

Long-term recommendations are those recommendations that will rely on the implementation of one or more short-term recommendation. In general, long-term improvements include:

- Additional infrastructure needed to support increased landfill diversion by the commercial sector
- Ability to increase landfill diversion, improve cost-effectiveness and raise public awareness
- Support for regional and state collaboration around new processing capacity and end markets

Long-term recommendations should be undertaken during the five-year period from 2026 to 2030. Some recommendations may not be completed until after the current DWRS planning period.

5.1 REGIONAL COMPOST CAPACITY

The landfill diversion of green waste, food waste and other organics is relatively limited in the Denver metropolitan region. Reasons include the disincentive from tip fees that exceed most landfill rates, high haul costs to remote processing sites, film and food waste package contamination and limited revenue from product sales. The ability to spur more composting in the future is also hampered in the metropolitan area by the limited potential of existing processors to accept significantly more materials.

CURRENT SYSTEM & NEED FOR IMPROVEMENT

Denver

In 2018, about 38,000 tons of organics were diverted from small residential and commercial generators which represented an overall capture rate of only 15% and 11% from each sector, respectively (see Appendix H). SWM contracts with A1 Organics (A1) for processing source-separated organics at its Rattler Ridge facility in Keenesburg, CO. Most commercially generated organics are either hauled to Rattler Ridge or to GFL's compost facility in Bennett, CO. Both are Class III facilities that accept food waste, yard waste, non-recyclable paper & compostable packaging⁴⁰.

SWM pays \$24.75/ton tip fee for materials delivered to Keenesburg plus a hauling cost that more than doubles this rate (see Table 4.15). As a result, small residences pay \$9.75/household-month for compost

⁴⁰ Other facilities in the region include the Class II BOSS Compost facility and Waste Management's Class III industrial compost facility co-located at DADS.

service while both trash and recycling service have \$0 user fees⁴¹. Commercial composting collection is also a fee-based service, with rates that vary with the hauler.

Given the cost of hauling and processing organics, and the relatively low revenue potential from product sales in the local marketplace, composting is a net-loss program. To address this, improved transfer options, closer processing facilities and greater demand for end products are needed. Until these solutions are in place, Denver will need to determine its ability to prioritize organics recovery by focusing on the attributes of reduced water need, less soil loss, carbon sequestration and less reliance on landfill disposal.

Regional & State Efforts

The value of developing regional compost capacity and opportunities for collaboration was the primary catalyst to a 2019 dialogue between SWM staff and DRCOG member representatives. A loose “Metro Waste Shed” network continues to discuss focus and actions. While future direction is unknown, this group could be a starting point for public regional partnership that evaluates the feasibility of a new regional compost facility.

At this time, there is limited organics diversion outside of Denver. Exceptions include Boulder (a privatized collection system in which all generators are required to divert organics); Golden, Lafayette and Louisville (which all contract for private residential compost collection); Longmont (public collection of residential organics); and sporadic commercial collections across the region.

Lastly, a pertinent bill was introduced in the 2020 legislative session that was unsuccessful but is expected to be introduced again in 2021. It will provide for state-wide end market and infrastructure studies, end-market recommendations for compost products and set procurement standards for using certified compost produced in Colorado. As such, it would provide a regional collaboration with a jump start on quantifying need and opportunity.

Future Regional Demand & Existing Infrastructure Capacity

A1 has estimated that its Rattler Ridge facility has available capacity of about 100,000 tons/year. GFL could not provide a capacity estimate but for the purpose of this analysis is expected to be less than 100,000 tons/year, yielding a total available capacity of between 100,000 and 200,000 tons/year.

Table 5.1 (next page) includes estimates of organics generation in Denver and throughout the DRCOG region over the DWRS planning period. It is clear that there is insufficient compost processing capacity even if the DRCOG membership only diverts modest levels of organics in the short term. Over the next 10 years as new city-wide programs and policies are added and mature, Denver alone could generate more organics than existing facilities can accommodate.

⁴¹ Approximately 18,000 households subscribed to compost service in 2018 while most of the city’s 180,000 small residences received trash and recycling service.

TABLE 5.1 ESTIMATED ORGANICS DIVERSION BY DRCOG MEMBERS		
	2020	2030
Denver		
Small Residential (Table 3.1)	9,000	80,000
Commercial (Table 3.3)	45,000	252,300
Subtotal	54,000	332,300
Other DRCOG Members⁴²		
Small Residential	30,000	101,000
Commercial	94,000	320,000
Subtotal	124,000	421,000
Total	178,000	753,300

Success in Other Communities

Table 5.2 provides examples of multi-government collaboration that may inform a regional coalition.


Table 5.2 MULTI-GOVERNMENT COLLABORATIVE EXAMPLES		
	Members	Service
3RC (Rooney Rd, CO)	Arvada, Edgewater, Golden, Lakewood, Lakeside, Morrison, Mountain View, Wheat Ridge & Unincorporated Jefferson County	HHW & paint recycling
Oak Grove Multi-Municipal Compost Processing Board (PA)	Lehman, Middle Smithfield & Smithfield Townships	Regional green waste compost facility (state mandate to divert leaves & yard waste)
Palm Beach County Solid Waste Authority (FL)	Palm Beach County municipalities & unincorporated county	Trash/recycling collection, 6 transfer stations, MRF, 7 HHW drop sites, renewable energy and biosolids processing facilities
Portland Metro (OR) (elected regional government)	Urbanized areas of Clackamas, Multnomah & Washington Counties	Recycling & trash transfer (to out-of-county landfill), public outreach & non-waste services
San Luis Valley Solid Waste Authority (CO)	Alamosa, Conejos, Costilla, Rio Grande, Saguache & San Miguel Counties	Regional landfill with recycling/HHW drop site, green waste processing

PROPOSED IMPROVEMENTS


-  **Develop a Regional Coalition or Formal Organization** – The organization’s purpose should be to develop a facility that could provide public partners with long-term compost infrastructure whether

⁴² DRCOG organics quantities based on Colorado State Demography Office population projections and assumed diversion rates (10% in 2020 and 30% in 2030).


they provide public organics collection directly or simply want a sustainable facility to support processing for organics separated by generators in their communities and hauled by the private sector.

 **Pursue Grant Funding** – Two opportunities for funding early facility planning (both based on landfill tip surcharges) include:

- CDPHE’s RREO grant program - available funds in the 2020/2021 fiscal year include \$2M available for all infrastructure projects (subject to change related to coronavirus, passage of 2020 legislation and other unforeseen factors)
- Front Range Waste Diversion grant program - beginning in 2021 this fund will have \$1.6M available but will increase to \$15M/year within five years (subject to change)

 **Conceptualize Facility & Determine Feasibility** – This work will ideally be completed with the help of an outside consultant with applicable expertise (this could be a grant-funded cost) and should include:

- Potential property – such as Denver-owned property adjacent to DADS, co-location with a new city MRF or transfer station or property provided by another DRCOG member
- Acceptable organic feedstocks – for example food packaging may be limited or prohibited to maximize end-product quality
- Determine the most advantageous PPP mechanism (which can include design, build, operate and/or transfer⁴³)
- Based on the estimated quantities for Denver compost capacity needs in Table 5.1 a preliminary estimation of the capital cost for a 300 ton/year compost facility is approximately \$7M to \$8M exclusive of land⁴⁴ (which would result in tip fees in the \$28/ton to \$30/ton range⁴⁵) – these costs are very preliminary given the unknowns of actual (regional) facility size, regional ownership, technology and location)


 **Implement Programs to Drive Organics Recovery** – This will vary by community. SWM is expected to implement residential PAYT including bundled composting in 2021. This DWRS includes recommendations that will lay the groundwork and foster more organics recovery in the commercial sector. However, significantly increased diversion probably cannot be supported until new, cost-effective composting capacity is added to the region.

⁴³ Potential bidders may include processors already operating in the Front Range, who may welcome the opportunity for access to additional tons at another more centrally located facility.

⁴⁴ This assumes 200,000 tons/year of yard waste and 100,000 tons/year of food waste, total site size of 70 acres and site development for a static aerated windrow system with an all-weather, non-paved compost pad.

⁴⁵ This rate may be comparable to future A1 tip fees but could be lowered with regional economy of scales and more efficient technology (such as the modified static aerated pile system A1 uses). A less remote site will also reduce Denver’s hauling costs over the current transfer to Rattler Ridge.

Other coalition members should consider PAYT programs (whether public, contract or open market collection systems) that include bundled composting as well as commercial requirements similar to those discussed for Denver. These policies will drive more tons and support a regional facility but will also provide consistency in how diversion is prioritized, and materials managed across the region.

-  **Develop End Markets for Compost Products** – Strong market demand for compost products will be critical for efforts to maintain feedstock and end-product quality. The ability to have adequate markets able to pay sustainable revenues will help offset the need for higher facility tip fees. See Section 5.2 for further end market discussion.

Denver Opportunities

- Expand/enforce Denver Water soil amendment requirement to specify compost produced locally (e.g., at a new regional compost facility)⁴⁶
- Require use of certified⁴⁷ compost/mulch produced locally on all city projects (including those with contractors and subcontractors) where permeable soil is disturbed; before sod, seeding or planting occurs; and where maintenance occurs in parks, rights-of-way and other spaces⁴⁸
- Expand master purchase order by the DPR to procure and supply all other government projects and maintenance – establish minimum purchase quantities in order to obtain best pricing
- Expand 2019 pilot to sell “Denver’s Own EcoGro” to full scale including high-value retail and box store markets and work with contract processor to include other greenhouse and nursery blends to raise public awareness

Other Opportunities

- Other DRCOG members – most of the Denver recommendations can also be pursued by other members (the ability to implement consistent requirements and enforcement across the region will bolster demand of local end product and reduce import of products made elsewhere)
- State Opportunities – regional and state market development initiatives will likely require coordination with CDPHE, Recycle Colorado and USCC and should include collaboration with state agencies like the Colorado Department of Transportation (which requires certified compost but cannot reliably find product local to all its projects).

IMPLEMENTATION CONSIDERATIONS

- Most DRCOG members are not as environmentally progressive as Denver and may not see costs and likely risks as being offset by potential benefits

⁴⁶ Other local communities that have similar requirements include Castle Rock (specifies compost quality) and Boulder, Fort Collins, Greeley, Westminster and Cheyenne, WY which require compost, aged manure, peat moss or other suitable organic product.

⁴⁷ The most commonly accepted national certification is the USCC Seal of Testing Assurance Program.

⁴⁸ These changes will build upon EO 123 requirements for environmentally preferable purchasing and use of recycled materials on city construction projects.

- This may be perceived as “a Denver project” and trust in shared risks and benefits may be less than needed for a successful coalition
- Without commitment from the largest DRCOG members⁴⁹ a regional effort may not support an economy of scale needed for cost-effective operations (even if private haulers who serve these communities utilize a regional facility)
- Finding suitable land in reasonable proximity to the coalition center will be challenging
- Programming to ensure high-quality feedstock will be challenging - failure can reduce revenues and/or increase tip fees

5.2 REGIONAL END-MARKET DEVELOPMENT

Unfortunately, most recycling and compost facility tip fees in the Front Range are higher than landfill fees. The lack of market demand for most materials/products generated by local diversion programs is one factor that keeps MRF and compost facility fees high. Solutions to “closing the loop” will need to be regional or even state-wide.

CURRENT SYSTEM & NEED FOR IMPROVEMENT

In Colorado, there are several pivotal reasons for limited market demand:

- Poor data for material sources, supply and quality – communities like Denver, Boulder, Golden, Lafayette, Longmont, Louisville and Northglenn are the exception; most DRCOG communities do not track this information nor require haulers operating in their jurisdictions to report same
- Inability to guarantee material supply – most DRCOG communities have no control over material collection⁵⁰
- Lack of affordable land in Denver metropolitan area – but could be lower if end-markets are outside of this area
- Other issues that are beyond the scope of the DWRS – such as Colorado’s relative geographic isolation, long-haul driver shortages, fuel prices, lingering impacts of coronavirus, etc.

Existing Business Opportunities

While tools and resources are available to businesses who are savvy enough to research and identify them, recruitment of new and expanding businesses to Colorado is not an active process. More specifically, neither Denver’s Department of Economic Development and Opportunity (DEDO) or the Colorado Office of Economic Development and International Trade (OEDIT) have staff with training in the waste management industry that pro-actively target and identify businesses with market demand. Both agencies have indicated that this is not likely to change given the strong economy and relatively low number of mid-level, white collar jobs created by this industry.

⁴⁹Aurora, Lakewood, Thornton, Arvada, Westminster, Centennial and Boulder all have populations >100,000. Collectively, they represent nearly half of non-Denver population organics generation.

⁵⁰ 68% of Colorado cities with populations >10,000 did not offer public collection, contract for collection or require hauler licensing/reporting in 2010; very few have changed in recent years (“Myth Busting,” LBA Associates, 2010).

Denver

DEDO provides several services that are available to new and expanding businesses. These include workforce centers and shared workspace, start-up toolkits, technical assistance, loan programs, property tax credit for eligible companies, and connections to trade groups and regional economic development tools.

State

OEDIT manages a state-wide system of enterprise zones, which overlap parts of Denver. These are typically areas of relatively higher unemployment and low per-capita income. Eligible businesses in these zones can take advantage of multiple tax credits that range from job training to commercial vehicle operation. The state reports that this is an under-utilized program, however, which may reflect lack of active promotion.

The State of Colorado also allows an exemption from state sales and uses taxes associated with the purchase of new and used equipment used to manufacture new products from diverted materials and can apply to multiple steps in the product chain including some intermediate processors.

As of the publication of this report, the 2020 legislature is still considering a bill to establish a state recycling market development center with tax benefits to help existing (and attract new) recycling businesses, a state-wide education campaign plus several research and technical assistance components. If successful, this program would give Denver and the regional coalition a head-start on any end-market efforts.

State of Colorado

A new bill was introduced in the 2020 legislative session that was unsuccessful but is expected to be reintroduced in 2021. Although no specific materials or end-products were specified, it would create a Recycling Market Development Center to:

- Evaluate capacity of existing markets to use current and future material quantities
- Actively identify and target new businesses to bring to Colorado
- Assist new and expanding businesses that use diverted materials by providing research, technical assistance, funding and public outreach campaigns
- Award property tax rebates for eligible businesses⁵¹ (similar to the DEDO credit)
- Develop a materials database for business to business matching
- Recommend local and state policies to support end-market businesses
- Implement a state-wide public education campaign

Successes in Other Communities


Table 5.3 (on the next page) includes some examples of governments that have developed successful business development and marketing programs.

⁵¹ Both equipment tax exemptions and property tax credits can have significant benefits – one materials processor in Broomfield reported business personal property taxes well in excess of \$100,000 in 2019.


Program	Components	Resources
Austin, TX Economic Development	<ul style="list-style-type: none"> ✚ Loan Program - for small businesses/family- & veteran-owned businesses, for businesses employing targeted populations ✚ Innovation competition ✚ On-line business & reuse directories ✚ Resource Recovery funds Economic Development Services Coordinator position in city’s Economic Development Dept 	Clean community fee from all households (see Table 4.18), grant & foundation funding
King County, WA Link-Up (regional focus)	<ul style="list-style-type: none"> ✚ Technical assistance including technology validation & supply chain facilitation (cannot provide land or funding) ✚ New Recycling Market Center – partnerships, accelerator, incubator, public databases, infrastructure research 	Generally funded county program (limited user fees)
Northeast Resource Recovery Association (six-state non-profit)	<ul style="list-style-type: none"> ✚ Brokers >80,000 tons/year ✚ Attracts buyers by marketing them to 400 members & does all billing ✚ Vets buyers & conducts price negotiations for members 	Member dues, registration fees, grants, equipment sales
Pennsylvania Recycling Markets Center	<ul style="list-style-type: none"> ✚ Partnership with Penn State Harrisburg ✚ Partnership with GreenCircle Certified to certify products with recycled contents ✚ Commodity pricing to state partners ✚ Equipment optimization using thermographic imagery 	
Phoenix, AZ Recycling Innovations & Solutions Network (regional focus)	<ul style="list-style-type: none"> ✚ Partnership with Arizona State University School of Sustainability⁵² – research, technical development & business development ✚ Public Works funds 1 FTE in city’s Economic Development Office 	Ellen McArthur Foundation, Closed Loop, U.S. Chamber of Commerce


PROPOSED IMPROVEMENTS

In general, these recommendations are based on a regional effort as the quantities generated by Denver alone may not be substantial enough to attract new businesses.

-  **Improve Data** – Historical generation and diversion quantities; projections based on population, planned programs and other expected changes; and composition data for both discarded and diverted streams should be developed (this means cities that are not currently collecting data should begin as soon as possible).


⁵² This program has become a highly skilled consulting resource for governments and businesses across the U.S.


 **Dedicate Staff** - Local resources will be required. These will ideally include staff housed in either SWM or DEDO (but directed at least in part by SWM) whose responsibility would be to verify data, coalesce regional supply, identify and pursue appropriate markets⁵³. This may be a task that SWM would assume on behalf of the DRCOG region. Both Austin and Phoenix waste management divisions fund a staff person in the city's Economic Development Office to focus on market development of discarded waste materials and products.

 **Target the Biggest Bang-for-the-Buck Materials** – The most effective market development will focus resources on generating local demand for materials/products whose consumption will have the biggest impact on sustainable economics⁵⁴. Several factors determine this impact including quantity generated, role in contaminating other streams, management costs, etc.

If reasonable market demand had been exerted for the top three materials discarded in 2018 (on quantity basis) about 350,000 tons could have been diverted instead of landfilled⁵⁵:

- Compost and mulch products - produced from food waste, yard waste, compostable paper and clean wood generated by small residential and commercial sectors
- Drywall – construction sector (largest generating sector in 2018)
- Shingles – construction sector (largest generating sector in 2018)

 **Actively Recruit Targeted Businesses** – As noted, there are no city or state-level government agencies that are actively identifying and pursuing businesses that will demand these materials/products, nor is this likely to change in the short-term (unless the 2020 legislation described above is successful).

 **Identify Facility Site** – After quantity needs, available land is a common obstacle to bringing new businesses to the Front Range. The ability of other communities to help identify potential property could be a huge incentive and may increase opportunities for an eco-industrial campus where multiple parties can share resources and decrease waste as they improve both economic and environmental benefits.

IMPLEMENTATION CONSIDERATIONS

- Developing regional efforts is challenging – if a regional compost coalition is formed it would be an ideal jumping-off point for other end-market demand efforts

⁵³ For example, municipal, county and state agencies (especially the Colorado Department of Transportation) that use compost and mulch products for erosion and water usage control on public and publicly contracted construction projects; and processors/manufacturers of new gypsum and asphalt products.

⁵⁴ King County concentrated on carpet, textiles, mattresses and shingles through 2018 but has moved its resources to organics in the last two years; Phoenix prioritizes plastics #3-#7, MRF residue and hard-to-recycle materials.

⁵⁵ Estimation considers SWM's small residential materials (based on SWM's 2016/2017 and 2019 waste audits); adjusted commercial and construction tons; demand assumed to drive 60% material capture.

- Obtaining cooperation from local and state business development agencies will be challenging for this industry – CDPHE may be the most helpful on a state level

5.3 REGIONAL C&D PROCESSING CAPACITY

Denver construction is the largest waste stream in the city. The ability to extend waste reduction to non-aggregate materials is a critical waste reduction mechanism. Given the industry's variability and the need for a critical mass to support processing and end markets, however, sustainability solutions will need to be regional or even state-wide (and will ideally build upon regional efforts around new compost capacity). Recycling of material other than those with existing markets will be delayed until new market demand is developed.

CURRENT POLICY & NEED FOR IMPROVEMENT

Construction debris made up about 51% of the waste by weight generated in Denver in 2018. Diversion levels were at least 17% although this value may under-estimate actuals (aggregate recycling and soil reuse are largely unmeasured). Aggregate products⁵⁶, rock, treated wood, drywall, roofing shingles and untreated wood were the most prevalent materials in audited trash loads.

There are many contractors, suppliers, haulers and trade organizations involved in the local construction industry. Many contractors and their subcontractors actively take advantage of existing market demand for source-separated aggregates and metals due to the cost benefit of diverting these materials. Some of these companies (especially those involved in LEED projects) provide minor separation of materials and quantity reporting for their clients⁵⁷. While these activities are inconsistent, they do indicate that some stakeholders are aware of the logistics and economics of C&D debris diversion.

Policy around construction waste from city projects is largely limited to LEED Gold requirements for new and renovated city buildings (established by EO 123). The key waste management criteria (i.e., construction debris diversion and reuse) are optional and diversion quantities are not rigorously monitored. There are no requirements for C&D diversion in the private sector.

Key diversion obstacles center around the variety of project types and sizes, the lack of mixed C&D debris processing and weak or non-existent end markets for many materials. Table 5.4 (next page) summarizes several C&D diversion programs developed to address these obstacles in other parts of the country. These programs primarily target building construction, which generate less total waste than road/bridge/utility projects but have less potential as debris is typically highly mixed with fewer materials that are valuable in local markets.

⁵⁶ Structural and bituminous concrete is the primary source of aggregate by-products (which are typically mixed with cement or asphalt binder) as well as steel, mesh and other materials.


⁵⁷ These include 5280 Waste Services, Colorado Cleanup Corporation, Hillen Corporation, GE Johnson and others.


Table 5.4 CONSTRUCTION DIVERSION PROGRAM EXAMPLES		
Municipality	Applicability	Diversion Requirement
Alameda County, CA	Any project with demolition permit, residential construction >1000 square feet or non-residential >3000 square feet	75% diversion of inert solids, 50% diversion of remaining debris
Austin, TX	Projects with building permits	50% diversion; no more than 2.5 pounds/project square foot
Chicago, IL	New construction >4000 square feet	50% diversion
	Any renovation requiring Certificate of Occupancy	
	Demolition >4 units or 4000 square feet	
Fort Collins, CO (disposal ban - cardboard)	New construction/renovation >2500 square feet	Recycle aggregates, metal, cardboard & wood; Waste Management Form
	Demolition	Recycle aggregates & metal; Waste Management Form
	Roofing projects	Use hail-resistant shingles; Waste Management Form
Orange County, NC (disposal ban - cardboard)	New construction & major remodels	Recycle cardboard, clean wood & metal; Recyclable Material management Permit
Plano, TX	New construction/demolition >5000 square feet	Deposit program; 60% diversion
	Renovation >10000 square feet	Deposit program; 30% diversion
Portland, OR	All building projects >\$50,000 cost	75% diversion; C&D Management Form
	Homes built before 1916	Deconstruction required
Seattle, WA (disposal ban - asphalt paving, bricks, concrete, metal, cardboard, gypsum, wood)	Renovation & demolition >750 square feet or >\$75,000 cost	Salvage Assessment & Waste Diversion Report

*Numerous California cities and counties also have exemplary programs driven by state diversion requirements
Appendix F includes additional information on these programs*

PROPOSED IMPROVEMENTS

Data reporting and use of licensed haulers should apply to all construction projects (public and private) in the city. Specific diversion requirements will likely apply to building construction only. The following improvements are described for Denver and could serve as an example progression for other coalition members.

 **Build Relationship Between SWM and Local Contractors** – The 2019 stakeholder meetings included an early dialogue with the Colorado Contractor’s Association and individual contractors. While these parties (as well as the Association of General Contractors of Colorado and others) already work closely with Denver’s IPM, it will be necessary for SWM to build relationships to gain support for improved data, project reporting and future diversion requirements⁵⁸. As city construction projects should also be regulated, SWM coordination with IPM will also be important.

 **Improve C&D Waste Generation & Diversion Data** – Until SWM has more complete data from this sector, evaluating progress and identifying solutions will be difficult. Section 4.1 recommendations addressed how both overall quantities and materials reused and recycled on site could be better tracked (measurement may require “guesstimating” for materials not containerized or weighed).

New requirements could include the submittal of project Construction Recycling Reports⁵⁹ as part of Certificate of Occupancy issuances – this should include verification of quantities generated, discarded and diverted (including materials diverted on site) and verify use of licensed haulers.

 **Require Recycling of Materials with Existing Markets** – Once basic data is being reliably obtained, initial diversion requirements could be implemented (potentially through the UWRO if developed):

- Require the diversion (and tracking) of a minimum list of recyclables that have local markets (without setting quantifiable diversion thresholds) - cardboard, metal, untreated wood and aggregate⁶⁰
- Encourage more on-site use of clean soil by working with DPHE’s Environmental Quality Division and CDPHE to facilitate testing costs and speed of approvals


Implementation should consider:

- Phasing in new requirements according to a schedule that considers project type and size
 - Initial application to new construction and demolition projects >5,000 square feet - could likely be required to submit Waste Management Reports and meet specific recycling thresholds in an initial phase
 - Subsequent projects in decreasing order - renovations requiring a Certificate of Occupancy- second phase, new construction and demolition projects >2,000 square feet and roofing projects
- Enforcement mechanisms such as enforcing material bans, withholding Certificates of Occupancy and requiring a refundable deposit with permit (see Table 5.4)


⁵⁸ CCA members are involved in utility, road, bridge, rail and similar construction; AGC members are involved in the building industry.


⁵⁹ Austin has a good example (see www.austintexas.gov/department/austin-resource-recovery/programs).

⁶⁰ Like Fort Collins and Orange County, the policy would initially be “soft”. Once early and practical recycling practices become routine, more aggressive requirements can be established.

 **Evaluate Regional Processing Capacity** – This process will be similar to that described in Section 5.1 for a new regional compost facility⁶¹. As recommended for regional compost infrastructure, professional assistance for preliminary facility feasibility, siting and PPP assessment tasks should be conducted (this work may be suitable for grant funding). Key resources that SWM should utilize in evaluating processing capacity and C&D end-markets include:

- Recycle Colorado’s C&D Council – this group works in conjunction with GE Johnson on a Contractor’s Challenge and developed end-market findings in a 2019 report that focused on the same three materials identified in SWM’s audit (plus carpet tile and plastics)
- CDPHE’s Solid Waste Management Division and Pollution Prevention Advisory Board – the latter is responsible for implementing the RREO grant program
- Other sources that can provide partnership or consulting assistance to feasibility process – such as the Arizona State University’s Resource Innovations & Solutions Network

 **Work Regionally to Develop New End Markets** – After aggregate products (the most common materials discarded in 2018 C&D loads) were treated wood, drywall and roofing shingles⁶². Markets for reusing or remanufacturing these materials is spotty nationwide. While some research has been done with recycling clean scrap drywall into new product and using shingles in asphalt pavement⁶³ these markets are not well-developed in Colorado and/or do not utilize significant quantities. Mechanisms for market development efforts were discussed in Section 5.2.

 **Long-Term Source-Reduction & Diversion Requirements** – Once regional C&D processing infrastructure is in place more aggressive waste reduction requirements can be established such as:

- Material-specific diversion requirements
- Compliance mechanisms such as refundable deposits
- Other requirements such as the use of hail-resistant shingles for residential roof repairs⁶⁴

Phasing for these could be the same as those suggested for recycling of materials with existing markets (above).

IMPLEMENTATION CONSIDERATIONS

These challenges will be similar to those described in Section 5.1 but will also include the obstacle of imposing new requirements on contractors who will be more difficult to identify and engage given the finite nature of construction projects. Altogether these challenges make it unlikely that actual development of new

⁶¹ C&D processing was identified as a future need of the DRCOG members initially involved in the Metro Waste Shed network.

⁶² “2019 C&D Waste Audit Results,” LBA Associates, August 2019.

⁶³ Colorado Department of Transportation limits recycled shingles to 5% in hot mix aggregate.

⁶⁴ Fort Collins requires use of UL2218 Class 4 impact-resistant shingles.

C&D processing capacity in the Front Range can occur during the DWRS planning period (especially if this infrastructure is secondary to new compost processing capacity on a regional level).

5.4 IMPLEMENTATION OF LONG-TERM RECOMMENDATIONS

COSTS FOR LONG-TERM RECOMMENDATIONS

Table 5.5 (on the next page) includes an estimate of city costs for implementing short-term recommendations (costs are expressed as 2020\$). These estimates are based on several assumptions:

- Costs begin with implementation and do not include policy development
- Labor costs are based on average 2020 burdened salaries for each category
- Costs are those additional expenses expected to be incurred by SWM staff – they do not include costs for city staff/activities that are not expected to exceed current workloads or consulting fees

[Labor Requirements](#) – New programming in the long-term will be limited to commercial expansion of two short-term policies (i.e., the URWO and the cardboard disposal ban) plus regional collaboration on new processing capacity and end-market development. As such, start-up SWM staffing will be less than in the short-term but may be more concentrated between 2026 and 2027.

On-going long-term operations are estimated to require about 0.65 FTEs at the Program Administrator level (this position is expected to conduct most of the long-term implementation efforts). The long-term labor requirements will be in addition to staffing associated with short-term improvements (see Section 4.11).

IMPLEMENTATION SCHEDULE FOR LONG-TERM RECOMMENDATIONS

Figure 5.1 (at the end of this section) provides a suggested sequencing of improvements recommended for the long-term period between 2026 and 2030.

Table 5.5 CITY COSTS ESTIMATED FOR LONG-TERM IMPROVEMENTS (2020\$)							
Improvement	Start-Up Year Costs				Subsequent Annual Costs		
	Capital	Labor ^a	Other	Notes	Labor ^a	Other	Notes
UWRO (add generator diversion requirements)	\$0	\$31,000	\$8,000	0.5 FTE Pgm Admin, software subscription	\$15,500	\$8,000	0.25 FTE Pgm Admin, software subscription
OCC Disposal Ban (commercial)	\$0	\$15,5000	\$0	0.25 FTE Pgm Admin	\$6,200	\$0	0.1 FTE Pgm Admin
Regional Compost Capacity	Denver share of compost facility unknown ^b	\$27,400	\$30K-\$40k	0.1 Super/Dir 0.25 FTE Pgm Admin Feasibility study (Denver share)	\$18,100	\$0	0.1 FTE Super/Dir 0.1 FTE Pgm Admin (Denver share of compost operations unknown ^b)
Regional End-Market Development	\$0	\$21,200	\$0	0.1 FTE Super/Dir, 0.15 FTE Pgm Admin	\$6,200	\$0	0.1 FTE Pgm Admin
Regional C&D Processing Capacity	\$0	\$9,300	\$0	0.15 FTE Pgm Admin	\$6,200	\$0	0.1 FTE Pgm Admin
Total Long-Term Improvements	Unknown ^b	\$104,400	\$38K-\$48K		\$52,200	\$8K	
Total Short- & Long-Term Improvements	Denver share of compost facility unknown ^b	\$0.9M-\$1.1M			\$2.4M-\$2.8M plus compost facility operations share		

^a Average annual burdened salaries: Supervisor/Director (Super/Dir) \$119,000; Program Administrator (Pgm Admin) \$62,000

^b See Section 5.1

Figure 5.1

DWRS LONG-TERM IMPROVEMENT SCHEDULE

	2026												2027												2028												2029												2030												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Universal Waste Reduction Ordinance (continued)																																																													
Expand: Require haulers to provide recycling to all accounts, organics to food waste businesses																																																													
Expand: Require all businesses to recycle, food waste businesses to compost																																																													
Residential Cardboard Disposal (continued)																																																													
Expand: Can disposal by commercial & construction sectors																																																													
Regional Compost Capacity (regional)																																																													
Development Coalition & Conceptualize Facility																																																													
Implement Programs to Drive Organics Recovery (Denver)																																																													
Compost End Market Development (Denver)																																																													
Facility Design/Construction																																																													
End Market Demand Improvements (regional)																																																													
Improve Regional Data																																																													
Identify Key Materials																																																													
Recruit Targeted Businesses																																																													
Regional C&D Diversion (regional/state)																																																													
Require Waste Management Project Reports																																																													
Require Recycling of Materials w/ Local Markets																																																													
Evaluate Regional Processing Capacity																																																													
Develop New Markets																																																													
Expand Diversion Requirements																																																													
Facility Design/Construction																																																													

Section 6.0 CONCLUSIONS

Currently, Denver’s city-wide landfill diversion rate (approximately 20%) is well below the national average and notably lower than most of the 30 largest U.S. cities. While the city conducted a comprehensive ten-year solid waste master plan in 2010, most of the plan’s recommendations have not been implemented. As a result, only slightly more than a third of projected diversion increases were achieved in the intervening years.

6.1 KEY CHALLENGES & SOLUTIONS

OVER-RIDING CHALLENGES

Reasons for Denver’s lack of progress can be grouped into two distinct categories. First are the factors that SWM and the City and County of Denver have little or no impact upon - but which dramatically affect potential diversion:

- Low cost of landfill disposal – a diversion disincentive for generators, haulers and city agencies
- Historical lack of regional and state leadership
- Recycled commodity market fluctuations which cause uncertainties in private contractor’s willingness to accept municipal materials
- Coronavirus pandemic – leading to SWM budgetary cuts of 8% year-to-date

Factors that SWM and the City/County of Denver do have the ability to change include:

- Absence of waste reduction incentives for 91% of the city’s waste stream
- Incomplete data - that hampers SWM efforts to develop effective commercial and construction sector programs
- Reliance on private processing facilities – that allows only limited city cost controls
- Decentralized management of disposal - DADS landfill is managed by DPHE while all other solid waste services and programs are conducted by SWM
- General Fund structure - that requires SWM to constantly compete for resources against transportation, wastewater and other programs and infrastructure
- The perception that solid waste management has a lower priority than other public services
- No practical regional collaboration within DRCOG - that could otherwise create an economy of scale and reduce Denver’s solid waste management costs

SOLUTIONS IN DENVER’S WASTE REDUCTION STRATEGY

Building the Foundation

The LBA Team has developed this DWRS to in large part address the commercial and construction sector data, policy needs and facilities necessary to augment small residential sector progress and achieve substantive increases in city-wide landfill diversion. Given the lack of progress with commercial and

construction sector diversion to date, however, the DWRS must balance aggressive improvements with several basic steps in order to:

- Establish diversion incentives city-wide – and technical assistance for sectors not previously supported
- Develop adequate infrastructure for recyclables processing and cost-effective materials transfer, and begin to address the need for compost infrastructure – on a larger scale than currently required
- Develop the needed administrative and financial structure and revenue-generating capability - for an efficient and sustainable SWM division
- Provide regional leadership to and collaboration with other DRCOG communities - to encourage consistent and comprehensive diversion practices, regional long-term infrastructure and market demand that will help reduce and stabilize recyclables pricing for Denver and other municipalities

This foundation represents critical strategy for Denver. Several of the recommended improvements are not direct generators of new recyclable and organics tons in the short-term. However, they are necessary building blocks to support the substantial levels of diversion that will follow; without them it is improbable that advances in city-wide diversion will occur.

DWRS Recommendations

Table 6.1 (on the next two pages) provides a summary of DWRS improvements including diversion potential and city cost impacts. The LBA Team recommends the following initial phase of improvements:

- ***Develop universal waste reduction policy*** – that provides the commercial and construction sectors with access to diversion collection, improves data and establishes the foundation for longer term diversion requirements
- ***Build a new Denver materials recovery facility for recyclables processing*** - to provide the city with the ability to significantly reduce annual processing costs for SWM, commercial and construction generators⁶⁵ (the MRF could be co-located with the DADS landfill or other city operation)
- ***Build a new three-stream city transfer station*** – to accommodate future SWM tons and provide another area of the city with drop-off center access to recycling and composting collection
- ***Implement residential PAYT and other residential improvements*** – the PAYT program and rates have been developed and are ready for implementation (they should be rolled out in tandem with modifications to current trash overflow/large item collections that would otherwise undermine the PAYT system) and a residential cardboard disposal ban
- ***Establish a solid waste enterprise for all solid waste functions and establish new revenue sources*** – to reduce competition with other city resources and make the enterprise economically sustainable

⁶⁵ A new city MRF that accepts SWM and regional materials could save as much as \$2.5M/year over projected contract facility fees (see Section 4.5).

Table 6.1 DWRS RECOMMENDATIONS SUMMARY					
Improvement	Benefits	Challenges	Time Frame ^a	Diversion Potential ^b (new tons/year)	City Costs ^c
Universal Waste Reduction Ordinance (commercial & construction sectors)	<ul style="list-style-type: none"> Improved non-residential data Increase generator accountability Increase diversion long-term 	<ul style="list-style-type: none"> New/revised city policy Staff outreach & technical assistance needs 	<ul style="list-style-type: none"> Short term - "soft" policy Long term - expand requirements 	<ul style="list-style-type: none"> Short term no direct increase Long term 246,900 	<ul style="list-style-type: none"> Short-term <ul style="list-style-type: none"> Startup \$39,000 Annual \$24,500 Long-term <ul style="list-style-type: none"> Startup \$43,000 Annual \$43,000
Pay-As-You-Throw (small residential sector)	<ul style="list-style-type: none"> Strong diversion incentives Cost of service/rate research already done 	<ul style="list-style-type: none"> New city policy New system & fees for residents New billing system & SRF for SWM 	<ul style="list-style-type: none"> Short term 	<ul style="list-style-type: none"> Short term 50,500 Long term 49,600 additional tons 	<ul style="list-style-type: none"> Included in proposed rates already developed
Reduce ETC/LIP (small residential sector)	<ul style="list-style-type: none"> Remove PAYT barriers Reduce SWM costs 	<ul style="list-style-type: none"> Change service Potential fees Short-term illegal dumping 	<ul style="list-style-type: none"> Short term 	<ul style="list-style-type: none"> Included in PAYT estimate 	<ul style="list-style-type: none"> Startup \$60,000 Annual \$60,000
Cardboard Disposal Ban	<ul style="list-style-type: none"> Increased diversion & awareness Responsive to on-line shopping 	<ul style="list-style-type: none"> New city policy New requirement for residents 	<ul style="list-style-type: none"> Short term small residential Long term commercial 	<ul style="list-style-type: none"> Residential - included in PAYT estimate Commercial included in UWRO 	<ul style="list-style-type: none"> Short-term <ul style="list-style-type: none"> Startup \$15,500 Annual \$6,200 Long-term <ul style="list-style-type: none"> Startup \$9,300 Annual \$6,200
Material Recovery Facility (regional)	<ul style="list-style-type: none"> Improve SWM control of costs & accepted materials Increase processing capacity Ability to earn revenue Ability to add DOC 	<ul style="list-style-type: none"> Urgency Capital & annual operating costs 	<ul style="list-style-type: none"> Short term 	<ul style="list-style-type: none"> No direct increase 	<ul style="list-style-type: none"> Startup \$211,900-\$261,900 Annual \$0.5M-\$0.7M
Transfer Station	<ul style="list-style-type: none"> Improved collection economics for all 3 streams Ability to add DOC 	<ul style="list-style-type: none"> Capital & annual operating costs 	<ul style="list-style-type: none"> Short term 	<ul style="list-style-type: none"> No direct increase 	<ul style="list-style-type: none"> Startup \$156,000 - \$206,000 Annual \$1.7M-\$1.9M
New Drop-Off Centers (residential only)	<ul style="list-style-type: none"> Access for recycling, composting, seasonal for MFUs Minimal capital costs (if city land/facility available) 	<ul style="list-style-type: none"> Modest annual operating costs 	<ul style="list-style-type: none"> Short term (up to 3 new DOCs) 	<ul style="list-style-type: none"> Short term 2,400 Long term no additional tons 	<ul style="list-style-type: none"> Startup \$81,000 Annual \$81,000

Waste Diversion at City Facilities (government only)	<ul style="list-style-type: none"> • Strong recycling program already in place • Consolidate most collections under SWM 	<ul style="list-style-type: none"> • Cost for more composting & expanded recyclables collection • New service fees • More purchasing & source reduction reqts 	• Short term	• No increase until advanced organics recovery	<ul style="list-style-type: none"> • Startup \$24,300 • Annual \$0
Equal Space Ordinance (commercial sector)	<ul style="list-style-type: none"> • Provide recycling space in all new/renovated commercial properties • Realistic spacing requirements 	<ul style="list-style-type: none"> • Extra space is limited • Impact for future construction is long-term 	• Short term	• Minimal increase	<ul style="list-style-type: none"> • Startup \$3,600 • Annual \$6,200
Administrative Improvements & Funding Sources	<ul style="list-style-type: none"> • Consolidate programs in one division • Decrease reliance on General Fund • Consolidate/develop funds for services 	<ul style="list-style-type: none"> • Reorganization • Coordination w DPHE • Move to Enterprise Fund • New fee assessments 	• Short term	• No direct increase	<ul style="list-style-type: none"> • Startup \$39,300 • Annual \$0
Regional Compost Capacity	<ul style="list-style-type: none"> • Ability to create stronger economy of scale • Future regional facility will share responsibilities & decrease costs 	<ul style="list-style-type: none"> • Involving & coordinating with governments • Change city practices to drive compost product demand 	• Long term	• No direct increase	<ul style="list-style-type: none"> • Startup \$45,600 - \$55,500 • Annual \$21,200 plus share of compost operations
End-Market Demand Improvements	<ul style="list-style-type: none"> • Increase ability to divert new/more materials • Add system revenue/decrease facility tip fees 	<ul style="list-style-type: none"> • Involving & coordinating with governments • Coordinating with local & state economic development agencies 	• Long term	• No direct increase	<ul style="list-style-type: none"> • Startup \$21,200 • Annual \$6,200
Regional C&D Diversion Capacity (construction sector)	<ul style="list-style-type: none"> • Increase ability to divert new/more materials • Add system revenue/decrease facility tip fees 	<ul style="list-style-type: none"> • Involving & coordinating with governments • New recycling requirements for contractors 	• Long term (may not have new processing facility by 2030)	<ul style="list-style-type: none"> • Short term no direct increase • Long term 150,100 	<ul style="list-style-type: none"> • Startup \$9,300 • Annual \$6,200

^a See Figures 4.5 and 5.1

^b See Appendix K – new tons are in addition to tons expected to be generated at current rate of diversion (with no improvements).

^c See Tables 4.19 and 5.5.

Subsequent DRWS implementation should include:

- **Additional DOCs for a total of four city-wide** - including the existing CCTS facility
- **Equal space ordinance revision** - to include commercial properties
- **Expansion of waste diversion in city facilities** – to improve efficiencies and organics recovery
- **Expansion of commercial diversion requirements** – to establish minimum diversion levels for all commercial and construction debris generators
- **Expansion of the cardboard disposal ban city-wide**
- **Facilitation of a coalition with DRCOG members** - with a strategy for new regional compost and C&D processing, and greater demand for recyclables and compost products in the metro area

The last improvement is expected to be tackled in the long-term and not fully completed during the planning period because of the time needed to develop a fully functioning coalition that will support sustainable infrastructure. This will be especially true for C&D processing, which will require considerable efforts by DRCOG members to identify and engage stakeholders, obtain data and establish partnerships. Figure 6.1 illustrates Denver’s future solid waste enterprise with responsibility and resources for these DWRS recommendations.

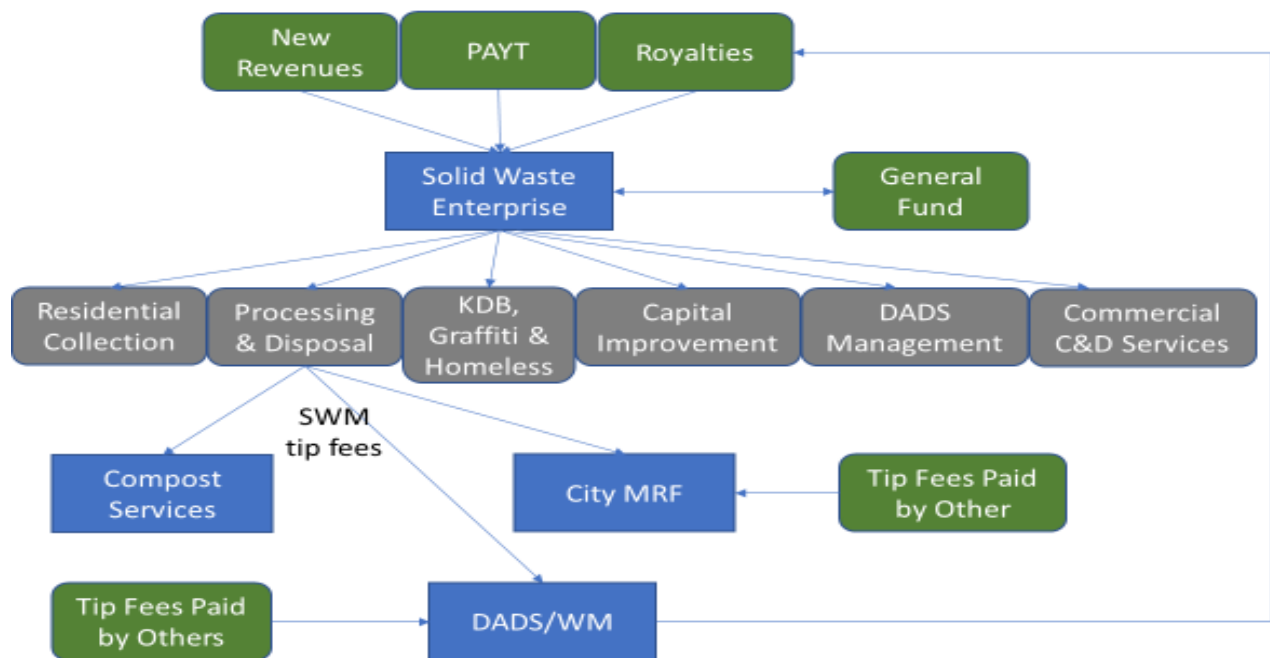


Figure 6.1 FUTURE DENVER SOLID WASTE ENTERPRISE

Revenue-Generating Needs & Options

Table 6.2 summarizes revenues needed to cover the short-fall expected between PAYT revenues and SWM costs for all services plus the estimated costs to implement all short- and long-term recommendations in the DWRS. Table 6.3 identifies funding options evaluated by the LBA Team. Sections 4.0 and 5.0 provide additional detail for both tables.

Time Frame	Capital Costs ^a	Start-Up Year Costs	Subsequent Annual Costs
Short-Term (2021-2025)	\$12.7M - \$15.8M	\$0.8M – 0.9M	\$2.5M - \$2.9M
Long Term (2026-2030)	\$0	\$0.1M - \$0.2M	\$0.06M
Total	\$12.7M - \$15.8M	\$0.9M - \$1.1M	\$2.6M - \$3M

^a Includes capital improvement funds included in proposed PAYT rates

Funding Options	Low Range	High Range
Environmental Protection Fee	\$4.2M	\$8.4M
Hauler Licensing Fees	\$4.8M	\$5.7M
DADS Landfill Tip Fee Surcharge	\$3.6M	\$6.0M

All three funding options have the ability to cover the future cost of both residential and non-residential services including the recommendations described in this document. Ideally, the city will implement multiple revenue sources to ensure stable resources over the ten-year planning period.

6.2 LANDFILL DIVERSION GOALS & GHG REDUCTIONS

REASSESSMENT OF LANDFILL DIVERSION GOALS

The SWM goals of 50% landfill diversion by 2025 and 70% by 2030 have been used throughout the DWRS as a guideline and basis for the infrastructure design considerations. The LBA Team conducted a review of the attainability of the goals using projected impacts of the DWRS recommendations (see Table 6.4 on the next page and Appendix K for diversion assumptions).

As shown, the ability to achieve SWM's landfill diversion goals city-wide with the improvements recommended in the DWRS is unlikely, although small residential sector levels can be expected to be mostly successful if the PAYT system is implemented early in the short-term. The commercial sector may approach the short-term goal by the end of the long term, while the progress in the construction sector may be limited. These estimates are based on assumed capture rates, actual recovery will fluctuate depending on when each improvement is implemented, how actively generators participate and the level of city enforcement.

As a result of these findings, the LBA Team suggests that SWM reconsider revising its landfill diversion goals to 50% by 2030. Future DWRS visioning and planning that considers strategies beyond 2030 should focus on a diversion goal of 70% or higher.

Table 6.4 POTENTIAL DIVERSION FOR CUMULATIVE DWRS IMPROVEMENTS				
	Small Residential Sector	Commercial Sector	Construction Sector	City-Wide
2018				
Total Generation (tons/year)	223,100	938,000	1,207,000	2,368,100
Diversion (tons/year)	51,600	216,300	208,800	476,100
Landfill Diversion Rate	23%	23%	17%	20%
Short-Term (2021-2025)				
Total Generation (tons/year)	228,200	1,023,400	1,316,900	2,568,500
Diversion (tons/year)	128,900	237,800	223,900	590,600
Landfill Diversion Rate	56%	23%	17%	23%
Long-Term (2026-2030)				
Total Generation (tons/year)	231,700	1,081,100	1,391,100	2,703,900
Diversion (tons/year)	153,900	497,900	386,600	1,038,400
Landfill Diversion Rate	66%	46%	28%	38%

New DOC tons included in commercial quantities

AVOIDED GHGs BASED ON 50% DIVERSION GOAL

The DPHE GHG analysis (see Section 2.1) estimated that 3.0M mtCO₂e could be avoided if a city-wide diversion rate of 50% is achieved by 2030. This increase represents a 350% improvement over the status quo scenario (or 0.8M mtCO₂e). See Figure 6.2 and Appendix L for additional detail.

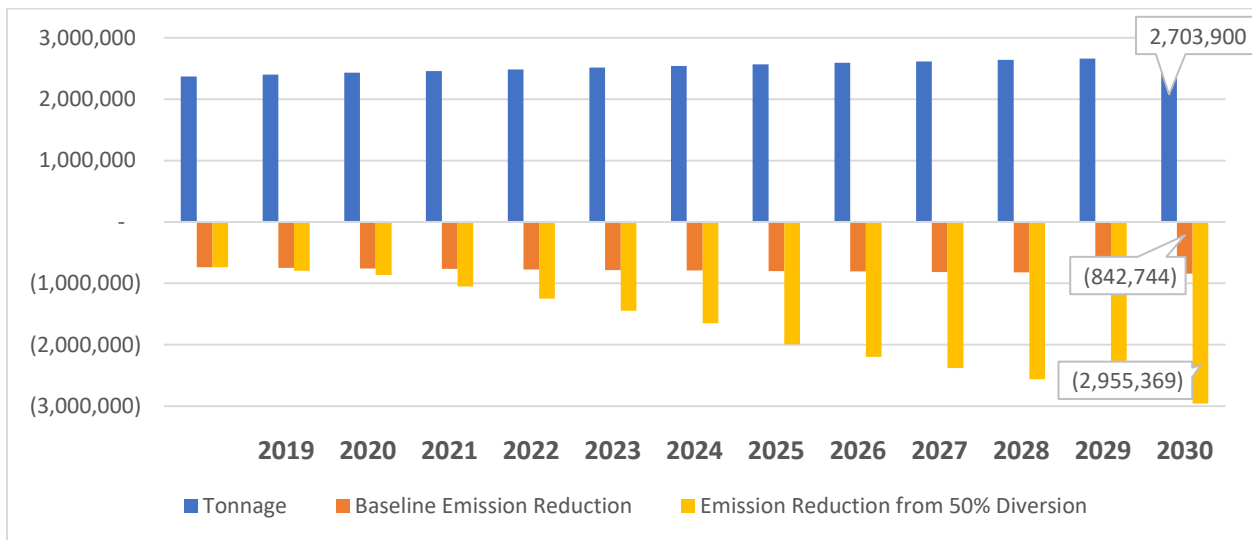


Figure 6.2 ADDITIONAL EMISSIONS REDUCTIONS FROM 50% LANDFILL DIVERSION⁶⁶ (mtCO₂e)

⁶⁶ “Final Updated Denver LCA Memo,” Lotus Engineering & Sustainability, April 2020. This reduction is equivalent to the annual emissions generated by about 113,700 U.S citizens or by 642,500 passenger cars.

6.3 FINAL CONCLUSIONS

To take full advantage of the strategy recommendations provided by the LBA Team in this DWRS, the City and County of Denver needs to prioritize solid waste management on par with other services provided by DOTI and other departments. This prioritization should accordingly include necessary administrative and financial restructuring and establishment of new revenue sources. Additionally, available resources should focus on the commercial and construction sectors which represent over 90% of the waste generated city-wide. Without this focus, substantive landfill diversion will not occur.

CDPHE and SWM have made a considerable investment in this DWRS. It will be important for Denver to make a comprehensive commitment to its implementation in order to avoid the missed opportunity represented by the 2010 SWMP, which has been largely unimplemented and has failed to meet its diversion potential by nearly two-thirds.

The implementation of the improvements described in this document will allow the city to change how all of its generators create and manage waste, maximize recycling and organics recovery and make significant GHG reductions. It will also notably advance Denver's ability to become a truly livable and sustainable community.

APPENDIX B

ADJUSTMENT of HAULER-REPORTED TONS

		Generation Rate ^d	Generation	Percent
Commercial Sector ^b	Employment ^c	Tons/FTE/Year	Tons/Year	
Manufacturing	20,000	1.55	30,900	3%
Wholesale Trade & Transport	45,000	2.28	102,500	11%
Retail Trade	74,900	3.11	233,200	25%
Services	263,600	1.6	421,500	45%
Other Trades & Services	26,600	1.7	45,100	5%
<i>Subtotal IC&I</i>	<i>430,100</i>	<i>1.94</i>	<i>833,200</i>	<i>90%</i>
Cannabis Cultivation^e	facilities	tons/facility-year	tons/year	
	220	45	9,900	
Multi-Family	dwelling units ^f	tons/unit/yr	tons/year	
10 or more units/structure	109,000	0.87	94,900	10%
Total			938,000	100%

Notes:

^a Prepared by KCI Consulting

^b Includes all NAICS industries in Denver (excepting Public Admin) - groupings used to simplify results

^c Source = 2016 US Census Bureau County Business Patterns

^d Source = CalRecycle "2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California" (Cascadia,

^e Approximation based on Denver retail-only licenses & generation rate per Gobris (May 23, 2019)

^f Source = American Factfinder (2017)

APPENDIX C

ZERO WASTE GOALS for TOP 30 U.S. CITIES

CITY	POPULATION (2018 estimate)	MSW DIVERSION GOAL	CURRENT DIVERSION	NOTES
New York, NY	8,399,748	90% by 2030	21% (2017)	Zero waste by 2030
Los Angeles, CA	3,990,456	90% by 2025 95% by 2035	76% (2018)	State diversion mandate for all sectors
Chicago, IL	2,705,994	75% of school waste	9% (2017)	
Houston, TX	2,325,502	55% - 75%	26% (2014)	
Phoenix, AZ	1,660,272	40% by 2020	20% (2015)	Zero Waste by 2050
Philadelphia, PA	1,584,138	~40% (2017)	Zero waste by 2035	
San Antonio, TX	1,532,233	60% by 2025 (residential)	30% (residential, 2014)	
San Diego, CA	1,425,976	75% by 2025	66% (2017)	Hauler+generator ordinance - state diversion mandate for all sectors
Dallas, TX	1,345,047	85% 2040	20% (residential, 2014)	
San Jose, CA	1,030,119	90% by 2022	66% (2015)	State diversion mandate for all sectors
Austin, TX	964,254	90% by 2040	42% (2016)	Universal recycling ordinance
Jacksonville, FL	903,889	75% by 2020	52% (Duval County, 2016)	State Recycling Goal applies to Counties over 100,000 population
Fort Worth, TX	895,008	40% by 2023	~21% (2015)	2017-2037 Fort Worth CSWMP
Columbus, OH	892,533	25% (SWACO)	23-33% (SWACO, 2017)	Solid Waste Assoc of Central OH
San Francisco, CA	883,305	Zero waste by 2020	80% (2016, including C&D)	State diversion mandate for all sectors
Charlotte, NC	872,498	Zero waste by 2030	12% (2017)	
Indianapolis, IN	867,125		7% (2018)	Subscription curbside recycling
Seattle, WA	744,955	75% by 2025	57% (2017)	Hauler+generator ordinance - R space ordinance
Denver, CO	716,492	34% by 2020	23% (2018)	
Washington DC	702,455	80% by 2032	23% (2018)	Also reduce generation by 25% & reuse 20%
Boston, MA	694,583	Launched Zero Waste Boston (2018)	25% (2017)	Carbon Neutrality Goal 2050
El Paso, TX	682,669		17% (2015)	
Detroit, MI	672,662		5% (2018)	Still deploying curbside recycling (GFL)
Nashville, TN	669,053	Zero waste plan in process	24% (2018)	
Portland, OR	653,115	90% by 2030	54% (2017)	Hauler+generator diversion ordinance - state law prohibits haulers from charging more for R than T
Memphis, TN	650,618		Increased diversion 61% in 2017	
Oklahoma City, OK	649,021			Curbside recycling - households within urban service districts
Las Vegas, NV	644,644	25%	21% (2017)	Stage goal 25% diversion
Louisville, KY	620,118	90% by 2042	49% (Jefferson County, incl C&D, 2015)	
Baltimore, MD	602,495	Zero waste plan in process	27% (2016)	

Sources:

Phoenix, AZ <https://www.phoenix.gov/sustainability/waste>

Jacksonville, FL (Duval County) <https://floridadep.gov/sites/default/files/FinalRecyclingReportVolume2forweb.pdf> page 839

Ft. Worth, TX <https://fortworthtexas.gov/codecompliance/swplan/Final-2017-2037-CSWMP.pdf> Page 325

Indianapolis, IN <https://www.indy.gov/activity/recycling>

Boston, MA https://www.boston.gov/sites/default/files/embed/file/2019-06/zero_waste_bos_recs_final.pdf

El Paso, TX https://www.elpasotexas.gov/~media/files/coep/community%20information/strategic-planning%20presentations/goal%208_council%20presentation.ashx?la=en Slide 10

Oklahoma City, OK <https://www.okc.gov/departments/utilities/recycling-faq>

APPENDIX D

SMALL RESIDENTIAL WASTE COMPOSITION

Materials		Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Glass Containers	4.2%	3.6%	4.7%
2	Other Glass	1.3%	0.7%	1.9%
	Total Glass	5.5%		
3	Aluminum	0.9%	0.8%	1.0%
4	Steel/Tin	0.8%	0.7%	1.0%
5	Other Metals	0.8%	0.5%	1.1%
	Total Metal	2.5%		
6	#1 PET Bottles	1.6%	1.4%	1.8%
7	#2 HDPE Bottles	0.8%	0.7%	1.0%
8	Rigid Containers #1-#7	1.4%	1.2%	1.6%
9	Bulky Rigid	1.1%	0.8%	1.3%
10	Styrofoam	1.0%	0.9%	1.2%
11	Film, Bags, & Wrap	4.2%	3.8%	4.7%
12	Other Plastics	2.6%	2.3%	3.0%
	Total Plastic	12.8%		
13	Cardboard/Kraft	3.5%	3.0%	4.0%
14	Newspaper	1.5%	1.2%	1.7%
15	Office Paper	1.7%	1.3%	2.1%
16	Chip/Paperboard	2.4%	2.1%	2.7%
17	Mixed Paper/Junk Mail	3.1%	2.6%	3.6%
18	Magazines	1.3%	1.0%	1.6%
19	To-Go Cups	0.3%	0.3%	0.4%
20	Aseptic Containers	0.3%	0.3%	0.4%
21	Other Paper (low-grade)	6.6%	6.1%	7.0%
	Total Paper	20.7%		
22	Food Waste	18.6%	17.0%	20.3%
23	Yard Waste	16.5%	14.3%	18.7%
24	Clean Wood	0.7%	0.5%	1.0%
25	Other Organics	12.1%	10.0%	14.1%
	Total Organics	47.9%		
26	Composites	2.2%	1.7%	2.8%
27	Textiles	2.9%	2.5%	3.3%
28	Electronics	0.6%	0.2%	1.0%
29	Batteries	0.0%	0.0%	0.1%
30	CFLs	0.1%	0.0%	0.1%
31	Paint	0.5%	0.2%	0.8%
32	Motor Vehicles	0.1%	0.0%	0.3%
33	C&D Debris	4.1%	2.9%	5.3%
34	Other Haz/Special Waste	0.1%	0.0%	0.1%
35	Residue	0.0%	0.0%	0.0%
	Total Other Materials	10.6%		
		100.0%		

"2016/2017 Trash & Recycling Composition Results," LBA Associates, May 2017.

APPENDIX E

COMMERCIAL WASTE COMPOSITION

	Material Category	Weighted Average	90% Confidence Interval	
			Lower Bounds	Upper Bounds
1	Cardboard/Kraft	8.3%	6.8%	9.8%
2	Newspaper	0.5%	0.3%	0.6%
3	Office Paper	1.1%	0.7%	1.4%
4	Chip/Paperboard	2.2%	1.8%	2.6%
5	Mixed Paper/Junk Mail	1.6%	1.3%	2.0%
6	Magazines	0.8%	0.4%	1.3%
7	To-Go Cups	0.5%	0.4%	0.7%
8	Aseptic Containers	0.2%	0.2%	0.3%
9	Compostable Paper	7.6%	6.6%	8.5%
10	All Other Paper	1.8%	1.0%	2.6%
	Total Paper	24.7%		
11	#1 PET Bottles	1.5%	1.3%	1.7%
12	#2 HDPE Bottles	0.8%	0.6%	1.0%
13	#1-#7 Containers	1.4%	1.2%	1.6%
14	Bulky Rigids	1.4%	0.6%	2.2%
15	Styrofoam	0.7%	0.5%	0.8%
16	Film, Bags, & Wrap	6.0%	5.3%	6.7%
17	Other Plastics	1.3%	1.1%	1.6%
	Total Plastics	13.1%		
18	Aluminum	0.9%	0.8%	1.0%
19	Steel/Tin Cans	0.6%	0.5%	0.7%
20	Other Metals	2.0%	1.1%	3.0%
	Total Metal	3.5%		
21	Glass Containers	3.7%	2.9%	4.5%
22	Other Glass	0.2%	0.1%	0.3%
	Total Glass	4.0%		
23	Food Waste	24.5%	21.0%	27.9%
24	Yard Waste	1.7%	0.5%	3.0%
25	Cannabis Waste	0.1%	-0.6%	0.9%
26	Clean Wood	2.2%	0.2%	4.2%
27	Other Organics	6.6%	2.9%	10.3%
	Total Organics	35.1%		
28	Textiles	3.1%	2.4%	3.7%
29	Carpet & Padding	2.0%	-0.4%	4.3%
0	Recyclable E-waste	0.4%	0.2%	0.7%
31	Other E-waste	0.0%	0.0%	0.1%
32	Batteries	0.1%	0.0%	0.1%
33	CFLs	0.0%	0.0%	0.0%
34	Paint	0.0%	0.0%	0.1%
35	Motor Vehicles	0.3%	0.0%	0.7%
36	C&D Debris	7.9%	4.6%	11.2%
37	Other Haz/Special Waste	0.1%	-0.2%	0.4%
38	Composites	5.2%	3.7%	6.6%
39	Residue	0.5%	0.2%	0.7%
	Total Other Materials	19.6%		
		100.0%		

“2019 ICI Waste Composition Findings,” LBA Associates, June 2019.

APPENDIX F

BEST MANAGEMENT PRACTICE REFERENCES

Aspen, CO – Universal recycling requirements, equal space requirements

<https://www.cityofaspen.com/DocumentCenter/View/618/Recycling-Ordinance-PDF?bidId=>
<https://www.cityofaspen.com/DocumentCenter/View/671/Solid-Waste-Ordinance-PDF?bidId=>

Austin, TX – Universal recycling ordinance, C&D diversion

<http://austintexas.gov/uro>
<http://www.austintexas.gov/department/austin-resource-recovery>
<http://www.austintexas.gov/cd>

Berkeley, CA – Plastics reduction

https://www.cityofberkeley.info/uploadedFiles/Public_Works/Level_3_-_Solid_Waste/Zero%20Waste%20Goal.pdf

Boulder, CO – Universal Ordinance, equal space requirements

https://library.municode.com/co/boulder/codes/municipal_code?nodeId=TIT6HESASA_CH3TRRECO_6-3-13PROWRERECOCO
https://library.municode.com/co/boulder/codes/municipal_code?nodeId=TIT6HESASA_CH12TRRECOHA
https://library.municode.com/co/boulder/codes/municipal_code?nodeId=TIT9LAUSCO_CH9DEST_9-9-18TRSTREAR

Chicago, IL – C&D diversion <https://www.recyclebycity.com/chicago> <https://www.recyclingcertification.org/>
<https://sustainchicago.cityofchicago.org/around-chicago/our-goals>

Fort Collins, CO – Cardboard disposal ban, C&D diversion, equal space requirements

https://library.municode.com/co/fort_collins/codes/municipal_code?nodeId=CH15LIBURE_ARTXVSOWACORESE
https://library.municode.com/co/fort_collins/codes/municipal_code?nodeId=CH12HEEN_ARTIICODIRERURE_S12-22RERE
https://www.fcgov.com/recycling/pdf/2018_Report.pdf?1567020785
https://www.fcgov.com/recycling/pdf/ordinance_number_023_mar-05-2013.pdf?1400088283
https://library.municode.com/co/fort_collins/codes/land_use?nodeId=ART3GEDEST_DIV3.2SIPLDEST_3.2.5TRREEN

Iowa City, IA – Cardboard disposal ban

<https://www8.iowa-city.org/WebLink/0/edoc/1938462/Climate%20Action%20Progress%20Highlights%20-%20Feb%202020.pdf>
https://www.sterlingcodifiers.com/codebook/index.php?book_id=953&keywords=cardboard

Lafayette, CO – Equal space requirements

https://library.municode.com/co/lafayette/codes/code_of_ordinances?nodeId=COOR_CH26DEZO_S26-19DEIMST_S26-19-25REWARECOAR

Lincoln, NE – Cardboard disposal ban

<https://lincoln.ne.gov/city/ltu/solid-waste/pdf/guide.pdf?19>
<https://lincoln.ne.gov/city/ltu/solid-waste/recycle/corrugated-cardboard.htm>
<https://online.encodeplus.com/regis/lincoln-ne/doc-viewer.aspx?secid=8472#secid=8472>

Linn County, IA – Cardboard disposal ban

https://library.municode.com/ia/linn_county/codes/code_of_ordinances?nodeId=PTICORR_CH22SOWA

Longmont, CO – Equal space requirements

https://library.municode.com/co/longmont/codes/code_of_ordinances?nodeId=PTIICOOR_TIT15LADECO_CH15.05DEST_15.05.130OUSESTEQLODI

New York, NY – Plastics reduction

<https://www1.nyc.gov/office-of-the-mayor/news/101-19/mayor-de-blasio-signs-executive-order-end-city-reliance-single-use-plastic>

Orange County, NC – C&D diversion

<https://www.orangecountync.gov/933/Regulated-Recyclable-Material-Ordinance>

Plano, TX – C&D diversion

<https://www.plano.gov/928/Construction-Demolition-CD-Recycling> <https://www.ntmwd.com/facilities/>

Portland, OR – Universal recycling ordinance, C&D diversion, plastics reduction

<https://www.portlandoregon.gov/bps/article/647260>

<https://www.portlandoregon.gov/bps/article/591797>

<https://www.portlandoregon.gov/bps/41466>

<https://www.portlandoregon.gov/bps/58975>

<http://www.masterrecycler.org/>

<http://www.resourcefulpdx.com/>

<http://repairpdx.org/>

<https://www.portlandoregon.gov/bps/article/534917>

<https://www.oregonmetro.gov/multifamily-recycling-research>

<https://beta.portland.gov/bps/garbage-recycling/single-use-plastics-reduction-policy>

Seattle, WA – Universal recycling ordinance, C&D diversion

<http://www.seattle.gov/utilities/businesses-and-key-accounts/solid-waste/food-and-yard/commercial-customers/food-packaging-requirements>

<http://www.seattle.gov/Documents/Departments/SPU/Services/Recycling/FoodPackagingRequirementsFlyer.pdf>

<http://www.seattle.gov/Documents/Departments/SPU/Services/Recycling/EnglishSPUFlyer-LetterStrawsandUtensilsAM.pdf>

http://www.seattle.gov/Documents/Departments/SPU/Services/FoodYard/Straws_Utensils_8-2018_English.pdf

<https://www.seattle.gov/utilities/services/recycling/reduce-and-reuse/plastic-bag-ban>

<https://www.seattle.gov/Documents/Departments/SPU/Services/Recycling/Bagbanflyer.pdf>

https://library.municode.com/wa/seattle/ordinances/municipal_code?nodeId=795352

https://library.municode.com/wa/seattle/ordinances/municipal_code?nodeId=520374

<http://www.seattle.gov/utilities/services/recycling/recycle-at-home/apartment-residents/recycling-volunteers>

<http://www.seattle.gov/utilities/businesses-and-key-accounts/solid-waste/recycling/commercial-recycling>

<http://www.seattle.gov/utilities/businesses-and-key-accounts/green-your-business>

https://library.municode.com/wa/seattle/codes/municipal_code/281112?nodeId=TIT23LAUSCO_SUBTITLE_IIILAUSRE_CH_23.54QUDESTACOREPASOWAST_23.54.040SOWAREMASTAC

Sioux Falls, SD – Universal recycling ordinance, cardboard disposal ban

<https://www.siouxfalls.org/news/2019/April/03/recycling>

[http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls_sd/titlevpublicworks/chapter57garbageandrecycling?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:siouxfalls_sd\\$anc=JD_57.027](http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls_sd/titlevpublicworks/chapter57garbageandrecycling?f=templates$fn=default.htm$3.0$vid=amlegal:siouxfalls_sd$anc=JD_57.027)

Superior, CO – Equal space requirements

<https://www.superiorcolorado.gov/home/showdocument?id=1404>

APPENDIX G

TECHNICAL ASSISTANCE for COMMERCIAL SECTOR

Increasing commercial recycling requires not only a concerted recycling education effort, but also a comprehensive technical assistance program to provide the tools and knowledge for generators to develop and maintain effective waste reduction systems. Providing technical assistance will help create awareness, inform, and educate generators and ultimately catalyze long-term behavioral changes.

A major challenge will be the ability to address the diverse types of commercial generators with the right kind of information (and transmit in a manner that is easily understood and used). MFUs, businesses, institutions and industries will all require different resources. MFUs and colleges/universities require specific attention to address their relatively transient populations. Other generator types need communications with “intermediate stakeholders” (i.e., property managers, owners and homeowner associations). Key program attributes are summarized below.

Program Logistics:

- Dedicated staff - communities with high-performing commercial diversion typically have dedicated staff (for cities the size of Denver, as much as one full-time staff may be required)
- Strategies for reaching out to generators:
 - Provision of user-friendly materials in general - such as those made available on-line
 - Programs such as training, webinars & workshops that serve multiple generators of the same type at one time – these provide networking opportunities, sharing of successes and an opportunity to distribute promotional materials/signage
 - One-on-one consultation and services – targeted to one generator at a time
- Expanded partnership with CGD – to increase commercial generator certification and recognition
- Partnerships with business groups – to leverage better access to generators, raising awareness on a broader scale, peer-to-peer mentoring and even peer pressure to encourage waste reduction practices¹
- Effective communication tools (see next page) – that rely on digital instead of print

Information, Resources & Tools Available On-Line and/or Via Interactive Mobile Apps:

- Searchable materials database
- Directory of DOCs for residential use and recycling and reuse options for all generators
- Hauler directory
- On-line reporting form, needs survey, appointment-making
- “Toolkit” information by generator type with step-by-step instructions for program set-up and on-going implementation – for example:

¹ Partners can include the organizations that SWM has already reached out to including the Apartment Association of Metro Denver, Building Owners & Managers Association of Denver, CAP Management, Colorado Apartment Association, Colorado Retail Council, Denver Metro Chamber of Commerce, Downtown Denver Partnership, individual businesses including valet companies and others.

- Information for institutional cafeterias and food establishments might include proper portioning, selling soon-to-expire food products for reduced prices and options for donations²
- Resources for MFUs might include example lease agreements that address recycling and example program announcements
- Strategies for zero waste events – provide links to resources that show steps to minimize waste at public events to include signage examples, procurement, volunteer training and overall “how-to” ideas.
- Downloadable signage and posters - free downloadable or customized signs (SWM can generate standard signs and provide modest customizing services)
- Frequently asked questions and answers
- Case studies with successes describing avoided costs and tons diverted
- Progress reports on what commercial generators have accomplished (at least annually)
- Links to non-city resources – for example, the College & Universities Recycling Coalition has numerous webinars² that may be invaluable for many of Denver’s institutions

Generator-Specific Programs & Consultations:

- Waste audits
- Assistance with:
 - In-house collection logistics
 - Right-sizing containers
 - Container placement
 - Hauler selection and contracting³
 - Compliance with annual reporting (and landfill diversion as appropriate)
 - CGD certification
- Training videos that focus on sorting directions and the impacts of contamination (the purchase and post-use management of plastic packaging will likely be a key component for most generators) - should be structured as a “train the trainer” session such that property owners/managers could conduct in the future
- Promotional materials with brand and resource information – such as reusable tote bags or plastic mini-bins

Other:

- Revisit Denver Recycles brand – to assess:
 - Whether upgrades or “facelifts” are needed to update information and increase efficiency for small residential customers (the PAYT roll-out may require this)
 - New commercial generators – separate pages can be developed for MFUs, businesses, colleges/universities and contractors (alternatively, a Denver Recycles sister brand may be effective in reaching commercial generators)

² Including protections under the Bill Emerson Good Samaritan Food Donation Act.

³ Contracting assistance was repeatedly mentioned by SMMS stakeholders in reference to obtaining recyclables and organics collection service, the use of evergreen clauses and generators’ ability to hold haulers to contract terms.

- Hotline – while most issues will likely be addressed through on-line resources, programs and individual consultations, a temporary hotline may be valuable during initial implementation (and each time policy is changed)
- Move from print to digital communications;
 - This will avoid static or dated information and will improve SWM’s ability to keep available information and guidance current and fresh
 - It will also reduce operating costs as both staff and printing costs are reduced⁴

The table at the end of this appendix includes some helpful examples of technical assistance programs and tools.

TECHNICAL ASSISTANCE EXAMPLES		
Program	Content	Link
Austin Resource Recovery	Searchable material & hauler databases; resource links (case studies, calculators, training sessions); on-line technical assistance appointments, reporting forms & anonymous survey; waste reduction programs including reducing waste at events	https://austintexas.gov/department/austin-resource-recovery/services https://austintexas.gov/department/austin-resource-recovery/programs
Boulder	Reporting form	https://bouldercolorado.formstack.com/forms/reporting
College & University Recycling Coalition	Links to events, workshops, webinars; toolkits, list serv (full web site)	http://curc3r.org/
Recycle Across America	Signage with focus on universality	https://www.recycleacrossamerica.org/
RecycleWorks Massachusetts	Searchable material database, case studies FAQs, resource links	https://recyclingworksma.com/how-to/recyclingworks-technical-assistance/
San Diego MFU Complex Recycling	Example lease agreements for recycling, example program announcements letter, guidelines for managers, list of DOCs, free equipment/promotional materials, case studies	https://www.sandiegocounty.gov/content/sdc/dpw/recycling/multifamily.html
Seattle, WA	Website provides direction for green business program that addresses the topics of recycling, food & compostables waste prevention, C&D	https://www.seattle.gov/utilities/businesses-and-key-accounts/green-your-business/reduce-waste
StopWaste Sign Maker (Alameda County)	Customizable signs & posters	http://www.stopwaste.org/signmaker
U.S. Department of Agriculture (USDA)	Valuable information and resources for businesses, schools, consumers and farmers and includes food donation and funding resources	https://www.usda.gov/foodlossandwaste
U.S. Environmental Protection Agency Food Recovery Challenge	Voluntary incentive program that provides participants access to data management software and technical assistance to help them quantify and improve their sustainable food management practices	http://www.epa.gov/sustainable-management-food/food-recovery-challenge-frc

⁴ When Austin made this move, they saved \$60,000 during the first year.

APPENDIX H

MATERIAL CAPTURE RATE ASSESSMENT

MATERIALS	RESIDENTIAL STREAM ^a					INSTITUTIONAL, COMMERCIAL & INDUSTRIAL STREAM ^b (adjusted)						
	Disposed		Recycled		Total Generated	Capture Rate	Disposed		Diverted ^c		Total Generated	Capture Rate
	2018 =	171,516	Single-Stream Rec	40,600			2018 =	797,971	Single-Stream Rec	110,400		
			Organics	10,700	Organics	27,700	Scrap Metal	900				
		Other Recyclables	NA									
Cardboard/Kraft	3.6%	6,200	17.2%	7,000	13,200	53.0%	8.3%	66,500	46.7%	51,600	118,100	43.7%
Newspaper	1.5%	2,600	7.9%	3,200	5,800	55.2%	0.5%	3,700	2.7%	3,000	6,700	44.8%
Office Paper	1.7%	2,900	4.2%	1,700	4,600	37.0%	1.1%	8,400	3.3%	3,600	12,000	30.0%
Chip/Paperboard	2.4%	4,100	8.8%	3,600	7,700	46.8%	2.2%	17,700	3.3%	3,600	21,300	16.9%
Mixed Paper/Junk Mail	3.1%	5,300	9.3%	3,800	9,100	41.8%	1.6%	13,100	6.3%	7,000	20,100	34.8%
Magazines	1.3%	2,200	6.2%	2,500	4,700	53.2%	0.8%	6,700	2.4%	2,600	9,300	28.0%
To-Go Cups	0.3%	500	0.2%	100	600	16.7%	0.5%	4,400	0.1%	100	4,500	2.2%
Aseptic Containers	0.3%	500	0.7%	300	800	37.5%	0.2%	1,800	0.3%	300	2,100	14.3%
Compostable Paper							7.6%	60,300			60,300	0.0%
All Other Paper	6.6%	11,300			11,300	0.0%	1.8%	14,400			14,400	0.0%
#1 PET Bottles	1.6%	2,700	4.1%	1,700	4,400	38.6%	1.5%	11,800	1.2%	1,300	13,100	9.9%
#2 HDPE Bottles	0.8%	1,400	3.0%	1,200	2,600	46.2%	0.8%	6,200	1.3%	1,400	7,600	18.4%
#1-#7 Containers	1.4%	2,400	2.7%	1,100	3,500	31.4%	1.4%	11,200	1.5%	1,700	12,900	13.2%
Bulky Rigids	1.1%	1,900	1.1%	400	2,300	17.4%	1.4%	11,500	1.0%	1,100	12,600	8.7%
Styrofoam	1.0%	1,700	0.2%	0	1,700	0.0%	0.7%	5,200			5,200	0.0%
Film, Bags, & Wrap	4.2%	7,200	0.0%	0	7,200	0.0%	6.0%	48,100			48,100	0.0%
Other Plastics	2.6%	4,500	0.0%	0	4,500	0.0%	1.3%	10,700			10,700	0.0%
Aluminum	0.9%	1,500	2.2%	900	2,400	37.5%	0.9%	7,100	0.8%	900	8,000	11.3%
Steel/Tin Cans	0.8%	1,400	2.2%	900	2,300	39.1%	0.6%	4,800	0.8%	900	5,700	15.8%
Other Metals	0.8%	1,400			1,400	0.0%	2.0%	16,100		900	17,000	5.3%
Glass Containers	4.2%	7,200	20.1%	8,200	15,400	53.2%	3.7%	29,600	8.6%	9,500	39,100	24.3%
Other Glass	1.3%	2,200			2,200	0.0%	0.2%	2,000			2,000	0.0%
Food Waste	18.6%	31,900					24.5%	195,100				
Yard Waste	16.5%	28,300		10,700	72,100	14.8%	1.7%	14,000		27,700	236,800	11.7%
Cannabis Waste							0.1%	1,000			1,000	0.0%
Clean Wood	0.7%	1,200		see FW/YW	see FW/YW	see FW/YW	2.2%	17,800			17,800	0.0%
Other Organics	12.1%	20,800			20,800	0.0%	6.6%	52,600			52,600	0.0%
Textiles	2.9%	5,000			5,000	0.0%	3.1%	24,600			24,600	0.0%
Carpet & Padding							2.0%	15,700			15,700	0.0%
Recyclable E-waste	0.6%	1,000			1,000	0.0%	0.4%	3,500			3,500	0.0%
Other E-waste							0.0%	300			300	0.0%
Batteries	0.0%	0			0	0.0%	0.1%	400			400	0.0%
CFLs	0.1%	200			200	0.0%	0.0%	0			0	0.0%
Paint	0.5%	900			900	0.0%	0.0%	300			300	0.0%
Motor Vehicles	0.1%	200			200	0.0%	0.3%	2,700			2,700	0.0%
C&D Debris	4.1%	7,000			7,000	0.0%	7.9%	63,200			63,200	0.0%
Other Haz/Special Waste	0.1%	200			200	0.0%	0.1%	800			800	0.0%
Composites	2.2%	3,800			3,800	0.0%	5.2%	41,200			41,200	0.0%
Residue	0.0%	0	9.9%	4,000	4,000	0.0%	0.5%	3,600	19.7%	21,700	25,300	85.8%
TOTALS	100.0%	171,600	100.0%	51,300	222,900	23.0%	100.0%	798,100	100.0%	138,900	937,000	14.8%

Notes:

Rounding errors may occur

^a Source = DSWM reports (including residential recycling & organics recovery only), 2016/2017 residential recyclable composition study (percent by weight values)

^b Source = 2018 hauler reports (tons), 2019 ICI waste composition study (includes recycling, organics & scrap metal only - percent by weight values)

^c Source = 2018 hauler reports (tons), "ICI Adjustment" worksheet values - no adjustment for increased ICI recyclables/organics has been made (results may underestimate actual diversion)

APPENDIX I

MRF COST ESTIMATE and TRANSPORTATION ANALYSIS

Recycling Transfer to Out Of County MRF - 30 Miles

20,800 tons/year

Item	Cost Estimate	
	Low	High
Capital Cost		
Transfer Trucks and Trailers	\$415,800	\$457,380
Total Capital Cost	\$415,800	\$457,380
Annualized Capital Cost		
Transfer Trucks and Trailers (10 yrs @ 2.5%)	\$47,000	\$51,700
Total Annualized Cost	\$47,000	\$51,700
Operating Cost		
Labor, Supplies, Maintenance, Repair & Management	\$249,400	\$275,100
Total Operating Cost	\$249,400	\$275,100
Total Annual Cost	\$296,400	\$326,800
Total Annual Cost (Per Ton)	\$14	\$16

Recycling Transfer to Out Of County MRF - 75 Miles

20,800 tons/year

Item	Cost Estimate	
	Low	High
Capital Cost		
Transfer Trucks and Trailers	\$693,000	\$762,300
Total Capital Cost	\$693,000	\$762,300
Annualized Capital Cost		
Transfer Trucks and Trailers (10 yrs @ 2.5%)	\$78,400	\$86,200
Total Annualized Cost	\$78,400	\$86,200
Operating Cost		
Labor, Supplies, Maintenance, Repair & Management	\$446,400	\$493,000
Total Operating Cost	\$446,400	\$493,000
Total Annual Cost	\$524,800	\$579,200
Total Annual Cost (Per Ton)	\$25	\$28

Materials Recovery Facility

Design Capacity: 30 ton per hour

Operating Parameters: 1 shift, 5 days per week

City MRF

Regional MRF

Item	City MRF Cost Estimate		Regional MRF Cost Estimate	
	Low	High	Low	High
Capital Cost				
Site Development	\$3,020,000	\$3,240,000	\$3,020,000	\$3,240,000
Buildings & Equipment	\$18,720,000	\$20,111,000	\$18,720,000	\$20,111,000
General Condition, Engineering & Contingency	\$3,567,200	\$3,738,280	\$3,567,200	\$3,738,280
<i>Subtotal - Facility Development</i>	<i>\$25,307,200</i>	<i>\$27,089,280</i>	<i>\$25,307,200</i>	<i>\$27,089,280</i>
Transfer Station Rolling Stock	\$1,240,000	\$1,375,000	\$1,240,000	\$1,375,000
Total	\$26,547,200	\$28,464,280	\$26,547,200	\$28,464,280
Annualized Capital Cost				
Facility Development (20 yrs @ 2.5%)	\$1,623,400	\$1,737,700	\$1,623,400	\$1,737,700
Rolling Stock (10 yrs @ 2.5%)	\$139,900	\$157,100	\$139,900	\$157,100
Total	\$1,763,300	\$1,894,800	\$1,763,300	\$1,894,800
Operating Cost				
Labor	\$1,134,840	\$1,202,920	\$2,269,580	\$2,405,940
Other Direct Costs	\$767,150	\$869,320	\$1,441,600	\$1,634,220
General, Administration & Profit	\$380,400	\$414,400	\$742,300	\$808,000
Total	\$2,282,390	\$2,486,640	\$4,453,480	\$4,848,160
Total Annual Cost	\$4,045,690	\$4,381,440	\$6,216,780	\$6,742,960
Per Ton	\$73	\$79	\$56	\$61
Revenue				
Commodity Sales	\$5,385,190	\$5,385,190	\$10,625,630	\$10,625,630
Operator's Revenue Share (@ 50%)	\$2,692,600	\$2,692,600	\$5,312,820	\$5,312,820
Net Revenue	\$2,692,590	\$2,692,590	\$5,312,810	\$5,312,810
Per Ton	\$48	\$48	\$48	\$48
Net Annual Cost (Revenue)	\$1,353,100	\$1,688,850	\$903,970	\$1,430,150
Per Ton	\$24	\$30	\$8	\$13

APPENDIX J

TRANSFER STATION COST ESTIMATE and TRANSPORTATION ANALYSIS

Transfer Station

Design Capacity: 600 ton per day

Operating Parameters: 1 shift, 5 days per week

Item	Cost Estimate	
	Low	High
Capital Cost		
Site Development	\$2,570,000	\$2,745,000
Buildings (Transfer Station & Fleet Facilities)	\$3,192,500	\$3,812,000
General Condition, Engineering & Contingency	\$1,440,700	\$1,639,300
<i>Subtotal - Facility Development</i>	<i>\$7,203,200</i>	<i>\$8,196,300</i>
Transfer Station Rolling Stock	\$1,000,000	\$1,100,000
Total Capital Cost	\$8,203,200	\$9,296,300
Annualized Capital Cost		
Facility Development (20 yrs @ 2.5%)	\$462,100	\$525,800
Rolling Stock (10 yrs @ 2.5%)	\$114,300	\$125,700
Total Annualized Cost	\$576,400	\$651,500
Operating Cost		
Labor, Supplies, Maintenance, Repair & Management	\$1,092,000	\$1,248,000
Total Operating Cost	\$1,092,000	\$1,248,000
Total Annual Cost	\$1,668,400	\$1,899,500
Total Annual Cost (Per Ton)	\$11	\$12

Waste Transfer to DADS

105,000 tons/year

Item	Cost Estimate	
	Low	High
Capital Cost		
Transfer Trucks and Trailers	\$1,452,000	\$1,916,640
Total Capital Cost	\$1,452,000	\$1,916,640
Annualized Capital Cost		
Transfer Trucks and Trailers (10 yrs @ 2.5%)	\$164,300	\$216,800
Total Annualized Cost	\$164,300	\$216,800
Operating Cost		
Labor, Supplies, Maintenance, Repair & Management	\$857,800	\$1,143,100
Total Operating Cost	\$857,800	\$1,143,100
Total Annual Cost	\$1,022,100	\$1,359,900
Total Annual Cost (Per Ton)	\$10	\$13

Recycling Transfer to MRF

20,800 tons/year

Item	Cost Estimate	
	Low	High
Capital Cost		
Transfer Trucks and Trailers	\$422,400	\$580,800
Total Capital Cost	\$422,400	\$580,800
Annualized Capital Cost		
Transfer Trucks and Trailers (10 yrs @ 2.5%)	\$47,800	\$65,700
Total Annualized Cost	\$47,800	\$65,700

APPENDIX J

TRANSFER STATION COST ESTIMATE and TRANSPORTATION ANALYSIS

Operating Cost		
Labor, Supplies, Maintenance, Repair & Management	\$238,700	\$332,700
Total Operating Cost	\$238,700	\$332,700
Total Annual Cost	\$286,500	\$398,400
Total Annual Cost (Per Ton)	\$11	\$16

Organics Transfer to A1

Item	31,200 tons/year	Cost Estimate	
		Low	High
Capital Cost			
Transfer Trucks and Trailers		\$858,000	\$1,089,000
Total Capital Cost		\$858,000	\$1,089,000
Annualized Capital Cost			
Transfer Trucks and Trailers (10 yrs @ 2.5%)		\$97,100	\$123,200
Total Annualized Cost		\$97,100	\$123,200
Operating Cost			
Labor, Supplies, Maintenance, Repair & Management		\$494,400	\$632,100
Total Operating Cost		\$494,400	\$632,100
Total Annual Cost		\$591,500	\$755,300
Total Annual Cost (Per Ton)		\$13	\$16

APPENDIX K

DIVERSION POTENTIAL ESTIMATIONS

POTENTIAL DIVERSION BY IMPROVEMENT

IMPROVEMENT		2025			2030			NOTES
Universal Waste Reduction Ordinance (also Cardboard Ban)								Commercial sector only - see Table 3.3 for total generation projections
	Status Quo Diversion Tons/Year							
	Recyclables	188,300			198,900			At current 23% (recyclables 80% / organics 20%) - i.e., no change until UWRO
	Organics	47,100			49,700			
	Recycling/Organics Capture Assumptions				25%	50%	100%	
	NEW Estimated Tons/Year Diversion							
	Recyclables				53,075	106,150	212,300	Trash composition (2019 ICI Audit) - 25.5% recyclables/33.8% organics
	Organics				70,350	140,700	281,400	
Pay-As-You- Throw (also ETC/LIP & Cardboard Ban)								Small residential only - see Table 3.1 for total generation projections
	Status Quo Diversion Tons/Year							
	Recyclables	41,500			42,100			At current 23% (recyclables 79% / organics 16%) - i.e., no change until PAYT
	Organics	8,400			8,500			
	Other	3,100			3,200			
	Recycling/Organics Capture Assumptions	50%	70%	100%	85%			Burns - 50% diversion with composting to all residences (no ETC/LIP/OCC changes)
	NEW Estimated Tons/Year Diversion							Trash composition (2016/17 audit) - 24.9% recyclables/35.1% organics
	Recyclables	21,900	30,660	43,800	37,800			
	Organics	30,850	43,190	61,700	53,200			
	Other	5,250	7,350	10,500	9,100			
New City Drop-Off Centers								Assume 3 new DOCs - see Table 3.1 for population projections
	Status Quo Diversion Tons/Year	600			600			Assume escalation by population increase
	NEW Estimated Tons/Year Diversion	1,800			1,800			Small residential composting will go down but MFU recycling may go up
Construction Diversion of Materials with Markets								Construction sector only - see Table 3.6 for total generation projections
	Status Quo Diversion Tons/Year	223,900			236,500			At current 17% - i.e., no change until diversion requirements added
	Recycling/Organics Capture Assumptions				25%	50%	100%	
	NEW Estimated Tons/Year Diversion							
	Recyclables/Organics				75,050	150,100	300,200	Trash composition (2019 C&D Audit) - 2% cardboard/5% metals/9% clean wood/10% aggreg

APPENDIX K

DIVERSION POTENTIAL ESTIMATIONS

POTENTIAL CUMULATIVE DIVERSION BY ALL IMPROVEMENTS

	2018	2025	2030
Small Residential Sector			
<i>Total Generation</i>	223100	228200	231700
<i>Status Quo Recyclables</i>	40,600	41,500	42,100
<i>New Recyclables</i>		70% 30,660	85% 37,800
<i>Status Quo Organics</i>	8,100	3,100	8,500
<i>New Organics</i>		70% 43,190	85% 53,200
<i>Status Quo Other</i>	2,900	3100	3,200
<i>New Other</i>		70% 7,350	85% 9,100
<i>Subtotal Diversion</i>	51,600	128,900	153,900
<i>Landfill Diversion Rate</i>	23%	56%	66%
Commercial			
<i>Total Generation</i>	938000	1023400	1081100
<i>Status Quo Recyclables</i>		188,300	198,900
<i>New Recyclables</i>			50% 106,150
<i>Status Quo Organics</i>		47,100	49,700
<i>New Organics</i>			50% 140,700
<i>Subtotal Diversion</i>		235,400	495,450
<i>Landfill Diversion Rate</i>		23%	46%
Construction			
<i>Total Generation</i>	1207000	1316900	1391100
<i>Status Quo Recyclables</i>		223,900	236,500
<i>New Recyclables</i>			50% 150,100
<i>Subtotal Diversion</i>		223,900	386,600
<i>Landfill Diversion Rate</i>		17%	28%
Drop-Off Centers			
<i>Total Generation</i>			
<i>Status Quo</i>	600	600	600
<i>New</i>		1,800	1,800
<i>Subtotal Diversion</i>		2,400	2,400
<i>Landfill Diversion Rate</i>			
City-Wide			
<i>Total Generation</i>	2368100	2568500	2703900
<i>Status Quo Recyclables</i>		454,300	478,100
<i>New Recyclables</i>		32,460	295,850
<i>Status Quo Organics</i>		50,200	58,200
<i>New Organics</i>		43,190	193,900
<i>Status Quo Other</i>		3100	3200
<i>New Other</i>		7,350	9,100
<i>Subtotal Diversion</i>		590,600	1,038,350
<i>Landfill Diversion Rate</i>		23%	38%

APPENDIX L

SUMMARY OF AVOIDED GHG EMISSIONS¹

The City and County of Denver (Denver) used the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) to calculate waste emissions in its annual GHG inventories from 2015 through 2018. The GPC’s traditional production-based GHG inventory calculates emissions generated from landfill and composted waste only. However, for the Solid Waste Management Division’s update to its 2010 master plan, Denver wants to understand the avoided emissions impact from an increased diversion rate by utilizing a life-cycle analysis-based approach. Unlike, the GPC inventory, life-cycle analyses calculate avoided emissions from recycling and composting and emissions generated from the landfill. Denver hired Lotus Engineering and Sustainability, LLC (Lotus) to complete a high-level analysis of the emissions currently being created or avoided from the management of the waste stream including landfilled waste, recycled waste, and composted waste.

Based on the revision recommended in the DWRS for a 50% landfill diversion goal by 2030, Lotus calculated the effect these diversion rates would have on GHG emissions. Figure 1 shows the additional emissions reductions that are possible with increased diversion, even with an increasing tonnage of waste collected. The emissions reduced will be 2,955,369 mt CO₂e compared to a status quo/baseline scenario of 842,744 mt CO₂e. **The increased diversion rate increases avoided emissions by 350 percent.** Significant increases in recycling and composting will be required to achieve this goal, however this inventory shows that implementing strategies to significantly increase Denver’s waste diversion will also play an important role in the City’s overall strategy to reduce GHG emissions to address Climate Change.

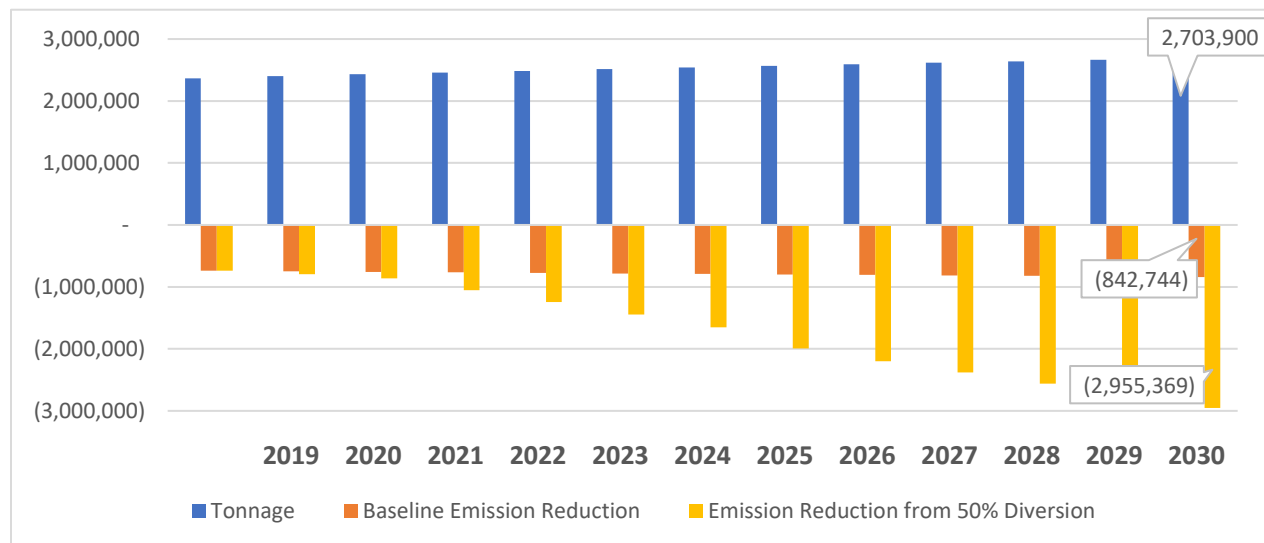


Figure 1. Additional Emissions Reductions from 50 Percent Diversion (mt CO₂e)

¹ Summary provided by SWM.