CITY OF BOULDER, COLORADO

ZERO WASTE EVALUATION STUDY
FINAL REPORT

January 2014

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List of Abbreviations

BCPH	Boulder County Public Health
BCRC	Boulder County Recycling Center
BRC	Boulder Revised Code
BVSD	Boulder Valley School District
CDD	Construction and demolition debris
CHaRM	Center for Hard-to-Recycle Materials
CRC	Center for Resource Conservation
DOC	Drop-off center
EOW	Every other week
FTE	Full-time equivalents
GBGP	Green Building Green Points Program
GHG	Greenhouse gas
HOA	Homeowners association
HMMF	Hazardous Materials Management Facility
KCI	Kessler Consulting, Inc.
LEAD	Local Environmental Action Division
MFU	Multi-family unit
MSW	Municipal solid waste
MFU	Multi-family unit
$mtCO_2e$	Metric tons of carbon dioxide equivalents
NA, na	Not applicable
P&R	Parks & Recreation Department
PDS	Planning & Development Services
SFU	Single-family unit
SS	Single-stream
USEPA	U.S. Environmental Protection Agency
WDS	Western Disposal Services
ZW	Zero waste
ZWTF	Zero Waste Task Force

Executive Summary

The City of Boulder has made significant strides in waste diversion, recording an overall solid waste diversion rate across all waste streams of 41 percent in 2011. As the City focuses on moving to a zero waste system, more aggressive policies and programmatic solutions will be required for reducing waste generation and maximizing material recovery.

The purpose of the City of Boulder's Zero Waste Evaluation Study is to evaluate the efficacy of the current waste diversion system and identify future alternatives for achieving the City's zero waste goals over a 15-year planning period. These goals include:

- Attaining a landfill diversion rate of 85 to 90 percent.
- Maximizing greenhouse gas (GHG) emission reductions.
- Maximizing job creation.
- Minimizing capital/implementation and operating costs.
- Additionally improving the options for source reduction, reuse, repair and reduced toxicity; engaging the public; supporting zero waste practices; easy implementation; good accountability from service providers; and partnership opportunities with local businesses and organizations.

This report provides recommendations for enhancing resource allocation within the City's existing programs, for implementing new or modified programs, and for general operational and partnership improvements across its solid waste system. The results of this study will be used to inform a Zero Waste Plan update in 2014.

ES.1 Existing Program Findings

The City operates several solid waste activities with Trash Tax revenues, which totaled over $1.7 million in 2012. Seventeen different programs with direct waste diversion impacts were evaluated in this study against both measurable and qualitative criteria. These criteria reflect the City's goals, and were established with the assistance of the Zero Waste Task Force (ZWTF). These programs fall into four categories:

- Diversion programs for single-family and multi-family residences.
- Diversion programs for local businesses.
- Support for waste diversion facilities owned and operated by City partners.
- Collection of diverted materials from City government buildings (contracted service).

The annual cost of these programs represent about one-third of the Trash Tax revenues, and cost the City an average $72/ton. The diverted materials are responsible for reducing GHG emissions equal to removing over 1,300 vehicles from Boulder roads. Some of the programs engender strong community involvement (especially Western Disposal Services', or WDS's, drop-off collection sites and Eco-Cycle's operations). Others have the potential for providing a strong foundation for future

zero waste strategies as they can be a direct stepping stone to more aggressive programming (all commercial programs, ReSource's used building material activities and the City's zero waste rebates for special events).

ES.2 New/Expanded Program Findings

While waste generators in the City of Boulder have posted laudable waste diversion progress in recent years, as much as 21,000 tons of recyclables and 20,600 tons of organics in the City's municipal solid waste stream are being landfilled. The City and the ZWTF chose to evaluate 11 program initiatives with the potential to help address this gap. These initiatives include:

- Every Other Week Trash Collection - mandatory policy to decrease single-family trash collection to every-other-week and increase organics collection to weekly.
- Multi-Family Composting - modify existing policy to require haulers to provide organics collection to homeowners with shared trash containers.
- Take-Out Packaging - encourage voluntary use of recyclable or compostable packaging by take-out restaurants.
- Homeowner Collection Service - modify existing policy to require all homeowners to subscribe to curbside trash collection (and other material collection as appropriate to the type of residence).
- Commercial Recycling - mandatory policy requiring businesses to subscribe to curbside recyclables collection.
- Curbside Organics Recovery - mandatory policy requiring food establishments to subscribe to organics collection.
- Construction and Demolition Debris (CDD) Deposit Program - modify Green Building Green Points (GBGP) requirements to include commercial projects and establish a refundable deposit.
- Special Events Diversion - modify existing policy to require diversion at all events requiring a City permit and to establish a deposit system.
- City Purchase of Local Compost - new policy to require the City to purchase only locally produced compost.
- Boulder County Recycling Center Improvements - City funding to support facility improvements targeted towards greater efficiency for processing more recyclables
- Existing Policy Enforcement - resources for improved City enforcement of existing recycling requirements for homeowners, construction/deconstruction projects and special events.

These initiatives were evaluated against the same measurable and qualitative criteria used for existing programming. It was estimated that if all 11 initiatives were implemented, the City's diversion level could potentially reach its diversion rate goal, reduce significant GHGs and enjoy numerous new partnership opportunities. Collectively, however, these programs would add new

City costs. Customers would also be impacted in terms of increased service rates and compliance costs.

As a means of prioritizing those initiatives most likely to meet the City's environmental and economic goals, three groupings (or bundles) of initiatives were created:

- Bundle #1 for Greatest Landfill Diversion/Greatest GHG Reductions - including Every Other Week Trash Collection, Homeowner Collection Service, Commercial Recycling, Commercial Organics Recovery and CDD Deposit Program.
- Bundle #2 for Lowest City Cost - including Every Other Week Trash Collection, Homeowner Collection Service, Multi-Family Composting, Take-Out Packaging and CDD Deposit Program.
- Bundle #3 for Lowest Customer Costs - including Every Other Week Trash Collection, Multi-Family Composting, Take-Out Packaging, Commercial Recycling and Commercial Organics Recovery.

The environmental and economic impacts of these bundles were evaluated over the 15-year planning period. When considered in the aggregate, Bundle #1 demonstrated the greatest environmental benefits, increasing the City's overall waste diversion rate to 79 percent and new GHG reductions equal to 15,000 less cars by 2027. Both Bundles #1 and #2 would generate net revenues when considered separately from existing programs - Bundle #2 had the highest with estimated annual earnings of $59,000 by 2020 and $72,000 by 2027. Alternatively, Bundle #3 is expected to create the lowest economic impact to customers with new monthly costs ranging from $2 to $6 (residential initiatives) and $15 to $50 (commercial initiatives). These costs reflect the exclusion of the CDD Deposit program from this bundle (as "green" building increases new construction costs).

ES.3 Additional Findings

As Bundle #1 may fall short of fully meeting the City's waste diversion goal and some of its qualitative goals, additional alternatives were considered. The primary alternative focused on the ability to clarify partner roles and increase diversion through contractual relationships. A review of existing partner contracts identified opportunities for the City to share revenues from the sale of recyclables, more firmly secure organics processing capacity at WDS's composting facility, support private-sector CDD processing, involve ReSource in the GBGP expansion, and obtain more detailed cost-accounting of the City's investment in CHaRM.

The concept of a single-hauler collection system was also revisited (the City has considered this concept in the past). This type of system would typically require a competitive procurement process to select a hauler to serve the City's single-family and small multi-family homes. Ultimate pros and cons cannot be definitively identified prior to implementation due to numerous variables. A comparison of residential services in Boulder (with an open-market collection system) to those in Louisville and Lafayette (both with a single-hauler contract) identified many of these variables, and observed that while rates are higher in Boulder, the level of service is higher as well. Key benefits of a change in Boulder to single-hauler collection are expected to include the potential for lower customer (homeowner) costs, greater City control over service, improved collection metrics and a new opportunity for a consistent, citywide public education campaign. Disadvantages will include loss of customers' ability to choose their hauler and loss of business for existing haulers who do not

win the contract (non-collection services and facilities operated by unsuccessful bidders may also be impacted).

A new contract with Boulder County regarding improvements and operation of the Boulder County Recycling Center (BCRC) was also considered as a means of having formal input to materials accepted for processing, and facility improvements to increase efficiencies.

ES.4 Recommendations

Initial recommendations address existing programs and will be the most timely and straightforward to implement. It is expected that these modifications would be made in 2014 and would save the City approximately $82,000 per year:

- Re-prioritize Eco-Cycle funding for Boulder Valley School District to direct reuse, recycling and composting activities.
- Modify all commercial programs (in anticipation of new diversion policy for this sector) - including refocusing funding to Boulder County Public Health for standardized tools useful to many businesses and eliminating recycling coupons, the zero waste start-up rebate and the compost subsidy.
- Expand the impacts of GBGP to accomplish increased diversion and improve the value of the City's investment in ReSource.
- Improve data capture from both City and vendor programs and improve the application of qualitative metrics - both will enhance the City's ability to review and value ongoing programming.

Once current programming has been maximized in terms of its ability to support the City's goals, the City can begin to expand these programs and tackle new zero waste policies. It is expected that the City Council, Environmental Advisory Board and ZWTF will review the study findings and decide whether one of the bundles of new initiatives should be adopted, or whether a new grouping should be developed from the 11 initiatives evaluated. Based solely on the findings of this report, the suggested course of action is implementation of Bundle #1. It is specifically recommended that this occur in two phases:

- Phase I (2014-2016) - revise BRC Chapter 6-12 to implement Every Other Week Trash Collection for single-family homes, create new policy for both Commercial Recycling (applies to all businesses) and Commercial Organics Recovery (applies to food establishments only) subscription requirements.
- Phase II (2017-2018) - revise BRC Chapter 10-7.5 to the CDD Deposit Program to add commercial construction to GBGP and establish a deposit program and revise BRC Chapter 6-3 to require all homeowners to subscribe to curbside trash service.

It is estimated that City costs for development and initial implementation of these initiatives will be about $105,000. This will primarily include salary costs for 1 to 2 new staff for research, a public input process, developing expanded/new partnerships with regulated and vendor groups, obtaining necessary approvals, pilot testing and stakeholder outreach. The CDD Deposit Program is likely to require the most intensive development, as a deposit structure, fee schedule and compliance verification system must be put in place.

Once this program is fully implemented, however, ongoing operations are expected to generate $45,000/year through 2020, and up to $74,000 by 2027 (both costs include 2 full-time staff). These favorable economics are due primarily to the CDD Deposit Program, which will provide revenues in the form of non-refunded deposits (customer costs are higher, however, with green construction estimated to increase costs by an average $13,800/project).

Also of economic significance is the impact Bundle #1 will have on the City's Trash Tax revenue potential. While commercial tax revenues will be lost as commercial and construction diversion increases and landfill tons drop, residential tax revenues will be gained as all homeowners are required to subscribe to collection service. The cumulative impact is expected to be significant, but earnings will depend on when initiatives are implemented, actual diversion, costs of programming not evaluated in this study staying constant, and enforcement.

Other recommendations to support Boulder's future zero waste program activities include:

- Increased investment in public outreach and education with universal messaging and branding - this has an approximate annual cost of $42,000 to $86,000 for the first few years in addition to current outreach costs (about $45,000/year).
- Increased enforcement of existing and future programs to ensure consistent implementation, increase diversion and maintain the City's credibility in terms of managing Boulder's zero waste system - the cost of $8,000 was included in Bundle #1.
- Redefining partner responsibilities through enhanced contractual relationships - this should include the WDS compost facility, CHaRM and ReSource/GBGP operations.
- Utilization of available acreage at 6400 Arapahoe Road - with space for assisting new initiative implementation (especially the CDD Deposit/expanded GBGP program), supporting additional materials diversion (CDD and materials not currently collected in Boulder), training and community engagement activities.
- Ongoing zero waste plan implementation - to include at least an every-other-year plan review as well as continual improvement of tracking metrics, review of costs against Trash Tax and CDD Deposit revenues, and audits to identify new diversion and public education needs.

Lastly, it is acknowledged that implementation of a contractual single-hauler system in Boulder would be difficult and was not recommended for consideration. It is strongly suggested, however, that this concept be pursued if the City is unable to obtain reasonably strong support from haulers for development and implementation of the Bundle #1 initiatives (or whichever initiatives the City ultimately selects in its 2014 Zero Waste Plan Update).

ES.5 Implementation Costs

Based on the study recommendations, it is estimated that the City would:

- Phase I (2014-2016) - spend an additional $115,000 to $187,000 per year over the current $1.7 million budget (this considers initial development of Bundle #1 initiatives, as well as projected CDD Deposit Program and phased-in changes to Trash Tax revenues).
- Phase II (2017-2027) - earn net revenues in the range of $500,000 per year (including projected CDD Deposit revenues and overall changes to Trash Tax revenues - net revenues

can be used to increase zero waste programming and expand public outreach and education activities, especially for multi-family and commercial generators).

These recommendations represent aggressive policy and programmatic initiatives. They will require fundamental changes to the status quo and significant effort by the City, waste generators and the City's partners. It will be important for the City to apply any data updates, revisions to the study assumptions and clarification of qualitative criteria to the initiatives ultimately selected to ensure the best estimation of environmental, economic and social outcomes. The KCI Team performed this analysis and developed these recommendations for the City to consider as part of a broad-based community process to update the City's Zero Waste Master Plan. The KCI Team believes that a delayed implementation schedule may significantly impact the City's ability to achieve its zero waste goals.

Section 1
Introduction

The City of Boulder has made significant strides in moving toward zero waste, recording an overall solid waste diversion rate of 41 percent in 2011. This success is all the more impressive as it was based primarily on voluntary measures and an open-hauler collection system.

As the City focuses on a zero waste diversion goal, more aggressive policies and programmatic solutions will be required for reducing waste generation and maximizing material recovery. Although simple concepts, these will take significant effort by the City, waste generators and City partners - and will require fundamental change in the status quo.

Despite the relatively high diversion levels currently observed, 42 percent of the City's residential waste and 68 percent of the City's commercial waste disposed of (landfilled) is compromised of recyclables and organics that could have been diverted through existing programs. On the industrial side, the ability to increase construction and demolition material diversion was estimated at over 200 percent. Clearly, the opportunity for increased diversion exists.

1.1 Study Purpose

The purpose of the Zero Waste Evaluation Study is to evaluate the efficacy of the current waste diversion system and identify future alternatives for achieving the City's zero waste goals over a 15-year planning period. These goals include:

- Maximizing landfill diversion - generally defined as a diversion level of 85 to 90 percent.[1]
- Maximizing greenhouse gas (GHG) emission reductions.
- Maximizing job creation.
- Minimizing capital/implementation and operating costs.
- Achieving additional criteria more qualitative in nature - including the ability for upstream conservation (source reduction, reuse, repair and reduced toxicity); to engage the public, raise awareness and broaden the foundation for zero waste practices; for smooth implementation; for the City to obtain reasonable accountability in services provided by others; and for partnership opportunities with community businesses and organizations.

The City developed the most recent version of its Master Plan for Waste Reduction in 2006 and will update it in 2014. This study will provide City staff with information that, along with a community and Council process, will help complete the Zero Waste Program Update in 2014.

[1] Based on the City of Boulder's Master Plan for Waste Reduction (prepared by the Office of Environmental Affairs in 2006) and the Zero Waste Community Planning Guide & Ten Year Strategy (prepared by Eco-Cycle in 2012).

1.2 Study Components

The study includes three distinct components for assessing the City's potential for achieving zero waste. These evaluations utilize data and input from City staff, the Zero Waste Task Force (ZWTF) and best management practices in other zero waste programs. They include:

1. Evaluation of Existing Waste Diversion Programs Supported by Trash Tax Revenues - This analysis is described in Section 2 of this report and provides:
   - Improved understanding of program effectiveness.
   - Identification of modifications to improve efficacy and provide a better foundation for future policy and programming.
   - Re-allocation of City dollars to program activities expected to better meet its zero waste goals.
2. Evaluation of Future Initiatives Identified by City Staff and the ZWTF - This analysis is described in Section 3 of this report and considers:
   - A wide range of initiatives for achieving the zero waste goals.
   - Criteria for short-listing and analyzing the initiatives.
   - Detailed analysis of those initiatives for which further environmental and economic analysis is needed to determine their value.
   - Bundling of initiatives to meet the City's measurable goals (i.e., diversion, GHG reductions, jobs and costs).
3. Consideration of Additional Activities - This analysis builds upon the findings of the future initiatives evaluation with additional recommendations for increasing the probability of reaching the City's zero waste goals, and is described in Section 4 of this report.

1.3 Project Background

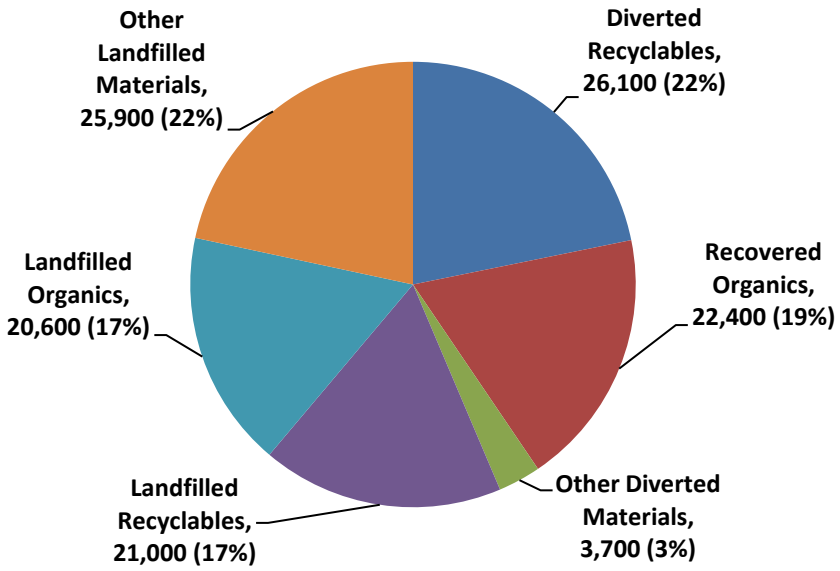
The City's waste diversion system includes a network of policy, programs and partnerships with private and non-profit service providers. Key components include:

1. Hauler Ordinance for Residential/Multi-Family Collection (BRC Chapter 6-12) - This requires haulers:
   - Who collect single-family and multi-family trash to also collect recyclables and organics every-other-week (only recyclables from multi-family homes).
   - To utilize variable rate trash pricing with embedded recycling/organics collection costs.
   - To take recyclables to the BCRC unless customers choose another option.
   - To report material quantities annually.
2. Commercial Programs – These include technical assistance, rebates and an organics collection subsidy.

3. Partnership for Materials Collection and Processing - The City works with WDS for the collection and/or processing of yard and wood waste, Eco-Cycle's CHaRM for hard-to-recycle materials, and the County's Hazardous Materials Management Facility (HMMF) for hazardous waste. The City also works with ReSource to provide infrastructure and customer outreach associated with the reuse/resale of used building materials and durable goods.
4. Hauler Occupational Tax (BRC Chapter 3-10) - The City requires all haulers to pay an occupational tax (known as the Trash Tax) that is essentially a pass-through to homeowner and commercial generators. Trash Tax revenues are the sole source of funding for City programs.[2]
5. Lease 6400 Arapahoe Property - Lessees include both Eco-Cycle and ReSource.
6. Miscellaneous City Programs - These include recycling/organics recovery at the Pearl Street Mall and several public outreach activities.

Figure 1.1 illustrates the diverted and landfilled recyclables and organics waste within Boulder's municipal solid waste (MSW) stream. The figure illustrates that the untapped diversion potential for these streams is high - as much as 21,000 tons of MSW recyclables and 20,600 tons of organics were landfilled. Landfilled non-MSW (primarily CDD), which is not well defined and therefore not included in this figure, represents additional diversion potential.

Figure 1.1: Current Diversion and Disposal of Boulder's Municipal Solid Waste Stream*



* Based on the City's 2011 Annual Waste Tracking report and 2012 waste composition studies (compiled in WDS's Summary of Waste Sort Results, March 2013).

[2] The City does not require all owner-occupied homes to subscribe to curbside collection, although rental properties do have this requirement. It is estimated that approximately two-thirds of all homes currently subscribe.

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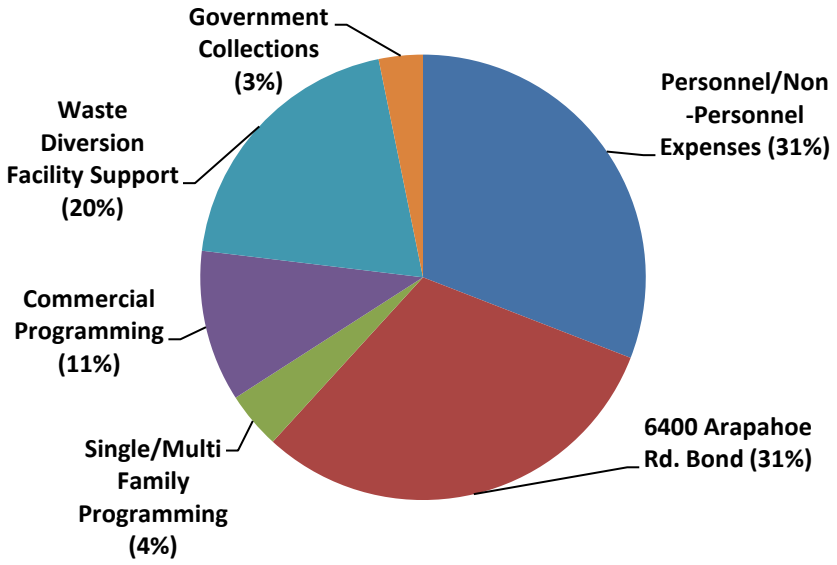
Section 2
Existing Trash Tax Program Evaluation

The purpose of this evaluation is to consider the effectiveness and cost efficacy of the existing waste diversion programs supported by Trash Tax revenues as the first component of meeting the City's zero waste goals. Figure 2.1 illustrates the current allocation of Trash Tax revenues.

Figure 2.1: 2012 City Trash Tax Expenditures



It is important to note that not all of the waste diversion programs funded by Trash Tax revenues were assessed in this evaluation:

1. Programs Included in the Evaluation - These include the mix of specific services provided directly by the City or with City funds, as well as diversion facilities supported by the City. In 2012, approximately 38 percent of the total $1.7 million Trash Tax revenue was spent on these programs.[3] In the same year, these programs were responsible for at least 31 percent of all tons diverted in Boulder.
2. Programs Excluded from the Evaluation - Activities funded by the remaining 62 percent of the 2012 Trash Tax revenues directly support the City's waste diversion mission; however, they were not evaluated because they could not be tied to specific programs or goal outcomes. These include:
    - Personnel expenses by the City's LEAD General Services for overall planning, policy development, research and training activities.

[3] Based on the City's FY2012 budget (still uses 2011 numbers).

- Non-personnel expenses including office equipment, office supplies, travel, consulting services, capital projects, etc.
- Bond payments for the 6400 Arapahoe Road property.
- Additional waste materials diverted through curbside collection services provided by private haulers and the University of Colorado recycling programs (none of which receive City funding).[4]

2.1 Process

The existing Trash Tax program evaluation process includes two steps:

1. Identification of criteria to assess the relative ability of any program or new zero waste initiative to help reach the City's goals.
2. Application of both measurable and applicable non-measurable criteria to exiting Trash Tax programs to assess relative value.

2.2 Results

2.2.1 Criteria Selection

Table 2.1 presents the evaluation criteria selected for this study. These were based on an initial list identified by City LEAD staff and the City Manager's Office (Information Packet Memorandum, December 2012), and subsequently modified with input from ZWTF members. These criteria were developed for use in evaluating both the City's existing programs and future zero waste initiatives. As noted below, not all criteria were deemed useful for the evaluation of existing Trash Tax programs due primarily to the fact that some programs were fully implemented or relatively mature.

2.2.2 Evaluation

The evaluation of the City's existing Trash Tax programs was based on 2012 data obtained from the City, haulers, Eco-Cycle and the Center for Resource Conservation (CRC).[5] Where data was missing or incomplete, assumptions were made to generate comparative estimates. Table 2.2 summarizes the results of this evaluation. Appendix B includes additional details. Key observations are noted below.

[4] City ordinances do impose requirements on residential MSW collection (i.e., materials to be collected, provision of containers, rate setting and other factors) as well as Trash Tax collection by haulers for service in all sectors.
[5] Note that this analysis is based on data collected specifically for this evaluation of the 2012 baseline year and does not rely on the 2011 database referenced in Table 1.1 (i.e., some values differ between these sources).

Table 2.1: Evaluation Criteria for the Zero Waste Evaluation Study

CRITERIA	RANKING BASIS	USED FOR EXISTING PROGRAM EVALUATION	USED FOR FUTURE ALTERNATIVES EVALUATION
Measurable Criteria			
Diverted Tons	tons diverted	Yes	Yes
Reduced GHG Emissions	metric tons CO_2 equivalents reduced	Yes	Yes
Jobs Creation Potential	jobs created	No	Yes
Costs	costs (capital or operating $/year)	Yes	Yes
Non-Measurable Criteria			
Support Source Reduction, Repair, Reuse and Reduced Toxicity (4 mechanisms)	1 for one mechanism up to 4 for all 4 mechanisms	Yes	Yes
Community Engagement (encourages participation and raises awareness)[a]	1 for engaging up to 25% of City households; 2 for up to 50%; 3 for up to 75%; 4 for up to 100%	Yes	Yes
Zero Waste Foundation (provides good basis for future zero waste activities)	1 for outreach to 25% of City households; 2 for outreach to 50% of households; 3 for supporting study initiative(s); 4 for additional support	Yes	Yes
Ease of Implementation (including policy needs)	1 for high effort (high cost, public vote, etc.); 2 for policy with high enforcement; 3 for policy with light enforcement or aggressive education; 4 for minimal effort	NA	Yes
Timeliness (effective within the 15-year planning period)[a]	4 for implementation in < 2years; 3 in < 5 years; 2 in < 10 years; 1 in < 15 years	NA	Yes
Service Provider Accountability (for services supported by the City)	4 for long-term contract; 3 for short-term contract; 2 for policy; 1 for minimal accountability options	NA	Yes
New/Expanded City Partnerships (with community businesses and organizations	4 for >2 new partners; 3 for 2 new partners; 2 for 1 new partner; 1 for existing partnerships	NA	Yes

[a] See Recommendations in Section 5.1 for suggested implementation schedule.

Table 2.2: Existing Waste Diversion Program Analysis (2012)[a] (rounded to the nearest 100 tons; 100 mtCO2e, $1,000 total $)

EXISTING CITY WASTE DIVERSION PROGAM	TONS DIVERTED	GHG REDUC-TIONS	COST IMPACTS (operating $/year, 2012$)			UP-STREAM CONSER-VATION[c]	COM-MUNITY ENGAGE-MENT[c]	ZERO WASTE FOUNDA-TION[c]
			Total $	$/mtCO$_2$e	$/ton			
SINGLE-FAMILY/MULTI-FAMILY RECYCLABLES and ORGANICS DIVERSION PROGRAMS								
BVSD/Com Gardens	0	0	$25,000	$769[b]	$2,365[b]	2	1	1
Eco-Cycle Outreach	NA	NA	$10,000	NA	NA	3	2	2
CRC Sponsorships	NA	NA	$8,000	NA	NA	1	1	0
Pearl St. Mall Program	NA	NA	$5,000	NA	NA	0	1	1
Event Education Table	NA	NA	$3,000	NA	NA	2	1	1
Special Event Rebates	NA	NA	$13,000	NA	NA	0	1	3
Recycling Green Team	NA	NA	$7,000	NA	NA	0	1	1
Subtotal	*0*	*0*	*$69,000*	NA	NA			
COMMERCIAL RECYCLABLES and ORGANICS DIVERSION PROGRAMS								
BCPH Outreach	NA	NA	$106,000	NA	NA	0	1	3
Recycling Coupons	NA	NA	$2,000	NA	NA	0	1	3
ZW Start-Up Rebate	NA	NA	$2,000	NA	NA	0	1	3
Composting Subsidy	4,700	900	$79,000	$84	$17	0	1	3
Subtotal	*4,700*	*900*	*$188,000*	NA	NA			
WASTE DIVERSION FACILITIES								
Organics								
Yard Waste DOC	8,000	1,100	$145,000	$134	$18	1	3	2
Wood Waste DOC	2,000	400	$31,000	$78	$16	1	1	1
Hard-to-Recycle Materials								
CHaRM Operations	700	2,200	$101,000	$45	$135	4	3	2
Used Building Materials/ReSource								
Customer Service	800	800	$63,000	$84	$81	2	2	3
Hazardous Materials								
County HMM Facility	100	200	$2,000	$10	$30	2	1	1
Subtotal	*12,300*	*5,400*	*$342,000*	NA	NA			
CITY GOVERNMENT DIVERSION COLLECTION								
City Govt Collection	200	400	$41,000	$103	$205	0	1	3
Subtotal	*200*	*400*	*$41,000*	NA	NA			
TOTAL	**16,500**	***6,000***	**$640,000**	**NA**	**NA**			

Rounding errors may occur.

[a] Appendix B includes estimating details for Table 2.2 (including estimated participation levels).

[b] Based on a report of 10 tons diverted and estimated 32 mtCO$_2$e reduction.

[c] See Table 2.1 notes for qualitative ranking approach (Appendix B includes participation estimates).

In reviewing the Table 2.2 results, the following observations stand out:

1. Diverted Tons - Table 2.2 indicates that City-funded programs were responsible for diverting 16,500 tons in 2012 (if tonnage data for all programs were available this number would be higher). Based on available data, the most successful diversion activities occurred at the yard and wood waste drop-sites and through the compost subsidy program.[6]
2. Costs - As shown in Figure 2.1, in 2012 the City spent:
   - 4 percent of annual Trash Tax revenues on residential/multi-family zero waste programs - which reflects the mature, City-regulated collection systems in these sectors (commercial diversion is voluntary and unregulated).
   - 11 percent on commercial zero waste programs - with Boulder County Public Health (BCPH) outreach and the compost subsidy comprising the bulk of this investment.
   - 20 percent on zero waste partner facilities - with WDS's yard waste drop-site and CHaRM receiving most of these dollars.
   - 3 percent on contracted collection of recyclables and organics from City operations and buildings - a full third of this investment was dedicated to management of this program and employee education.
   - Expenditures equate to an average $72 per diverted ton and $77 per reduced metric ton of carbon dioxide equivalents (mtCO2e) for programs with available metrics (the BVSD outliers were not included in this average).
3. Greenhouse Gas Emissions - All program estimates indicate that GHG emissions were reduced, with at least 6,000 less mtCO2e than would be created without these diversion activities (which is equivalent to the carbon dioxide emissions of over 1,400 vehicles each year)[7]. As these estimates are tied to tons diverted, they could not be calculated for the programs that do not track this metric.
4. Source Reduction, Reuse, Repair and/or Reduced Toxicity - Most programs have relatively limited direct impact on upstream conservation. Eco-Cycle's collective activities, (including overall outreach, the new Fixit Clinic workshops and CHaRM), however, have the greatest direct focus on reusing and repairing components of the waste stream.
5. Community Engagement - The yard waste drop-off and CHaRM programs may have the greatest community outreach, based on estimated participation by City users (see Appendix B - this estimate is based on an assumed level of repeat customers, however, and should be verified in the future).
6. Foundation for Future Zero Waste Activities - Based on a combination of participation levels and being direct stepping stones for new programs or policies, several existing programs will serve as good foundations for future initiatives. These include all of the

[6] The compost subsidy program tracks subscribed tons (not actual tons diverted), and Table 2.2 likely overestimates actual diversion.

[7] Includes passenger cars, vans pickup trucks and sport/utility vehicles and assumes all waste tons are managed at a landfill that has a gas collection and energy recovery system (based on U.S. Federal Highway Administration and U.S. Environmental Protection Agency calculations at http://www.epa.gov/cleanenergy/energy-resources/calculator.htm#results).

commercial programs in Table 2.2, the ReSource used building materials facility and special events rebates.

2.3 Existing Program Recommendations

These recommendations are based on the quantitative findings in Table 2.2 and anticipate potential new policies and programming described in subsequent sections of this report. They focus on the ability to reallocate current investments to future waste diversion activities that are expected to improve the City's opportunity for achieving its zero waste goals. Section 5 includes a suggested implementation schedule and cost impact estimate associated with these recommendations.

1. Improve Data Capture - This should include accurate hauler reporting of collection accounts and tons by waste generator category[8], as well as increased reporting of program effectiveness on any programs benefitting from City revenues. Without better tonnage, account and program data, evaluations will continue to have less-than-optimal value.
2. Utilize Non-Measurable Criteria - Due to their subjectivity, these criteria are more challenging to apply. Their ability to verify the value of programs that cannot be fully defined with quantitative metrics, however, is important (especially where low tons are diverted or higher costs are incurred, but education and awareness-raising are strong). Strategies for maximizing value with these metrics include development of a sound ranking basis, consistent application, consistent evaluators from one year to the next, and clear documentation (Table 2.1 provides the ranking basis used in this study to evaluate existing programs in this section and future initiatives).
3. Re-prioritize Use of Eco-Cycle Funds for BVSD Program - These should primarily support direct reuse, recycling and organics recovery in Boulder schools and associated education activities relative to sound recycling and composting practices. While student education alone is expected to have strong impacts on long-term waste diversion, these impacts are indirect and represent the most expensive investment by the City on a per-ton basis.
4. Re-focus BCPH's Services Solely on Technical Assistance - This should include standardized tools that can be used to help a relatively large number of businesses comply with future diversion mandates with limited staff involvement. As nearly 6,800 businesses would be impacted by the commercial mandates described in Section 3[9], the ability to utilize current funding to reach more businesses will be important. As the mandates are implemented, these efforts and associated costs should decrease over time.
5. Eliminate Compost Subsidies - Despite the estimates indicated for this program in Table 2.2, it is likely that City costs are closer to $7 per cubic yard (current tonnage measurements are based on subscription levels, but tonnage data indicates that only about 30 percent of

[8] Support for this recommendation include the haulers' inconsistency in reporting multi-family versus commercial accounts, incompleteness of the City's 2012 databases and lack of reporting by the City's Pearl St. Mall contract hauler.

[9] Per the City's 2011 Hauler Waste Inventory, less than 50% of these businesses subscribed for trash collection services (it is assumed that the rest self-hauled their waste directly to local landfills - according to the Boulder Economic Council, 80% of the total reported businesses had fewer than 10 employees). Of the total trash accounts, just over half had recyclables collection service and less than 10% had organics collection service.

subscribed tons were actually diverted). Given this relatively high cost and the targeting of nearly 1,000 food establishments by the commercial organics mandate described in Section 3, it is recommended that these payments be eliminated as the mandate is implemented.[10]

6. Eliminate/Reduce Redundant Programs When Future Policies are Implemented - These should include eliminating the recycling coupons and zero waste rebates available to businesses as future commercial mandates become effective. The City should also consider eliminating other programs that appear to have very low household influence (see Appendix B), such as the CRC sponsorships.
7. Work with WDS to Track Users of Yard/Wood Waste Drop-sites - This should be tailored to address specific questions about residential usage. Results should identify unique versus repeat customers and evaluate usage by residences with curbside service. These data collection requirements should be added to future WDS contract language.
8. Better Understand of Impact of City Funding on CHaRM's Operations and Costs - Require documentation verifying that CHaRM's accomplishments support the City programs and are in line with the City's investment (which is high on a strict per-ton basis). Examples include the provision of service gaps (such as the need for more reuse and repair activities) and measured usage by City taxpayers. These requirements should be added to future Eco-Cycle contract language.
9. Increase the Cost-Effectiveness of ReSource Investments - One key way of accomplishing this would be by increasing the tons of used building materials and durable goods diverted (ideally through new requirements for CDD diversion/an expanded GBGP program in the future).

[10] Per the City's 2011 Annual Waste Hauler Inventory, less than 300 businesses subscribed for organics collection service.

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Section 3
Future Zero Waste Initiatives Evaluation

The purpose of this evaluation is to identify those future zero waste policy and programmatic initiatives that will best help the City meet its zero waste goals, and to subsequently analyze those initiatives in terms of the evaluation criteria previously selected.

3.1 Process

The evaluation process is three-fold and includes:

- Identification of potential initiatives with reasonable political, social and economic feasibility - then prioritize those requiring further environmental and economic analysis to estimate their value.
- Detailed evaluation of 11 individual initiatives against measurable criteria and non-measurable criteria (See Table 2.1) - analyzed in present time.
- Consideration of 3 aggregated bundles of initiatives that best meet the City's quantitative goals of greatest diversion/greatest GHG emission reductions, lowest city costs and lowest customer costs - analyzed against non-measurable criteria over the 15-year planning period.

3.1.1 Alternatives Identification and Selection

An extensive list of potential initiatives was developed by the ZWTF and City staff. It was in part based on the City's 2006 Master Plan for Waste Reduction and the City of Boulder's Strategies Toward Zero Waste report (SERA, 2012). This list was subsequently prioritized to select key initiatives for further evaluation.

3.1.2 Evaluation of Initiatives

To maximize the value of this step, the evaluation is conducted as follows:

- Analysis of each individual initiative against all applicable criteria without consideration of any other initiative.
- Bundling of those initiatives with the potential to achieve specific City goals for subsequent analysis against measurable criteria.

The primary sources of data for these evaluations are the City's Annual Waste Tracking and Hauler Waste Inventory reports (both 2011 and 2012 data were used to provide the best assessment of current conditions and compensate for incomplete 2012 data). Information from private/non-profit haulers and facility operators is used where available. Metrics and published information from other programs is used where needed to fill in data gaps and allow a reasonable analysis of

each initiative. The analyses also include a number of assumptions pertaining to participation and/or diversion levels.

3.2 Results

3.2.1 Initiative Selection

Appendix C includes the extensive list of potential initiatives originally developed by the ZWTF and City staff. Table 3.1 includes the priority list of 11 initiatives with a description of each. As shown, this list covers all sectors of waste generators and includes optimization of existing programs, diversion incentives and services, new generator requirements, material market improvements and future relationships between the City and its partners.

Table 3.1: Description of Future Zero Waste Initiatives

ZERO WASTE INITIATIVE	SECTORS IMPACTED	VOLUN-TARY?	CITY ROLE AFTER POLICY DEVELOPMENT	NEW LEAD/CITY PARTNERSHIPS
Every Other Week Trash (for existing subscribers)	Single-family	Mandatory	Minimal	No
Multi-Family Composting (requirement for hauler service)	Multi-family	Mandatory for haulers, voluntary for homeowners	Minimal	Homeowner associations, Boulder Area Realtor Association
Take-Out Packaging (recyclable/ compostable products)	Individuals, restaurants	Voluntary	Reporting	Colorado Restaurant Association/Boulder County Chapter
Homeowner Collection Service (single-family and owner-occupied multi-family)	Single-family & Multi-family	Mandatory	Enforcement	No
Commercial Recycling (all businesses)	Commercial	Mandatory	Enforcement	Local business association, CO Association for Recycling, Rocky Mountain Organics Council, US Composting Council), etc.
Commercial Organics Recovery (food establishments only)	Commercial	Mandatory	Enforcement	WDS, local business association, US Composting Council
CDD Deposit Program (diversion, deposit requirements for all construction, deconstruction)	All	Mandatory	Review/track/report & manage deposits	City Finance Dept, City PDS, Built Green Colorado, US Green Building Council
Special Events (any covered by City Special Events permit)	Events	Mandatory	Review, enforcement & manage rebates	City P&R Dept., Boulder Commercial Districts, Downtown Boulder, Inc., Council for Responsible Sports[a]
City Purchase of Local Compost	City departments	Mandatory	None	City Purchasing Department
BCRC Improvements (increase efficiency, cost efficacy)	NA	NA	Coordination with Boulder County	Boulder County
Existing Policy Enforcement (existing recycling programs)	All	Mandatory	Review, enforcement & manage deposits/rebates	City Finance P&R & PDS Departments

[a] Council for Sports (non-profit interested in partnering with Boulder to incentivize sustainable sports events).

3.2.2 Evaluation of Individual Initiatives

For consistency, all implementation is assumed in present time (waste generation estimates, existing diversion levels and the time-value of money is based on 2011/2012 levels). The results of each initiative's impact on quantitative criteria are summarized in Table 3.2. The results from comparing them against non-measurable criteria are described in Table 3.3. Appendix D includes the supporting modeling data for this analysis.

Several key observations can be made from this evaluation:

1. Aggressive implementation of all Initiatives will be required to meet the City's zero waste goal of 85 to 90 percent diversion:
    - A mix of residential, multi-family, commercial and construction initiatives will be needed.
    - Full implementation of all 11 initiatives could divert as much as 53,400 additional tons - when this tonnage is added to current diversion levels, a community-wide diversion level of 82 percent could be achieved.[11]
    - This will require successful policy development, high participation, consistent follow-through and enforcement.
    - Many assumptions were used in this analysis to compensate for lack of data or unknown conditions - where these assumptions are not verified and adjusted in the future, the City's ability to reach its goal may be compromised.
2. GHG Emission Reductions potential is equivalent to the emissions generated by between 10,000 and 16,000 vehicles (detailed GHG estimates for all analyses were completed by Gracestone, Inc. and are provided in Appendix F).
3. Job creation estimates may not be useful in determining the City's future Zero Waste Strategy (job creation estimates for individual initiatives are included in Appendix G).
    - Most new jobs would be created from initiatives with the greatest quantity of new tons requiring collection (the highest job creator) and/or processing.
    - The basis of these estimates is national sources (some were limited to other parts of the country or only to certain materials) and information supplied by WDS, Eco-Cycle and Boulder County (which represent a snapshot in time and may not reflect future operations) - while the findings provide some indication of potential job creation, they should not be considered a definitive indicator without additional analysis.
    - Tracking jobs created in Boulder through the reuse/repair and the collection/processing of recyclables, organics, and other materials will help the City further validate the value of waste diversion programs.[12]

[11] For 2011, a total of 131,700 tons were generated and 54,100 of these tons were diverted.

[12] For example, the North Carolina Department of Environment and Natural Resources recently confirmed that job creation in the State of North Carolina has tripled in the last two decades. This type of statement can be extremely useful in passing new policy, obtaining state or regional grant funding and garnering public support.

Table 3.2: Summary of Individual Initiatives Evaluation - Quantitative Analysis

INITIATIVE	DIVERSION IMPACTS (nearest 100 tons/year)	COST IMPACTS TO CITY[a]				COST IMPACTS TO CUSTOMERS ($/month)		GHG REDUCTIONS (nearest 100 $mtCO^2e$)[b]	JOBS (nearest FTE)[c]
		Initial Development		Ongoing Costs (Revenues)					
		$/Yr (nearest $1,000)	$/ Ton	$/Yr (nearest $1,000)	$/ Ton				
Every-Other-Week Trash	2,500 - 5,000	$16,000	$4	$0	$0	$2 - $3		2,600 to 5,200	2 to 3
Multi-Family Composting	300 - 600	$12,000	$27	$0	$0	$3 - $4		< 100	1
Take-Out Packaging	100 - 200	$13,000	$87	$2,000	$13	$2 - $6		< 100	0
Homeowner Collection Service									
Single-Family	7,400	$24,000	$3	$3,000	$0	$20 - $25		15,000	19
Multi-Family (owner-occupied)						$11 - $16			
Commercial Recycling	5,500 - 11,900	$30,000	$3	$10,000	$1	$15 - $30		17,000 to 36,600	15 to 33
Commercial Organics Recovery[d]	8,600 - 17,100	$30,000	$2	$5,000	$0	$30 - $50		1,800 to 3,600	19 to 39
CDD Deposit Program[e]									
New Construction	5,400	$37,000	$7	($63,000)	($12)	$13,800		1,200	2
Deconstruction						$0		3,000	6
Special Events	0	$14,000	NA	$18,000	NA	$0		< 100	0[i]
City Purchase of Locally-Produced Compost[f]	0	$18,000	NA	$18,000-$23,000	NA	$0		NA	0
BCRC Improvements[f, g]	0	$158,000 (place-holder)	NA	NA	NA	NA		NA	22
Existing Policy Enforcement									
3 Volume Service to SFUs	200	$8,000	$5	$0	$0	$0		400	0
50% MFU Recycling	1,400					$0		4,300	4
Residential GBGP[h]	500 - 4,200	$0	$0	$93,000	$40	$0		4,700	1 to 8
Special Events[h]	0	$0	$0	$5,000	NA	$0		< 100	0
TOTAL	**31,900 - 53,400**	**$360,000**	**NA**	**$91,000 - $96,000**	**NA**	**NA**	**NA**	**50,200 to 74,200**	**91 to 137**

Rounding errors may occur (programs with less than 50 tons are represented as 0 tons).
[a] Appendix D includes waste generator/vendor costs (differ from City costs due to multiple variables) - all costs in 2012$.
[b] Appendix F includes estimating details for GHG reductions.
[c] Appendix G includes estimating details for job creation from collection and processing (differentiation is not made between public and private-sector jobs, but it is expected that most will be in the private sector).
[d] Savings from the elimination of existing commercial compost subsidy program based on 2012 costs of $78,500.
[e] Revenues from administrative fee and small number of un-refunded CDD deposits were estimated to be $200,000/year.
[f] Tons affected do not represent new diversion (City compost purchase = 1,600 to 2,000 tons, BCRC modifications = 48,000 tons).
[g] Potential costs could not be estimated without future City discussions - this value is a placeholder only.
[h] These analyses are duplicative of others summarized earlier in table.
[i] City has discussed the possibility of adding dedicated staff for this program.

Table 3.3: Summary of Non-Measurable Impacts from Individual Initiatives[a]

ZERO WASTE INITIATIVE	UPSTREAM CONSER-VATION	COM-MUNITY ENGAGE-MENT	ZERO WASTE FOUNDA-TION	EASE OF IMPLE-MENT-ATION	TIME-LINESS[b]	SERVICE PROVIDED ACCOUNT-ABILITY	NEW/ EXPANDED CITY PARTNERSHIPS
Every Other Week Trash	0	2	3	3	4	2	1
Multi-Family Composting	0	1	3	3	1-2	2	4
Take-Out Packaging	0	2	3	3	1-2	0	3
Homeowner Collection Service	0	2	3	3	3	2	1
Commercial Recycling	0	3	3	2	4	2	4
Commercial Organics Recovery	0	2	3	2	4	2	4
CDD Deposit Program	2	1	4	2	3	3	4
Special Events	0	1	3	4	1-2	1	4
City Purchase of Local Compost	0	1	3	4	1-2	0	2
BCRC Improvements	0	2	3	1	1-2	4	1
Existing Policy Enforcement	0	1	3	2	4	0	2

[a] Table 2.1 provides a description of criteria and ranking basis.
[b] See recommendations in Section 5.1 for suggested implementation schedule.

Additional observations from the evaluation of individual initiatives include:

1. Customer (Waste Generator) costs are tied to the level of existing services:
   - Initiatives for altering or enforcing existing services (i.e., every-other-week collection, multi-family composting and existing policy enforcement) are expected to increase customer costs only minimally, making these easier to put in place (at least from a cost perspective).
   - Initiatives for adding new services are estimated to result in greater cost increases - some of which would ultimately be offset by avoided tip fees from self-hauled materials (homeowner collection service), reduced trash collection costs (commercial diversion) or by tax refunds (CDD deposit).[13]
2. Ability to create revenue to offset other program costs:
   - Most of the initiatives would incur expenses but generate no revenues.
   - The exception is the deposit CDD program, which is estimated to generate as much as $200,000 per year from administrative fees and un-refunded deposits (may decrease as the program matures) - this revenue would help to offset the costs of other initiatives

[13] Tax refunds will apply primarily to deconstruction projects. New construction projects are expected to incur higher net costs - it is noted, however, that residences have been subject to similar regulation since 2007.

(it would, however, be subject to many variables that will likely change from year to year).

- The ability to eliminate the current commercial programs (i.e., recycle coupons, zero waste start-up rebate and compost subsidy) when the commercial mandates are phased in will improve the potential for a revenue-generating system.

3. CDD processing infrastructure - Most of the initiatives described in Table 3.1 are policies that were analyzed assuming that the County, private and non-profit sectors would provide the infrastructure for collection and processing (most of which is currently in place). The exception in the future may be CDD processing. While clean wood is managed at WDS's drop-site and WDS also provides mixed CDD sorting, the CDD Deposit Program may generate enough tons to require additional processing space and storage capacity.[14]
4. City staffing requirements - These are estimated in Table 3.4 for both the initial development and ongoing operations (Appendix D includes detailed modeling results). It is noted that some programs have City costs other than staffing and other programs have revenue potential that would more than offset staffing expenses.

Table 3.4: City Staffing Estimates[a] (rounded to nearest $1,000)

ZERO WASTE INITIATIVE	INITIAL COSTS (YEAR ONE)		LONGER TERM COSTS	
	FULL-TIME EQUIVALENTS	SALARY COST ($/year)	FULL-TIME EQUIVALENTS	SALARY COST ($/year)
Every Other Week Trash	0.17	$16,000	0	$0
Multi-Family Composting	0.12	$12,000	0	$0
Take-Out Packaging	0.14	$13,000	0.02	$2,000
Homeowner Collection Service	0.21	$24,000	0.05	$3,000
Commercial Recycling	0.29	$30,000	0.17	$10,000
Commercial Organics Recovery	0.29	$30,000	0.09	$5,000
Deposit CDD Program	0.37	$37,000	1.76	$137,000
Special Events	0.18	$14,000	0.16	$12,000
City Purchase of Local Compost	0.16	$18,000	0	$0
BCRC Improvements	0.05	$6,000	0	$0
Existing Regulation Enforcement	0.08	$8,000	1.25	$97,000

[a] All costs in 2012$.

5. Value cannot be completely defined by Tons diverted -as the City's over-arching goal from this study is to achieve a zero waste system, initiatives that can divert high tons have the most direct, most obvious value. However, the evaluation of measurable benefits (though challenging to conduct) can provide both the City and its partners with helpful input for future program and policy implementation:
   - Voluntary initiatives (multi-family composting and recyclable/compostable take-out packaging) - divert minimal tons but would build a foundation for future mandates.

[14] The Boulder County Construction & Demolition Infrastructure Study, Materials Generation Estimate & Market Analysis report (UHG, 2012) identified the need for a 7-12 acre site to aggregate and transfer CDD generated countywide.

- Special events diversion - diverts negligible waste but builds awareness, educates the community and demonstrates the City's commitment to zero waste.
- City purchase of locally-produced compost - would help drive the local compost market, improving the economics of private operations and (ideally) decreasing future tip fees by reducing operator risk associated with a stable end-market (current trip fees at WDS's facility are about three times as high as local landfill rates).
- Improvements to increase BCRC's processing capacity - would support other initiatives, allow the diversion of more materials and increase efficiencies such that hauler rebates may increase over time, which in turn would increase the City's diversion rate and (ideally) reduce customer costs (these benefits will help offset the initial investment likely required by the City).
- Ability to better leverage the resources of the City and its existing partners - several of the initiatives (multi-family composting, commercial diversion, CDD program and special events diversion) have the opportunity to add new partner organizations to the City's overall waste management efforts (public and non-profit groups are identified in Table 4.4), which may ease implementation, expand community engagement and improve overall success rates.

3.2.3 Evaluation of Bundled Initiatives

The intent of this evaluation is to evaluate the ability to achieve specific goals identified by the City. Each bundle includes multiple initiatives analyzed individually in Section 3.2.2. Unlike the individual analyses, the bundled scenarios analysis:

- Evaluates maturation over the City's 15-year zero waste planning period with a mid-point in 2020 and end-point in 2027.
- Considers coordinated development and phased-in implementation of all initiatives.

Table 3.5 provides a results summary for each bundle. Appendix E includes the supporting modeling results. A discussion of the pros and cons for each bundle follows the table.

Table 3.5: Summary of Bundled Initiative Evaluation

ZERO WASTE SCENARIO	DIVERSION (nearest 100 tons)			CITY COSTS (REVENUES)[a] (rounded to nearest $1000)			CUST-OMER COSTS[a]	GHGS (nearest 100 $mtCO_2e$)	
				Devel-opment	Ongoing ($/year)		($/month)		
	2020	2027	% Diversion		2020	2027	2027	2020	2027
BUNDLE #1 - GREATEST DIVERSION/GREATEST GHG EMISSION REDUCTIONS									
Every-Other-Week Trash Collection	13,400-28,800	25,300-50,000	79.0%	$105,000	($45,000)	($74,000)	$2 to $3	13,600-37,800	31,700-71,100
Homeowner Collection Service (new service)							$11 to $25		
Commercial Recycling							$15 to $30		
Commercial Organics Recovery							$30 to $50		
CDD Deposit Program							$13,800[b] per project		
BUNDLE #2 - LOWEST CITY COSTS									
Every-Other-Week Trash Collection	4,000-5,900	9,800-14,300	51.9%	$92,000	($59,000)	($72,000)	$2 to $3	4,400-6,200	10,600-15,100
Homeowner Collection Service							$11 to $25		
MFU Composting							$3 to $4		
Take-Out Packaging							$2 to $6		
CDD Deposit Program							$13,800[b] per project		
BUNDLE #3 - LOWEST CUSTOMER COSTS									
Every-Other-Week Trash Collection	10,900-26,100	19,300-43,100	73.8%	$80,000	$7,000	$2,000	$2 to $3	10,800-34,800	24,700-63,300
MFU Composting							$3 to $4		
Take-Out Packaging							$2 to $6		
Commercial Recycling							$15 to $30		
Commercial Organics Recovery							$30 to $50		

[a] All costs in 2012$.
[b] Represents average construction project deposit.

Bundle #1 – Greatest Diversion/Greatest GHG Emission Reductions

This bundle includes the five initiatives included in Table 3.5 and Figure 3.1. Figure 3.1 shows the estimated diversion potential of Bundle #1, and Figure 3.2 depicts the estimated reduction in GHG.

Figure 3.1: Bundle #1 Diversion Potential (projected 2027 tons)

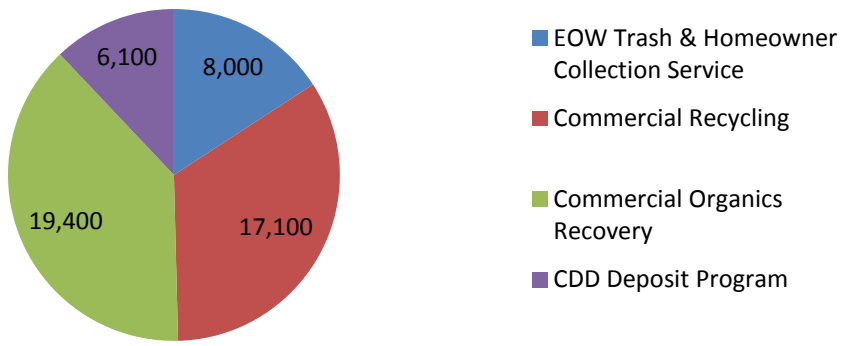
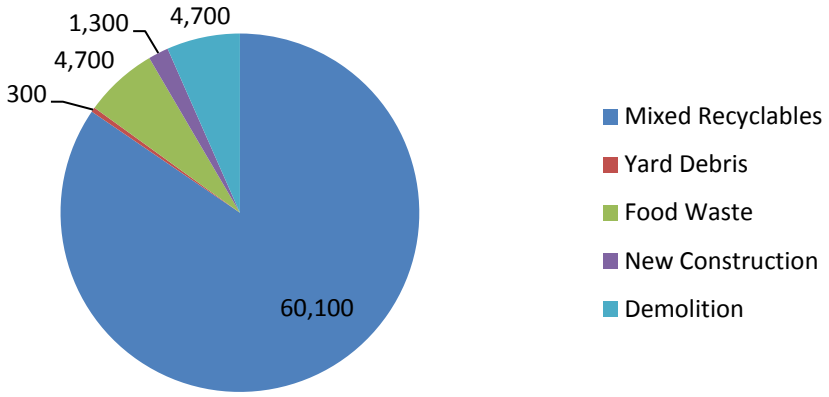


Figure 3.2: Bundle #1 GHG Emission Reductions (mtCO2e, 2027)



The pros and cons of Bundle #1 are as follows:

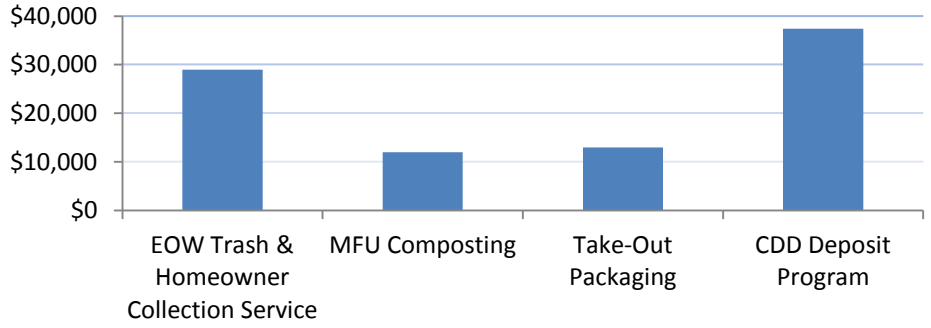
- PRO - Up to 50,000 new tons would be diverted by 2027 (these initiatives represent nearly 94 percent of the total tonnage potentially diverted by all 11 initiatives evaluated individually).
- PRO - High increase to City's overall solid waste diversion rate (up to 79 percent by the end of the planning period).
- PRO - High GHG emission reductions equivalent to the carbon dioxide emissions from nearly 15,000 vehicles (2027).

- PRO - Ability to cover costs and generate revenue (the CDD deposit program's potential revenues are expected to offset other program costs - based on the assumption that 2.5 percent of deposits will not be refunded due to lack of compliance).
- CON - Implementation requires comprehensive new policy for five mandatory programs; high participation by waste generators, haulers and City departments; and effective enforcement.
    - Impacts on single-family/small multi-family residents - only 62 percent of single-family, duplex and triplex residents currently subscribe for trash/recycling service (also organics service for homes with individual containers).[15]
    - Impacts on large multi-family residents - Over 1,000 multi-family accounts with more than three units currently have trash/recycling service (it is unknown how many actual residences this represents).[15]
    - Impacts on commercial generators (previously noted in Section 2.3) - just over 40 percent of existing businesses currently subscribe to trash collection (only 21 and 4 percent, respectively, subscribe to recyclables and organics collection).[15]
- CON - Current compost tip fees minimize the financial benefit of every-other-week trash collection program (WDS's tip fees are approximately three times local landfill rates).
- CON - Higher customer costs from the CDD deposit program (which increases project costs by an average $13,800 for new construction).

Bundle #2 – Lowest City Costs

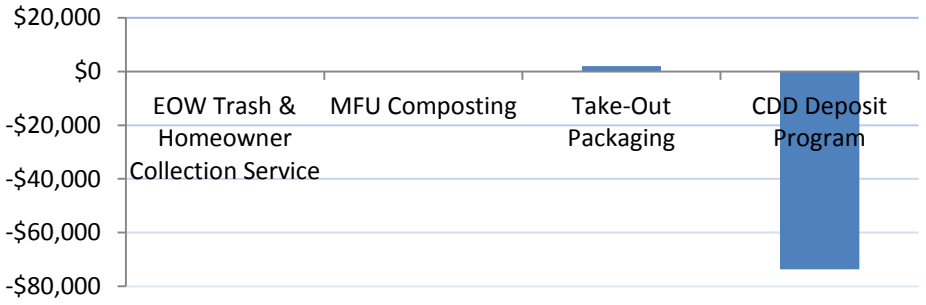
This bundle includes the five initiatives listed in Table 3.5 and Figure 3.3. Figures 3.3 and 3.4 estimate the City's initial development costs and annual costs, respectively.

Figure 3.3: Bundle #2 City Costs/Initial Development (2012$)



[15] Based on the City's 2011/2012 Annual Waste Hauler Inventories - these values assume that the universe of commercial trash accounts is the same as total subscribers (when some businesses may have recycling collection but not trash) and that haulers consistently define multi-family and commercial accounts (which is known to be faulty but better data does not exist at this time). Note that it is expected that new City policy affecting these waste generators would include waivers to address residents and businesses with defensible hardship conditions related to collection.

Figure 3.4: Bundle #2 City Costs/Annual Costs (2012$, projected 2027 tons)



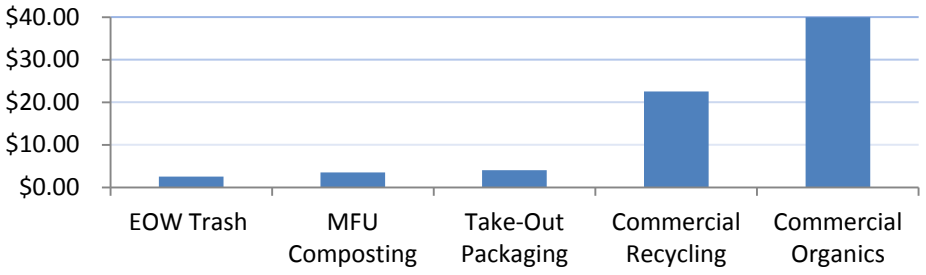
The pros and cons of Bundle #2 are as follows:

- PRO - Ability to cover costs and generate revenue (the CDD deposit program's potential revenues are expected to offset other program costs - based on the assumption that 2.5 percent of deposits will not be refunded due to lack of compliance).
- PRO - GHG emission reductions are estimated to be equivalent to the emissions of more than 3,000 vehicles (2027).
- CON - Implementation requirements, including comprehensive new policy for three mandatory and two voluntary programs; high participation by waste generators, haulers and City departments; and effective enforcement (see the impacts on waste generators listed for Bundle #1 above).
- CON - Low diversion (only 14,300 new tons by 2027).
- CON - Low increase to City's overall solid waste diversion rate (to only 51.9 percent through the planning period).
- CON - Current compost tip fees minimize the financial benefit of every-other-week trash collection program (WDS's tip fees are approximately three times local landfill rates).

Bundle #3 – Lowest Customer/Waste Generator Costs

This bundle includes the five initiatives shown in Table 3.5 and Figure 3.5, which estimates the potential impact to customer costs.

Figure 3.5: Bundle #3 Customer Costs (2012$/month, projected 2027 tons)



The pros and cons of Bundle #3 are as follows:

- PRO - Moderately high tonnage diversion (up to 43,100 new tons by 2027).
- PRO - High increase to City's overall solid waste diversion rate (up to 73.8 percent through the planning period).
- PRO - High GHG emission reductions equivalent to the emissions of over 13,000 vehicles (2027).
- PRO - Low City development costs of only $80,200 (see Appendix E).
- PRO - Low customer costs (this bundle does not include the CDD Deposit program).
- CON - Implementation requirements include comprehensive new policy for three mandatory and two voluntary programs; high participation by waste generators, haulers and City departments; and effective enforcement (see the impacts on waste generators listed for Bundle #1 above).
- CON - Current compost tip fees minimize the financial benefit of every-other-week trash collection program (WDS's tip fees are approximately three times local landfill rates).
- CON - Lack of City revenues generated by the CDD deposit program to offset other programs.

3.3 Future Zero Waste Initiatives Recommendations

These recommendations are few in number as it will be up to the City to verify whether the bundled scenarios capture those future initiatives that truly reflect the City's overall zero waste goals. While every effort was made to identify study objectives prior to the research and analytical steps, review of project results may cause the City to revise its objectives slightly (especially when multiple options are considered in the aggregate).

While Section 5 presents overall recommendations for Boulder's future zero waste programming, there are several important considerations relative to future initiatives:

1. Improve Analytical Assumptions - In the course of the study analyses, unknown outcomes, data gaps and conflicting information were managed with either metrics and published information from other programs or assumptions based on professional experience (especially for estimating participation and diversion levels). To provide the most useful and accurate results, these metrics and assumptions should be verified with actual data. For example, the City should work with local haulers to improve the quality and consistency of reported account and tonnage numbers for 2013 and subsequent years.[16] This data should be used to update the analytical results in Appendices D and E.
2. Identify the Best Bundling of Initiatives to Achieve the City's Goals - This is expected to include a review of study findings with the community, City Council, the City's Environmental Advisory Board and the ZWTF. Although different combinations of future

[16] Of particular note are the categorization of multi-family and commercial accounts (often applied differently between haulers and even within the same hauling company) and the reporting of bundled trash/recycling/organic accounts versus accounts for a single material collection.

initiatives may ultimately be selected for implementation, Bundle #1 appears to include the best potential for meeting the City's measurable goals (described in Section 3.2.3). The non-measurable impacts for the individual Bundle #1 initiatives (listed in Table 3.3) do not present a clear direction for City reviewers, however. This bundle will likely:

- Provide strong partnership opportunities but only moderate community engagement and service provider accountability potential.
- Present implementation challenges for the new commercial programs and expanded CDD programs (the commercial mandates essentially represent the first regulation of solid waste in this sector, and the CDD program represents significant new requirements and costs for new construction).

3. Consider Impacts to Annual Trash Tax Revenues - Bundles #1 and #2 include initiatives that will increase revenues by increasing the number of homeowners affected by BRC Chapter 3-10 (at $3.50/month). All three bundles will also decrease revenues by reducing the commercial tons landfilled (by increasing the diversion of commercial and/or construction waste) at $0.85/cubic yard. While several variables impact the outcome,[17] the increased revenue from the homeowner service collection initiative is expected to trump any commercial loss, and is quantified in Table 5.1.

[17] Variables include the timing of initiatives implementation, actual diversion success, the likelihood of the cost of Trash Tax programs not evaluated in this study staying constant, and enforcement (City costs for enforcement are included in Bundle #1 and Bundle #2 results).

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Section 4
Additional Alternatives

The purpose of this section is to evaluate what additional program, policy or infrastructure alternatives the City might utilize to reach its zero waste goals over the next 15 years. While the initiatives evaluated in Section 3 include the means for largely achieving these goals, they fall short in areas (i.e., Bundle #1 was estimated to have a potential diversion of 79 percent instead of 90 percent as well as potential challenges implementing some initiatives). Three alternatives based on best management practices observed in other communities have been considered for improving the City's ability to achieve zero waste success:

- Contract changes or relationships aimed at improving service consistency, data collection and contractor accountability.
- Financial incentives to encourage haulers to work with the City and their customers to increase diversion.
- Public education and outreach including best management practices from other zero waste cities.

4.1 Contractual Relationships

The City currently has an open-market system for residential solid waste collection service, but establishes required service levels through local ordinance. On multiple occasions, the City has considered the pros and cons of contracting for solid waste collection, commonly referred to as a single-hauler system.[18,19] These discussions all resulted in a decision to maintain the existing open-market system.

4.1.1 General Residential Recyclables Collection Needs

Regardless of whether the City retains its open-market system or implements a single-hauler system, the following residential diversion improvements are needed:

- Universal Collection (or Curbside Recycling for All Residents) – Approximately one-third of homeowners do not subscribe to curbside trash/recycling collection service. Although these homeowners have access to the County drop-off center, the convenience of curbside service has been demonstrated to increase recycling rates. It is expected that this would be accomplished by ordinance. This option was evaluated in Section 3.2.2 (see the Homeowner Collection Service initiative).

[18] Previous studies use the term single-hauler system; however, the City could contract with more than one hauler, each having its owned defined service area.

[19] Colorado state law prohibits local governments from requiring multiple family homes with more than seven units or establishments to use or pay for municipal waste services or from setting commercial service fees.

- Greater Accountability in Hauler Data – To increase accuracy and completeness, the City should have greater control over the data that is provided and require clear documentation to support the data. The City could potentially accomplish this through local ordinance; however, meaningful consequences (e.g., loss of the right to provide collection services in the City) for not complying with the ordinance would need to be established and enforced. A more common approach is to establish these requirements and consequences as part of a license or contract.
- Recycling Revenue – The City could supplement its Trash Tax earnings by sharing in the revenue generated from the sale of residential recyclables collected within its boundaries (approximately $159,000 was paid to haulers by BCRC for the City's 10,600 tons of single-family and multi-family recyclables collected curbside in 2011[20]). Louisville and Lafayette, both of which have single-hauler systems, receive revenue from residential diversion. The City could accomplish this revenue sharing by continuing to direct haulers to deliver residential recyclables to the BCRC and incorporating a revenue share for these materials into an agreement with Boulder County. Because of the fluctuating nature of commodity markets, haulers typically do not rely on recycling revenue when setting their collection fees; therefore, this change should not have significant impact to the haulers' collection fees.

For Boulder to make these improvements and achieve its zero waste goal and objectives, significant policy changes will be required. Depending on the success of these changes and level of hauler support, a single-hauler system (described below) may be a necessary alternative.

4.1.2 Single-Hauler Versus Open-Market Collection Systems

Table 4.1 summarizes the potential impacts to the City of converting to a single-hauler system as compared to an open-market system. Given WDS's predominance in the local market, Boulder essentially has a single-hauler system at this time - but without the conditions and controls of a contractual relationship that would enable the City to more directly govern the level, quality and cost of service. Although some requirements could be incorporated into local ordinance, City staff has indicated that resources are not available to enforce existing ordinance components. Lack of enforcement hurts the City's credibility and represents missed opportunities associated with the benefits described in the following table.

Table 4.2 provides a comparison of WDS's residential services/rates in Boulder with those in Louisville and Lafayette, both of which have single-hauler contracts in place with WDS. Direct comparison of fees between municipalities is cautioned because fees are impacted by a variety of factors, including differences in service level, density of customers, and local market competition. If all other factors were equal, the expectation would be that a larger service area (in terms of number of accounts) would yield lower fees as the hauler's fixed costs could be spread over more accounts. Because the City of Boulder residents currently receive a higher level of service than the other two cities, they pay a higher rate. These service fees could potentially be reduced if the City competitively procured collection service, even if the current service level and ancillary services were retained.

[20] Based on an average BCRC payment of $15/ton last year - these revenues can vary dramatically (e.g., in May 2013, BCRC paid only $5 per ton for residential materials).

Table 4.1: Single-Hauler Versus Open-Market System

POTENTIAL IMPACT	SINGLE-HAULER SYSTEM	OPEN-MARKET SYSTEM
Level of Service, including Universal Curbside Collection	Formalize minimum and consistent level of services in binding contract with clear penalties for lack of compliance.	Sets minimum level of residential/MFU service through ordinance - but minimal enforcement. Haulers provide varied service.
Cost to Homeowners (two potential impacts)	Service fees may be reduced if service is competitively procured. Further reduction is possible with lower service levels.	Service fees set by haulers (not controlled by competition in Boulder due to one primary hauler).
Cost to City	Additional staff time required to procure and administer contract, verify compliance/data.	Minimal Trash Tax dollars are required to collect/report hauler data.
Material Recovery Rates	Ability for consistent service to all customers generally leads to higher material recovery.[a] Also potential to establish hauler incentives for increasing diversion.	May be improved through program changes and public education (although more mandatory approaches are needed). Hauler incentives typically not feasible.
Recycling Revenue	Revenue sharing can be included in collection contract or in a separate processing contract.	City earns no revenues (versus revising hauler ordinance and/or contracting with BCRC).
Hauler Reporting and Accuracy of Data	Contract typically includes reporting requirements, penalties for noncompliance and ability to audit contractor's records.	Reporting and auditing is currently required, but completeness and accuracy is not strictly enforced.
Ability to Direct Flow of Materials	Could direct flow of materials to incentivize infrastructure investment and reduce tip fees (especially for organics). Limits potential for legal challenge from non-contracted haulers.	City directs recyclables to BCRC by ordinance. Though not likely in the near future, there could be risk of legal challenge in the future if WDS loses its majority service share.
Truck Traffic and Associated Fuel Consumption/GHG Emissions	Would further reduce truck traffic, fuel consumption and GHG emissions (minimal improvement expected).	Western services about 95% of residential/MFU accounts; therefore, reduction in truck traffic and GHG emissions might not be significant.
Quality of Service	Could set clear service standards with liquidated damages for noncompliance.	City sets standards through ordinance, but has limited enforcement capability.
Residents'/MFU's Ability to Select Hauler	Competitive procurement would select one (or more) hauler(s). If WDS not selected, 95% of accounts would be serviced by a new hauler.	Residents/MFUs can currently select hauler for curbside collection (WDS serves 95%) or self-haul.
Potential for Haulers to Gain or Lose Market Share	Limited number of haulers will retain/gain share (rest will lose) via procurement process.	This is currently determined by market competition and individual residents' choice.
Consistent Messaging & Branding	City/hauler can work on outreach materials/ brand (especially long-term contracts).	Haulers have independent, separate means for customer communications and outreach.
Potential Impacts on Other Waste Management Operations	Ability to direct materials can encourage facility investment, increased capacity/ efficiency - or operations managed by existing haulers/subsidized by collection fees may be impacted (WDS's composting operation may be impacted if this hauler is not selected).	Currently the City guarantees no material flows outside the BCRC ordinance language for recyclables. Without this guarantee for organics, CDD, and other materials, private vendors will be reluctant to invest in new/expanded facility infrastructure.

[a] Despite the fact that WDS currently has about 95% of single-family and multi-family accounts in Boulder, the combined diversion rate from these sectors was only 48% - it is also probable that contractual requirements to increase diversion for single-family and small multi-family accounts would influence (increase) diversion by the same hauler for any large multi-family and commercial accounts serviced but no covered by the contract.

Table 4.2: Western Disposal Service and Rate Comparison

	BOULDER (Trash/Recycling/Organics bundled)	LOUISVILLE (Trash/Recycling bundled, Organics extra)	LAFAYETTE (Trash/Recycling bundled, no Organics)
SERVICE AREA	Approx. 19,000 SFUs & 1,000 MFUs	5,100 SFUs (excludes HOAs that are not SFUs)	5,421 SFUs (excludes 5,000 HOA homes)
HAULER SCENARIO	Open system with regulation for SFUs & MFUs	5-year contract with WDS	5-year contract w/ 2-year extension with WDS
SINGLE-FAMILY LEVEL OF SERVICE	Trash - 1x/week Recycling - EOW (SS to BCRC) Organics - EOW Bulky - generally a charge	Trash - 1x/week Recycling - EOW (SS to BCRC) Organics - EOW (extra charge) Bulky - 2 free collections/year	Trash - 1x/week Recycling - EOW (SS to BCRC) Organics - not available Bulky - 1 item free/quarter
CARTS	Not required, but WDS provides automated trash, recycling & organics carts	WDS provides automated trash, recycling & organics carts	WDS provides automated trash carts; City provides recycling carts
2013 PRICING (MONTHLY FOR COLLECTION and DISPOSAL/PROCESSING)	Prices exclude Trash Tax (60% of units have 32-gal service or smaller)	Rates effective 8/1/13 - exclude city administrative fee (39% of units have 32-gal service)	Rates effective 7/1/13 - exclude city fees (18% of units have 32-gal service)
	32-gal trash = $23.40 (includes recycling, organics)	32-gal trash = $8.58; 32-gal organics = $2.97	32-gal trash =$6.85
	64-gal trash = $35.60 (includes recycling, organics)	64-gal trash = $15.42; 64-gal organics = $5.94	64-gal trash = $13.70
	96-gal trash = $47.80 (includes recycling, organics)	96-gal trash = $22.29; 96-gal organics =$8.90	96-gal trash = $20.54
	Overflow 32-gal trash = $3.30	Overflow 32-gal trash = $2.92	Overflow 32-gal trash = $3.17
	Overflow recycling/organics - no cost up to 1,212 gal/collection	Overflow 32-gal recycling/organics = $2.92	Overflow recycling - no cost
BILLING	Hauler bills; option of credit card, e-billing, automated clearing house	City utility bill (Enterprise Fund) includes $0.60/month for administration (~$3k)	City utility bills include $1/month for recycling carts & $0.15/mo for admin (< $1k)
CITY REVENUES	Trash Tax with SFU/MFU & commercial equivalents - earns $1.7M/year	100% recyclable revenues from BCRC	100% recyclable revenues from BCRC Cart revenues (carts paid off)
ADDITIONAL SERVICES			
Pre-paid bag option	Yes	No	No
EOW trash option	Yes	No	No
Seasonal service	Switch anytime at no cost	Switch anytime at no cost	Switch monthly at no charge
Senior discounts	10%	No	No
Extra trash stickers	Charged & mailed	Must be picked up in person at city offices	Must be picked up in person at city offices
Alley collection	At no cost	Fee if regular collections are at the curb	Fee if regular collections are at the curb
Christmas tree collection	Free on route	Free if in compost cart	NA (city has drop-site)
Reminders	Through email, telephone, newsletter, Smartphone app - also free diversion challenge	By subscription at $0.61/month	NA

4.1.3 Other Contractual Relationships Between City and Partners

The City partners with various entities to provide other collection and processing services for recyclables and organics, as well as education and public outreach. The City's role in the local solid waste management system relative to its partners, which is summarized in Table 4.3, is similar to that of many local governments.

Table 4.3: Diversion Program and City Contracts/Partnerships

ROLES and RESPONSIBILITIES	LOCAL GOVERNMENT	PRIVATE SECTOR PARTNERS	NON-PROFIT PARTNERS
Ensure Goals/Objectives Are Met (i.e., basic solid waste services, waste diversion minimums, etc.)	X		
Set Standards and Establish Policy (including enforcement)	X		
Establish System for Public, Private and Non-Profit Service Providers (can be structured or incidental)	X		
Administer Service Contracts (not all services provided by others are covered by contract)	X	May have subcontracts for service provision	May have subcontracts for service provision
General Service Provision	X Often must offer services (typically low-profit or hard to implement services) not provided by others - examples include education/outreach and reward/ recognition/rebate programs	X Must comply with local/state/national policy but need to generate profit (therefore services may vary with economy)	X Must comply with local/state/national policy (typically do not fluctuate as much as private sector with economy)

While this division of responsibilities is typical, the leadership provided by local government and the number of services provided by private and non-profit partners governed by contract (versus by ordinance or, in many cases, no policy at all) varies widely. The City utilizes a mix of relatively strong policy, service contracts and incentive programs to drive waste diversion in all sectors. Table 4.4 describes the City's existing contracts and partnerships.

Table 4.4: City's Existing Contracts and Partnerships

PROGRAMS	CITY SERVICE CONTRACT?	CONTRACTOR OR ENTITY RESPONSIBLE for SERVICE
RECYCLING		
City Organization Collection	Yes	WDS
CHaRM	Yes	Eco-Cycle
Residential:		
Single-Family Curbside	No	Haulers; BCRC
Multi-Family Curbside	No	Haulers; BCRC
Community:		
BCRC Drop-off Center	No	County
Commercial Curbside	No	Various Haulers
University of Colorado Recycling	No	University of Colorado
Transfer Station Recovery	No	WDS
HMMF Diversion	Yes	County
CDD Recycling	No	Various Haulers
ReSource Yard Diversion	Yes (lease)	CRC
ORGANICS RECOVERY		
City Organization Collection	Yes	WDS
Storm Debris Cleanup	Yes	WDS, others as needed
Single-Family Curbside	No	Various Haulers
Multi-Family Curbside	No	Various Haulers
Commercial Curbside	No	Various Haulers
University of Colorado Compost	No	
Yard Waste Drop-off	Yes	WDS
Wood Waste Drop-off	Yes	WDS

While the City's waste diversion policy is fairly aggressive, both its enforcement capabilities for existing ordinances and its contractual relationships could be improved to better support a zero waste system (enforcement has been addressed elsewhere in this report). Formalizing its strategic partnerships through new or enhanced contractual relationships would provide stability to programs, enhance the accountability of service providers in terms of contract compliance and data reporting, and work to continually increase diversion.

The following paragraphs provide a brief summary of contractual relationships the City should consider. Based on the current flow of tons, the areas of greatest waste diversion opportunities relate to commercial recyclables and organics. Therefore, contractual relationships that provide stable, long-term partnerships with the owners and/or operators of facilities that process these materials should be of high priority for consideration.

Recyclables Processing and Marketing - City ordinance requires haulers to deliver single-family and multi-family recyclables to the BCRC; however, since expiration of the Intergovernmental Agreement that governed the Boulder County Recycling and Composting Authority, no contractual relationship exists between the City and County relating to this facility. These recyclables (10,600

tons in 2011) represent 40 percent of the MSW recyclables diverted from disposal - an additional 21,000 tons of residential and commercial recyclables are still being disposed that could potentially be captured for recovery (see Figure 1.1). This contractual relationship is important as the City considers implementing other initiatives outlined in this study that will increase recovery of residential and commercial recyclables.

Although the City could potentially require haulers to share recycling revenue through ordinance, another approach would be to limit hauler services to collection only and contract directly with the County for processing the collected recyclables.[21] An agreement between the City and County could provide the City with the following benefits:

- Revenue to the City for Residential Recyclables - Based on an industry-accepted market index, over the past year, materials typically found in single-stream recyclables have a combined market value in the range of $100-$140 per ton.[22] Processing these materials into marketable commodities costs approximately $60 per ton, leaving about $40 to $80 in profit to be shared between the various stakeholders, which should include the City.
- Assured Capacity to Process Recyclables Collected Within the City.
- Greater Input by the City Regarding Materials Accepted at BCRC, Processing Efficiencies and Expansions - An initiative discussed in Section 3.2.2 (see the BCRC Improvement initiative) addressed improvements currently needed at the BCRC with an estimated cost of about $3 million. If the City contributes toward funding these improvements, the City should have a contractual relationship with the County to protect this investment.[23]

Organics Processing and Marketing - The City contracts with WDS to accept yard and wood waste from homeowners, commercial businesses and the City organization at its Boulder location for processing. Efficiencies can be realized by having a single composting operation for this material - currently, WDS has the only large-scale composting operation in the immediate vicinity. While the City requires that WDS accept residential and multi-family organics from other haulers, WDS is free to set the tip fee for this material. These fees could conceivably put other haulers at a disadvantage when competing to provide collection services.

Although 22,400 tons of organics were diverted in 2011, an additional 20,600 tons of residential and commercial organics were landfilled (see Figure 1.1). Achieving zero waste will not be possible without increasing diversion of organics from disposal. Therefore, ensuring a viable facility is available to process these materials is critical for other program components to be effective. A contract for composting organics would provide the City with the following benefits:

- Enable the City to Offer a Facility with Established Fees for All Haulers - This would ensure that all haulers have a place to deliver organics for a reasonable fee. If the City establishes a single-hauler system, the City could utilize contractual flow control to require the

[21] Because of the fluctuating nature of commodity markets, haulers typically do not rely on recycling revenue when setting their collection fees; therefore, this change should not have significant impact to the haulers' collection fees.
[22] Based on commodity prices for the South Central/Midwest/Central, Southwest and Pacific Northwest U.S. as reported on RecyclingMarkets.net and the typical composition of a ton of residential single-stream recyclables.
[23] The cost of this investment is unknown at this time - a place-holder of $158,000 (5 percent of the total estimated cost) was used in Table 3.2 as a discussion starting point. As the City's recyclables constitute a notably larger percent of the total materials processed by BCRC, however, this value may need to be increased during contract negotiation.

contracted hauler to deliver organics to this facility.[24] Ensuring this flow of materials to the facility would provide the processor with an assured flow of tonnage that might be needed to invest in expansion or upgrades, and also should enable the City to establish a fee structure that competes favorably with other regional compost and landfill facilities.

- Enable the City to Designate a Drop-site for All Organics - Instead of just yard and wood waste (i.e., amend the current contract with WDS or Eco-Cycle for CHaRM operations).
- Enable the City to Specify the Quality of Mulch and Finished Compost.
- Enable the City to Purchase Finished Compost at Discounted Rate - This would be similar to the current drop-site contract, and could go hand-in-hand with establishing a purchasing policy requirement for City departments to use locally made mulch/compost (see City Compost Use analysis). Through this contract, the City could also continue to provide free mulch to residents.
- Potentially Reduce the Use of Organics Drop-Site and Associated City Expense - As collection of homeowner and commercial organics by the haulers increases, the amount of materials received at the drop-sites should decrease.[25]
- Enable the City to Require Accurate Data Reporting - This will be necessary in ongoing efforts to strive for zero waste.

CDD Materials Processing and Reuse - The City leases a facility at 6400 Arapahoe Road to the Center for ReSource Conservation (CRC). CRC's ReSource operation diverts about 700 tons of used building materials and durable goods annually through reuse and resale. This represents about 12 percent of the total CDD diverted in 2011. The City also contracts with CRC to support a customer service coordinator at ReSource. While the City currently relies on ReSource less than it has in the past to provide deconstruction services on behalf of the City, this organization was instrumental in implementing the Green Building Green Points (GBGP) program, including contractor education, residential deconstruction services, and data collection.

Future contractual relationships related to CDD diversion might include the following:

- City-Subsidy of WDS's Existing Mixed CDD Processing Operations - WDS provides this sorting at its transfer station, which may be expanded in the future. If the City decides to provide a subsidy for CDD processing to WDS or any other partner, it should do so through a contract that includes setting targets or required material recovery rates, setting gate rates for other haulers that deliver mixed CDD to the facility and requiring a detailed accounting of expenditures and revenues.
- Provide Additional Space for CDD Management - If the CDD Deposit Program initiative evaluated in Section 3 is successful, additional processing capability/space may be required. The City may consider working with Boulder County and other regional partners to implement a transfer station for source-separated CDD materials (one version of which was

[24] Despite the fact that WDS currently has about 95% of all single-family and multi-family accounts in Boulder, the combined diversion rate from these sectors was only 48%.
[25] Use of the drop-sites by homeowners is currently very high, even though most residents have curbside organics collection. Western currently is conducting a survey to better understand this issue.

evaluated in the County's 2012 study). A CDD partnership could cover facility property, capital development and/or operating costs.[26]

- Expand CRC's Contract for Assistance with the Existing/Expanded GBGP Program - CRC staff could conduct contractor education regarding any changes made to the GBGP program (e.g., see the CDD Deposit Program analysis), conduct audits, review permits/approvals, assist with enforcement, prepare reports, perform data tracking, and otherwise assist City LEAD and Planning and Development Services (PDS) staff with the program.

Hard to Recycle Materials Processing and Marketing - The City currently contracts with Eco-Cycle to operate CHaRM. In 2011, the City paid a fee of approximately $100,000 to CHaRM, which equated to about $135 per ton of material recovered (see Table 2.2). The City should further evaluate the cost-effectiveness of this contract, including:

- Require a more detailed accounting of how City funds are expended.
- Ensure the City's ability to audit CHaRM's records.
- Require a more detailed breakdown of the types of materials recovered and evaluate other options for managing these materials.

4.2 Hauler Financial Incentives

Although an evaluation of potential hauler incentives was conducted for this study (see Appendix H), it was ultimately concluded that the ability to create meaningful financial incentives for haulers to increase waste diversion within the City's existing open-market system will be difficult because of the haulers' ability to simply pass any financial consequences on to their customers. Where open-market systems have a high level of competition between vendors, passing this financial burden on to its customers can affect the ability of a hauler to compete - however, this is not likely to occur in Boulder when WDS services more than 95 percent of residential customer accounts.

Given the limitations of establishing an effective financial incentive within the City's current open-market system, future zero waste efforts should prioritize greater collaboration with local partners (especially WDS) for meeting the City's goal and objectives.

4.3 Zero Waste Education Programs

Costs for outreach and education can vary widely depending on population densities, whether new programs are being implemented or major changes introduced. SWANA and Curbside Value Partnerships used an expenditure of $1 per household for existing recycling programming, but recommended a budget as high as $4 per household-year on residential education and outreach

[26] The Boulder County Construction & Demolition Infrastructure Study, Materials Generation Estimate & Market Analysis report (UHG, 2012) identified the need for a 7-12 acre site, $7M to $15M capital costs and $300,000 to $550,000 annual operating costs.

when new programs or major changes are implemented.[27] Based on these targets, it appears that Boulder:

- Has adequate funding for its current residential programs (the City spent $45,000 in 2012 - or just over $1/household).[28]
- May need to increase expenditures to between $87,000 and $131,000 in the short-term as the initiatives are implemented (shrinking back to current levels as the programs mature).[29]
- Allocate some of the short-term increase to jointly develop, with its partners, a strong brand and consistent recycling messaging.[30]
- Needs to continue to focus separate (additional) dollars and programs on education and outreach for the commercial and construction sectors.

4.3.1 Best Practice Examples

Two examples of effective waste diversion outreach programs are summarized below.

1. Halifax Regional Municipality, Nova Scotia[31] - www.halifax.ca/wrms:
    - Region includes Halifax, Halifax County and two other municipalities (about 160,000 households).
    - Achieved 59 percent diversion across all sectors - based on every-other-week trash collection.
    - Mandatory separation by all generators of recyclables and organics and mandatory CDD diversion.
    - Annual $500,000 education and promotion budget (for all sectors); included staff dedicated to this program.
    - Successfully used a consensus-based multi-stakeholder group to develop a new waste management strategy in the late 1990s (and continues its implementation today).
    - Unlike Boulder, the Halifax Regional Municipality supports comprehensive waste disposal bans and an average waste disposal rate of only 1.7 pounds/person-day (Boulder's disposal rate was about 4.3 pounds/person-day in 2011).

[27] Solid Waste Association of North America, "Manager of Recycling Systems Training Manual," (prepared by Kessler Consulting, 2009) - cites averages of $1 per household-year and recommendations of higher investments for new programming.
[28] Includes the residential/MFU programs listed in Table 2.1 (excluding CRC sponsorships, Pearl Street Mall diversion and zero waste event rebates).
[29] Based on assumed increase to $2-$3 per household.
[30] Currently, internet searches for "City of Boulder recycling" and "City of Boulder zero waste" yield numerous partner links but limited access to City sites - countywide program options appear diverse and unconnected (and access to LEAD's zero waste information is not obvious).
[31] HRM contact = Jim Bauld, Solid Waste Resources Manager, 902-490-6606, bauld@halifax.ca.

2. San Francisco, CA[32] - www.sfenvironment.org/zero-waste:
    - Achieved 80 percent diversion across all sectors - based in large part on the "Fantastic 3" three-bin, PAYT curbside collection system (have a single-hauler contract).
    - Current annual budget is $5M for education and outreach for all sectors (120,000 single-family and 470,000 multi-family units plus over 60,000 businesses).
    - Maintains a strong focus on MFU and business generators (approximately 80 percent of all businesses and all MFUs with less than 6 units divert recyclables and organics) based heavily on one-on-one consultations and social marketing, including onsite waste sorts, waste assessments, online compliance toolkit, performance audits, and regular reporting.
    - Utilizes a multi-lingual staff assigned by city sector with specific expertise (i.e., CDD, commercial accounts, government collection, etc.) and bolsters outreach efforts with "green job trainees" (many of whom represent underserved communities and provide strong advocacy in traditionally hard-to-reach areas of the city).
    - California has state-level diversion mandates; however, San Francisco's environmental ethic and drive for zero waste is similar to Boulder.

4.3.2 Other Resources

- Alameda County, CA has developed effective education materials and optimized use of printed and electronic media (see www.cityofalamedaca.org/Go-Green/Zero-Waste).
- Austin, TX's communications plan calls for a research-based approach to target specific audiences - allocated two FTEs and $3.5M/year.[33] http://austintexas.gov/department/austin-resource-recovery
- Castro Valley Sanitary District, CA has developed a strong brand used consistently in all communications and has an exemplary commercial assistance/audit/award program. www.cvsan.org/BizRecyclingandOrganics
- Champaign, IL (home of the University of Illinois at Urbana-Champaign) has an exceptional attention-grabbing brand and great marketing campaign and brand. See the "Feed the Thing Recycling Logo" from the City of Champaign below. http://ci.champaign.il.us/departments/public-works/residents/recycling
- Charlotte, NC used focus groups to target prominent community values and increased neighborhood diversion levels by 12 percent in a three-month period. http://portal.ncdenr.org/web/deao/outreach/recycling-education-campaigns
- Curbside Value Partnership provides example programs, best practices and numerous resources for outreach campaigns. www.recyclecurbside.org/index.cfm

[32] San Francisco contact = Donald Oliveira, San Francisco Department of the Environment, 415-606-8039, donald.oliveira@sfgov.org.
[33] Austin contact = Gena McKinley, Austin Resource Recovery, 512-974-1915, gena.mckinley@austintexas.org.

- Excellent resources on social marketing techniques (especially those by Canadian Doug McKenzie-Mohr, who has brought some of his classes to Boulder in the past on making measurable outreach changes and validating budgets).[34]

In addition to increasing future public education and outreach funding for new zero waste policy and programs, Boulder's future strategies might include a project with University of Colorado graduate students to:

- Conduct City-specific research on a clearer call to action than "Zero Waste" (which doesn't relate directly to the individual homeowner or business). Example messages instead might be, "Do you really want to buy things that have to go in the garbage?," "Over one ton of aluminum landed in the garbage today, was some of it from you?," or "Four out of five people remove all their recyclables - do you?"
- Develop branding options based on City-specific barriers and motivators that captures attention and engenders a desire to be part of the solution.
- Evaluate how to use regular data reports of lower trash/higher diversion tons to keep waste diversion practices "real" and "alive" for Boulder's citizens (this would require more consistent and comprehensive data collection than is currently in place).

[34] For example, "Social Marketing to Protect the Environment: What Works" by Mohr, et.al. (SAGE Publications, 2012) and "Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing," by Mohr and Smith (New Society Publishers, 1999).

Section 5
Recommendations

Based on the research, analysis and best management alternatives evaluated for Boulder's Zero Waste Evaluation Study, several program and policy recommendations have been formulated to support the City's continued efforts towards zero waste. Some of these recommendations will be challenging to put in place and implement at the aggressive levels needed to reach 85 to 90 percent diversion. While Boulder has made laudable progress to date with largely volunteer measures and an open-market collection system, future policy and program changes are expected to require more mandatory measures and changes in the status quo for customers, City partners and LEAD operations.

Section 5.1 identifies recommended strategies that will produce measurable results by the end of the planning period; however, not all recommendations can be quantified in terms of their ability to achieve the City's diversion goal, minimize costs, maximize GHG emission reductions or and maintain existing partnerships. Therefore, Section 5.2 addresses additional strategies that, while not fully measurable, are expected to assist the City in achieving its zero waste goals.

5.1 Measurable Implementation Strategies

The following recommendations can be measured in terms of one or more of the City's zero waste goals. The financial implications of these recommendations are described in Table 5.1.

1. Eliminate/Modify Existing Programs - Section 2.3 describes specific recommendations for changes to the City's zero waste programs. Specifically, they represent approximately $82,000 in annual savings and include elimination of the commercial recycling coupon, zero waste rebate and compost subsidy programs. It is expected that these incentives will not be necessary once mandatory commercial recycling and organics recovery policy is in place (phasing these programs out should be tied to the 2014-2016 period during which commercial service diversion mandates are put in place - see Bundle #1 implementation below).

2. Implement Bundle #1 Initiatives - Section 3.2.3 identifies Bundle #1 (greatest diversion/ greatest GHG reduction potential) as coming the closest to meeting the City's measurable zero waste goals of all the bundled scenarios (including a 79 percent diversion rate and reduction of 71,100 $mtCO_2e$ of GHGs by 2027). As noted in Table 3.5, these initiatives are expected to cost approximately $105,000 to develop. They were also estimated to have a payback period of less than three years and would yield net revenues following that period.

   These initiatives are presented in suggested order of implementation, according to a schedule that would allow all programs to be in place and by 2018 and fully mature over the rest of the planning period. This schedule acknowledges the time for City staff to conduct the necessary research; program testing; collaboration with haulers and other City departments; meetings with the public, Environmental Advisory Board (EAB) and Council; and promotion. Should the City delay implementation, its zero waste goal may not be achieved by the end of its 15-year planning period.

2014-2016

- Every-other-week trash collection limitation for all single-family accounts (simultaneously increase organics collection to weekly) - will require a revision to existing ordinance BRC Chapter 6-12 (WDS has already described plans for conducting a pilot study in early 2014 that can be modified to a permanent program if the pilot is successful).
- Commercial recycling service mandate - will require a new ordinance (ideally in tandem with new organics recovery policy) that should apply to all City businesses and build upon existing City incentives.[35]
- Organics service mandate for food establishments - will require a new ordinance (ideally in tandem with new recycling policy) that should apply to all food establishments in the City.[36]

2017-2018

- CDD refundable deposit program for new residential/commercial construction and demolition projects (residential projects are already targeted in Boulder's GBGP program) - will require revision to existing ordinance BRC Chapter 10-7.5 and additional research (possibly pilot testing) to:
  - Verify ability of new commercial projects to meet diversion requirements.
  - Verify deposit basis and cap.
  - Verify administrative fee.
  - Revise current project tracking methods to include appropriate metrics for this program.
- Mandatory homeowner curbside service (applicable to all single-family and owner-occupied multi-family properties, but expected to impact primarily single-family customers) - will require revision of existing ordinance BRC Chapter 6-3 with language similar to that in Chapter 6-3-3(b) and:
  - May be phased in by sections of the City.
  - Will include trash service bundled with recycling and organics collection in accordance with Chapter 6-12 as revised.

As noted previously, successful implementation of these initiatives into fully mature programs will be challenging and require comprehensive policy development; high participation by waste generators, haulers, and City departments; and effective enforcement. Other factors will be beyond the City's control (e.g., recessionary economy would likely reduce the number of CDD projects and therefore potential revenue the City may earn from un-refunded deposits).

3. Education and Outreach - Section 4.3 described the potential need to increase 2012 spending by $42,000 to $86,000 per year for the first few years of implementing Bundle #1 initiatives. These estimates are based on limited research, however, and expenditures will

[35] Ordinance should include exemption waiver for hardship conditions.
[36] Includes food manufacturers, supermarkets/groceries, health care/social service cafeterias, full and limited service restaurants and food service contractors.

vary depending on the City's ultimate implementation schedule and partner outreach efforts.

4. Existing Program Enforcement - The analysis described in Section 3.2.2 (see the Existing Policy Enforcement initiative) included an initiative dedicated to enforcement of existing programs that would cost $8,000 to develop (with high ongoing costs to cover the GBGP). Although this initiative was not selected for inclusion in any of the goal-driven bundled scenarios, its inclusion in future operations is important to safe-guarding the City's zero waste investments, maintaining its credibility in the industry, and building a platform for future programs.

5.2 Non-Measurable Implementation Strategies

The following recommendations are intended to improve the City's achievement of its zero waste goals, although metrics associated with their implementation cannot be reasonably measured.

1. Improve Data Collection - In order for the City's zero waste goals to be credible, the City needs access to good data on a regular basis to clearly track and review appropriate metrics for each waste generation sector. This includes:
   - Hauler data - including working with haulers to develop consistent procedures for tracking customers (e.g., differentiating between multi-family and commercial accounts, and single-family versus multi-material service accounts) and tons.
   - Metrics for programs run by the City - e.g., Pearl Street Mall collections and GBGP.
   - Customer demographics - e.g., those for food waste establishments.
   - Job creation from new and future programs.
2. More Clearly Define City versus Contractor Responsibilities - This should include improved contract relationships relative to the BCRC, WDS compost facility, future CDD processing and GBGP program, and Eco-Cycle's CHaRM facility.
3. Single-Hauler Collection System - This system option is not recommended initially, but should be undertaken immediately if and when the City is unable to obtain reasonably strong hauler support for development and implementation of each of the initiatives described above for Phase I of the planning period (2014 through 2018).
   - Active and visible hauler support (especially from WDS and its majority customer base) will be critical to the timely and successful implementation of Bundle #1's mandatory initiatives - in terms of providing expanded collection services and in overall political backing. Hauler support for Phase I should be defined early, and should include productive input on policy components followed by appropriate outreach to customers, as well as the Environmental Advisory Board and City Council. The outcome of City, hauler and community collaboration should be successful policy development and program start-up at each step that builds public support and moves the City towards its zero waste goals.
   - If the haulers cannot support these initiatives (or help the City develop alternative win-win options), a competitive procurement process to obtain a single-hauler contract

should be initiated. Table 4.1 identified key components the City should consider in developing its contract.

4. Utilize the 6400 Arapahoe Road Property - This space may not directly lead to the diversion of significant tons, but could provide an additional level of engagement with immeasurable ripple effect throughout the community. Given the small acreage available (about 2 acres), this property could be used for:

   - Centralized location for GBGP/CDD program implementation (especially if ReSource again plays a management role) including space for:
     - Small meetings during initial program expansion.
     - Providing face-to-face compliance assistance to contractors and homeowners.
     - Providing public access to hard copies of relevant policies, guidance documents and Boulder project examples.
     - Training activities for related job skills (such as deconstruction practices).
     - Records maintenance and storage (the current GBGP program was observed to suffer from incomplete recordkeeping).
   - Temporary storage and staging for diverted CDD materials management by the County, WDS, ReSource or other future partners - it is noted that this site is probably not large enough for a full-scale transfer operation (such as that evaluated by Boulder County in its 2012 study).
   - Expansion of Eco-Cycle operations - this may include a permanent, multi-function space for special interest and informal community group activities associated with education, reuse, repair, etc. including:
     - Periodic "repair cafes" or "fixit clinics" such as those currently held by Eco-Cycle and community to teach/assist the public in repair small appliances, electronics, tools or other.[37,38]
     - Class or meeting room for school groups, scout troops or other groups whose exposure to ReSource and Eco-Cycle operations would generally raise awareness about resource management.
   - "Soft" skills training program for individuals needing job-readiness training to find/keep employment and develop productive work habits (may include mentally/physically challenged persons, at-risk youth, offenders in transition from a corrections system or even new workers) - would likely involve a multi-step curriculum conducted by qualified trainers (providing a new partnership opportunity for the City) and targeting cognitive, social and emotional skill sets.[39]
   - Other small non-profit or social enterprise organizations whose mission and operations are consistent with ReSource and Eco-Cycle - these might include new City partners

[37] General information on the repair cafe concept can be found at http://repaircafr.org/.
[38] This activity has been considered by Eco-Cycle for their second phase of expansion at the 6400 Arapahoe site.
[39] ReNew Salvage is a non-profit organization that until recently offered a similar program (as well as a used building material facility, retail store and deconstruction program). Due to financial difficulties during the recent recession, ReNew and its website is currently in transition http://rewewsalvage.org/.

interested in collecting/managing materials not routinely collected in Boulder (such as mattresses and box springs).

5. Ongoing Zero Waste Program Implementation - This should include:
   - Annual assessment of overall system progress against needs for improvement - this should include quality reporting by all service providers early in the calendar year.
   - Review of annual commercial audits and overall enforcement records to identify need for additional outreach and/or compliance resources.
   - Review of actual expenditures against Trash Tax revenues - to determine the adequacy of current funding and any future need for additional revenue streams.
   - Audit of landfilled waste at least every-other-year - to verify additional diversion opportunities (ideally haulers and BCRC will provide ongoing reports of recyclables and organic stream quality so that outreach targeted at contamination can be bolstered if needed).
   - Verify basis of estimations in future assessments - a key example is the estimation of future waste generation rates, which was based on the City's projected population growth in this study (tying waste quantities to population may not be an accurate representation for Boulder over the full planning period).[40]
   - Program reevaluation at least every-other-year - to allow adjustments to implementation schedules, ordinance language and goals, as appropriate.

5.3 Estimated Expenditures

Table 5.1 provides a summary of potential net program costs and revenues should the City proceed with implementing the recommendations discussed above. The table considers existing Trash Tax revenues and programming. As shown, the City will likely have net costs of between $115,000 and $187,000 per year during the first three years of implementation (Phase I). These costs are due to the cost of developing new policy and reduced Trash Tax revenues as commercial diversion increases. In Phase II and throughout the rest of the planning period, however, net annual revenue approaching $500,000 may be realized as the initiatives mature and new homeowners become subject to the Trash Tax. If the City is able to implement the Homeowners Service Collection initiative earlier than Phase II, these revenues can be accrued sooner than noted in Table 5.1.

However, the City should more closely evaluate these estimates prior to actual implementation and on an ongoing basis over the planning period as:

- Cost estimations are based on sparse actual data and many assumptions.
- Actual implementation time frames are unknown.

[40] The USEPA recently observed that the national MSW generation rate declined slightly between 2007 and 2011 despite an increasing census numbers ("Municipal Solid Waste in the United States: 2011 Facts and Figures," May 2013).

- Actual rate of CDD deposit refunds are unknown (while it was assumed that only 2.5 percent of total deposits would not be refunded, this value could vary significantly from year to year).
- Implementation of other programs is unknown.
- Trash Tax revenues are subject to variables outside the scope of this study.

If excess revenues are available for zero waste programming at any point in the future, additional resources could be allocated to update zero waste plan metrics, assumptions and programming in Phase I, and invest more aggressively in both the BCRC and public outreach and education (especially for multi-family and commercial generators) in Phase II.

Table 5.1: Existing Versus Future City Zero Waste Expenditures[a] (annual costs unless otherwise noted)

PROGRAMS	COSTS (REVENUES) IN 2012$		
	2012	Phase I (2014-2018)[b]	Phase II (2019-2027)[b]
Revenues			
Trash Tax[c]	$1,776,000	($1,711,000) - ($1,739,000)	($2,131,000) - ($2,222,000)
Bundle #1 Initiatives (see Appendix E)	NA	($200,000)	($142,000)
Revenue Subtotal	$1,776,000	($1,911,000) - ($1,939,000)	($2,273,000) - ($2,364,000)
Costs			
Existing Trash Tax Expenditures			
Programs Evaluated in Study[d] (Table 2.2 Programs)	$657,000	$575,000	$575,000
LEAD General Services Activities[e]	$543,000	$543,000	$543,000
Recycle Row Loan/Bond[f]	$576,000	$576,000	$576,000
Bundle #1 Initiatives (Table 3.5)			
Development	NA	$105,000[g]	NA
Ongoing Operations (net revenues - see above)	NA	$155,000[g]	$68,000[g]
Education and Outreach[h]	$45,000	$87,000 - $131,00	$45,000
Existing Policy Enforcement			
Development	NA	$8,000	NA
Ongoing Operations (net revenues - see above)	some $ included in Table 2.2 programs	$5,000	$5,000
Costs Subtotal	$1776,000	$2,054,000 - $2,098,000	$1,812,000
TOTAL NET COSTS/REVENUES	$0	$115,000 - $187,000 net costs	($461,000) - ($552,000) net revenues

[a] Does not include non-measurable implementation strategies for which costs/revenues are not available - most are assumed to be included under LEAD General Service activities.
[b] Based on projected 2027 tons.
[c] Considers loss of commercial tax revenues in Phase I/II (19,500-34,300 more tons of commercial/construction waste diverted instead of landfilled at $0.85/cubic yard, assumed 900 pounds/cubic yard) and gain of residential revenues in Phase II (10,000-11,500 new subscribers at $3.50/month) (see Appendix D for initiative estimates).
[d] Assumes recycling coupon, zero waste rebate, commercial organics subsidy eliminated ($82,000 total savings/year).
[e] Based on the City's FY2012 budget (still uses 2011 numbers).
[f] County loan of $136,000/year paid off in 2013.
[g] Costs/revenues consider requirement for 1 to 2 new staff during development; 2 staff for ongoing operations.
[h] Based on $2-$3 per household and current expenditure of $45,000.

APPENDIX A
DIVERTED AND DISCARDED MSW COMPOSITION DATA[a]

MSW MATERIAL	RESIDENTIAL MSW	COMMERCIAL MSW	MIXED MSW
	Waste Composition % by Weight[c]	Waste Composition % by Weight[c]	Waste Composition % by Weight[c]
PAPER			
OCC	1.2%	8.1%	5.6%
ONP	0.8%	0.8%	0.8%
High Grade	not measured	1.7%	1.1%
Mixed Paper	not measured	7.4%	4.7%
Paperboard	not measured	2.1%	1.3%
Magazines/Junk Mail	not measured	1.1%	0.7%
Shred	not measured	0.1%	0.1%
Other Recyclable Paper	7.8%	not measured	2.8%
subtotal	*9.8%*	*21.3%*	*17.2%*
PLASTIC			
PET #1 Clear	4.0%	0.8%	2.0%
PET #1 Pigmented		0.1%	0.1%
HDPE #2 Natural		0.4%	0.3%
HDPE #2 Color		0.4%	0.3%
PVC #3		0.6%	0.4%
LDPE #4		0.7%	0.4%
PP #5		0.9%	0.6%
PS #6		1.1%	0.7%
Other #7		0.3%	0.2%
Film Plastic		3.5%	2.2%
Juice/Milk Cartons	0.3%	not measured	0.1%
subtotal	*4.3%*	*8.8%*	*7.2%*
GLASS			
Glass	1.3%	2.4%	2.0%
subtotal	1.3%	2.4%	2.0%
METALS			
Ferrous Metal	1.0%	0.9%	0.9%
Aluminum	0.3%	0.4%	0.4%
Aluminum Foil	0.0%	0.2%	0.1%
Aluminum Foil	2.1%	not measured	0.8%
Appliances/Mixed Metals	not measured	1.5%	1.0%
subtotal	*3.4%*	*3.0%*	*3.1%*
ORGANICS			
Yard Waste	6.0%	8.8%	7.8%
Food	16.1%	14.9%	15.3%
Painted/Treated Wood	not measured	4.1%	2.6%
C&D/Clean Wood	1.5%	4.1%	3.2%
subtotal	*23.6%*	*31.9%*	*28.9%*
OTHER DIVERTED MATERIALS			
E-Waste	0.0%	1.5%	1.0%
Textiles	3.6%	4.0%	3.9%
Hazardous Waste	0.0%	0.6%	0.4%
subtotal	*3.6%*	*6.1%*	*5.2%*
REMAINING MSW			
subtotal	*54.0%*	*0.0%*	*36.4%*
TOTAL[d]	**100.0%**	**73.5%**	**100.0%**

[a] Includes MSW only (CDD excluded)

[b] Based on multiple waste composition studies in City/County of Boulder (WDS' "Summary of Waste Sort Results", March 2013)

[c] Based on City's 2011 Annual Waste Inventory, MSW trash composition

residential = 36% by weight

commercial = 64% by weight

APPENDIX B

EXISTING ZERO WASTE PROGRAM ANALYSIS

	PARTICIPATION LEVEL		TONS DIVERTED		GHG SAVINGS	COST IMPACTS (2012$)				
						Operating $/Year				
	Actual Direct	Number of Households Influenced [a]	Tons/ Year [b]	Tons/ House-holds	$mtCO_2e$ [c]	PE	NPE	$/household influenced	$/GHG	$/ton
RESIDENTIAL/MFU RECYCLABLES & ORGANICS DIVERSION PROGRAMS *(direct participant type - level of household impact)*										
BVSD/Com Gardens *(students - high)* [d]	1,054	737	10	0.0	(32)	$1,600	$23,000	$33	-$769	$2,365
Eco-Cycle Outreach *(households - high)*	18,000	12,600	na	na	na	$300	$10,000	$1	na	na
CRC Sponsorships *(participants - very low)*	1,560	16	na	na	na	$1,600	$6,000	$487	na	na
Pearl St. Mall Diversion *(na - very low)* [e]	na	218	na	na	na	$400	$4,100	$21	na	na
Event Education Table *(contacts - low)*	237	12	na	na	na	$400	$2,100	$211	na	na
Zero Waste Event Rebates *(participants - very low)* [f]	3900	39	na	na	na	$9,700	$3,000	$326	na	na
Recycling Green Team *(contacts - low)*	441	22	na	na	na	$300	$6,900	$327	na	na
Subtotal			**10**		**(32)**	**$14,300**	**$55,100**			
COMMERCIAL RECYCLABLES & ORGANICS DIVERSION PROGRAMS *(participant type - level of household impact)*										
BCPH Outreach *(advising contacts - low)* [g]	261	170	na	na	na	$4,400	$101,300	$623	na	na
Recycling Coupons *(business - medium)* [g,h]	4	16	na	na	na	$400	$1,200	$103	na	na
ZW Start-Up Rebate *(business - medium)* [g,h]	4	16	na	na	na	$400	$1,500	$122	na	na
Composting Subsidy *(business - medium)* [g,h,i]	337	1,314	4,686	3.6	(937)	$400	$78,100	$60	-$84	$17
Subtotal			**4,686**		**(937)**	**$5,600**	**$182,100**			
WASTE DIVERSION FACILITIES *(participant type - level of household impact)*										
Organics										
Yard Waste DOC *(trips - medium)* [j]	26,408	26,408	7,985	0.3	(1,082)	$300	$144,600	$5	-$134	$18
Wood Waste DOC *(trips - medium)* [j]	2,036	2,036	1,980	1.0	(396)	$400	$30,500	$15	-$78	$16
Hard-to-Recycle Materials										
CHaRM Operations *(multiple - medium)* [g,k]	27,428	28,141	747	0.0	(2,212)	$600	$100,000	$4	-$45	$135
Used Building Materials										
ReSource Customer Service *(transactions)* [l]	13,766	13,766	777	0.1	(754)	$3,200	$60,100	$5	-$84	$81
Hazardous Materials										
County HMM Facility *(households - na)*	5,060	5,060	71	0.0	(219)	$300	$1,800	$0	-$10	$30
Subtotal			**11,560**		**(4,663)**	**$4,800**	**$337,000**			
CITY GOVERNMENT DIVERSION COLLECTION (participant type - level of household impact)										
City Govt Collection *(employees - medium)*	1,200	360	200	0.6	(398)	$4,700	$36,200	$114	-$103	$205
Subtotal			**200**		**(398)**	**$4,700**	**$36,200**			
TOTAL			**16,456**		**(6,030)**	**$29,400**	**$610,400**			

PE = City personnel expense NPE = other costs (contract payments, partnership payments, direct service costs, etc na = not available/not applicable

[a] Estimated number of households influenced to increase diversion due to actual, direct program (Column D) based on 1) one-time versus on-going programming and 2) level of discrete contacts (generally assumes that each student/participant/business influences one household):

kessler consulting inc.
LBA Associates

EXISTING ZERO WASTE PROGRAM ANALYSIS

	On-Going Programming	More than One Contact (discrete tours, demonstrations, communications, etc.)	Assumed Percentage of Households to Increase Diversion
HIGH	yes	yes - one or more direct contacts	**70%**
MEDIUM	yes	no	**30%**
LOW	no	no - but had direct contact	**5%**
VERY LOW	no	no - no direct contact	**1%**

Number of total households = **43,617**

[b] Based on data obtained from actual program reports where available (quantities escalated as noted)

[c] Based on ICLEI-Local Governments for Sustainability USA's "Recycling and Composting Emissions Protocol, for Estimating Greenhouse Gas Emissions and Emissions Reductions Associated with Community Level Recycling and Composting" (Section 3, v1.0 July, 2013) - detailed modeling and assumptions are included in Appendix F

[d] Participation/tonnage values escalated from actual 2011 values (based on population growth between 2011 and 2012) = **104%** increase

[e] Assumes individuals from 50% of total households are exposed to Pearl St. containers/business signage each year - does not include one-time container costs

[f] Zero Waste Event rebate program assumes an average 300 participants/event for 13 actual events

[g] Assumes an average 13 employees/business based on the Boulder Economic Council's Market Profile (January 2013)

[h] Number of actual businesses averaged over calendar year

[i] Compost subsidy program tons based on subsidies paid, an average 500#/cy conversion factor and 60% of subscribed tons (based on 2010 actual data)

[j] Assumes residents use YW and WW once/year, businesses use YW six times/year and WW twice/year (excludes city use)

[k] CHaRM program includes residential, commercial use and special events

[l] Assumes each household made one transaction

APPENDIX C

POTENTIAL ZERO WASTE INITIATIVES

SINGLE-FAMILY	MULTI-FAMILY	COMMERCIAL
ALREADY PLANNED FOR 2013/2014		
Add meat, dairy to curbside organics (city pilot)	Provide model lease language for recycling collection to property managers (also addressing organics for some properties)	
Test reducing trash to EOW collection (WDS pilot)	Pilot education, data gathering, unit containers (city pilot)	
	Expand Greenpoints requirements including deconstruction standards	
Lobby for state product stewardship laws at state & federal level (e-waste, paint)		
Improve data from haulers (revise reporting forms, standardize weight estimates)		
Work with Boulder County to create clear, unified/standardized zero waste branding, messaging, labels, guidelines		
Provide support for county-wide or regional CD&D facility		
Support development of Repair Café within existing leased areas at 6400 Arapahoe (encourage artist studios and material-specific workshops)		
Enforce existing recycling and zero waste requirements at permitted events		
Require zero waste for all permitted events		
SOURCE REDUCTION/REUSE		
Work with strategic partners to target materials for reuse (art supplies, textiles, carpet, etc.)		
Work with strategic partners to develop sustainable markets to accept CHaRM materials (such as mattresses)		
Support thrift stores and other reuse opportunities throughout the city		
Provide spreaders for residents/businesses to borrow/rent for applying much/compost (manage through tool library)		
Expand environmentally preferable purchasing practices to schools, other organizations		
Encourage backyard composting with mid-sized in-vessel composting		Encourage/require all take-out packaging to be recyclable or compostable
COLLECTION		
Enforce existing PAYT requirements	Enforce current ordinance for 1/3 recycling containers (review ordinance against space/enclosure/parking issues)	
Require all residential haulers to use automated carts to provide adequate recycling capacity		
Increase PAYT pricing for 64-/96-gallon containers		Require waste diversion plans as a precursor to actual diversion requirements in future (including audits)

APPENDIX C

POTENTIAL ZERO WASTE INITIATIVES

SINGLE-FAMILY	MULTI-FAMILY	COMMERCIAL
COLLECTION (continued)		
Increase education, challenges, clearer guidelines, signage, etc. to encourage greater diversion with existing system (could require some property manager responsibility)		Require businesses to subscribe to recycling service (with recycling cheaper than trash) OR require trash haulers to provide recycling to customers in all sectors
	Require property managers to make recycling as convenient as trash (inside buildings/units also)	Require restaurants to divert organics
	Provide incentives for haulers to increase diversion	Require PAYT with adequate diversion incentive
Mandate and enforce recycling with existing system		Increase education, technical assistance, recognition
	Evaluate organics collection	Require restaurants/bars to divert containers ("ABC") including source-separation of glass
		Mandate and enforce recycling (require actual use of service)
		Expand existing ordinance to require space for diversion on new/renovated commercial properties
CONSTRUCTION, DECONSTRUCTION & DEMOLITION		
Enforce existing Greenpoints requirements	Mandate Greenpoints program diversion for materials with existing markets	
Assess need for city transfer facility in consort with county/regional C&D facility		
Require refundable deposits for C&D materials with existing markets including source-separation requirement for contractors		
PROCESSING		
Increase materials processing capability and capacity of Boulder County Recycling Center		
	Develop wet/dry or mixed waste processing facility for multi-family and commercial waste streams	
Increase space for ReSource operations		
Create sorting capacity of residual waste stream as final step before disposal		
Assess feasibility of conversion technology facility		
GENERAL POLICY		
Require all homeowners to subscribe to collection service		
Provide some city control over trash, recyclables and organics collection to serve the public good (i.e., better control over rates, city revenues, etc.)		
Require haulers to offer recycling to trash customers in all sectors (could limit to regular subscription service or all collection)		

POTENTIAL ZERO WASTE INITIATIVES

SINGLE-FAMILY	MULTI-FAMILY	COMMERCIAL
GENERAL POLICY (continued)		
Require haulers vehicles to be hybrid or powered by alternative fuels		
Evaluate ability to support specific BCRC improvements and obtain some input to owner decisions		
Evaluate potential conflict of roles between BCRC operator and recyclables hauler		
Evaluate changing yard/wood waste drop-site contract terms to cover compost operations (address hauler access, tip fees, etc.)		
Enhance contract to provide some city control of CHaRM services		
Enhance contract to provide some city control of ReSource services		
Increase promotion of existing facilities (ReSource, CHaRM, MRF, HMM)		
Expand source reduction and direct diversion activities to all schools (possible expansion of existing Greenstar School program)		
Add market development tasks to existing City staff job descriptions		
Require city organization to use mulch/compost for landscaping and erosion control		
Expand City mulch ordinance requiring new lawns and projects requiring site plans/water permit use high-organic content topsoil		
Implement advanced disposal fees on hard-to-recycle materials (paints, pesticides, mercury-containing products)		
Disposal/collection ban materials for cardboard, glass, aluminum, white goods, yard waste/grass clippings, etc.		
Reinstate periodic trash collection/clean-up events on the Hill		
Require adequate trash container capacity on the Hill		

Individual Zero Waste Initiative Impacts

INITIATIVE	DIVERSION IMPACTS (nearest 100		COST IMPACTS TO CITY				COST IMPACTS TO CUSTOMERS ($/month)		GHG REDUC-TIONS (nearest 100 $mtCO_2e$) [b]	JOB IMPACTS (nearest 1 FTE) [c]	NOTES
	TONS/YEAR DIVERTED		INITIAL DEVELOPMENT COSTS		ON-GOING COSTS						
	Low	High	$/Yr (nearest $1000)	$/Ton (near-est $1)	$/Yr (nearest $1000)	$/Ton (near-est $1)	Low	High			
Every-Other-Week Trash Collection	2,500	5,000	$16,000	$4	$0	$0	$2	$3	2,600 to 5,200	2 to 3 excludes collection	
Multi-Family Composting	300	600	$12,000	$27	$0	$0	$3	$4	<100	1	Customer costs exclude kitchen pails ($15 to $25 initially)
Take-Out Packaging	100	200	$13,000	$87	$2,000	$13	$2	$6	<100	0	
Homeowner Collection Service											
Single-Family	7,400		$24,000	$3	$3,000	$0	$20	$25	15,000	19	
Multi (owner-occupied)							$11	$16			
Commercial Recycling	5,500	11,900	$30,000	$3	$10,000	$1	$15	$30	17,000 to 36,600	15 to 33	Potential savings from elimination of recycling coupons & start-up rebates
Commercial Organics Recovery	8,600	17,100	$30,000	$2	$5,000	$0	$30	$50	1,800 to 3,600	19 to 39	Potential savings from elimination of compost subsidies
Deposit CDD Program											
New Construction	5,400		$37,000	$7	$137,000	$25	$13,800 (new)		1,200	2	Annual revenues of $200k from permit fees & un-refunded deposits
Deconstruction							$0 (decon-		3,000	6	
Special Event Diversion	0	0	$14,000	na	$18,000	na	$0	$0	<100	0	
City Purchase of Locally-Produced Compost	0	0	$18,000	na	$18,000-$23,000	na	$0	$0	na	0	Creates demand for 1,600 to 2,000 tons not new tons diverted
BCRC Improvements	0	0	$158,000	na	na	na	na	na	na	22	New 48,000 ton capacity but not new tons diverted - City investment is place-holder only
Existing Policy Enforcement											

Individual Zero Waste Initiative Impacts

INITIATIVE	DIVERSION IMPACTS (nearest 100		COST IMPACTS TO CITY				COST IMPACTS TO CUSTOMERS ($/month)		GHG REDUC-TIONS (nearest 100 $mtCO_2e$) [b]	JOB IMPACTS (nearest 1 FTE) [c]	NOTES
	TONS/YEAR DIVERTED		INITIAL DEVELOPMENT COSTS		ON-GOING COSTS						
	Low	High	$/Yr (nearest $1000)	$/Ton (near-est $1)	$/Yr (nearest $1000)	$/Ton (near-est $1)	Low	High			
PAYT Service to SFUs	200		$8,000	$5	$0	$0	$0		400	0 excludes collection	Cost impacts combined for PAYT and MFU recycling program enforcement
50% MFU Recycling Service	1,400						$0		4,300	4	
Residential GBGP	500	4,200	$0	$0	$93,000	$40	$0		4,700	1 to 8	
Special Events	0	0	$0	$0	$5,000	na	$0		<100	0	
TOTALS (including BCRC Improvements)	**31,900**	**53,400**	**$360,000**	**na**	**$291,000 to $296,000**	**na**	**na**	**na**	**50,200 to 74,200**	**91 to 137**	**Potential savings from eliminating existing programs phased out when new initiatives phased in Potential revenue - $200,000**

FTEs = full-time (job) equivalents
GBGP = City of Boulder's Green Building Green Points
[a] Based on estimated quantities of diverted materials in disposed MSW stream, per Western Disposal's Summary of Waste Sorts (March 2013)
[b] Greenhouse gas emission reduction estimates detailed in Appendix F (Future Initiatives worksheet)
[c] Jobs creation estimate based on Jobs worksheet, includes collection and processing unless noted (utilizes local hauler/processor estimates for recyclables and organics)

Individual Zero Waste Initiative Impacts

INITIATIVE	TYPE	APPLICATION	KEY ASSUMPTIONS	OBSERVATIONS
Every-Other-Week Trash Collection	Existing policy revision	Residential collection customers	Assumes current recycling tons increase 10-20%, current organics tons increase 40-80%	As local compost facility tip fees are about 3 times higher than landfill tip fees, monthly customer costs may increase slightly *Together with requiring all homes to have curbside collection service, may divert most recyclables generated by SFUs/MFUs*
Multi-Family Composting	Existing policy revision	MFU collection customers (or owners/managers)	Assumes number of accounts diverting organics increases from 8% to 20-30%	Increased MFU customer cost due primarily to inclusion of kitchen pails
Take-Out Packaging	Voluntary program	Fast food/limited service eating establishments	Assumes 15-30% of establishments switch to recyclable/compostable cups & containers	Limited diversion expected
Homeowner Collection Service Residential Multi-Family	Existing policy revision	Every homeowner (or owners/managers)	Assumes 100% compliance	Initial inter-departmental coordination & on-going enforcement required *Together with EOW trash collection, may divert most recyclables generated by SFUs/MFUs* New customer costs comparable to existing customer rates
Commercial Recycling	New policy	All commercial generators	Assumes at least 90% compliance	Initial inter-departmental coordination & on-going enforcement required *These combined policies may divert most organics generated by commercial sector* Increased jobs creation due part to increased collection *Elimination of existing compost subsidy reduces city costs*
Commercial Organics Recovery	New policy	Food manufacturing, supermarkets/ groceries, restaurants including institutions, health care, food contractors	Assumes nearly 1,000 establishments divert 30-50% of waste stream	
Deposit Program for Construction /Deconstruction New Construction	Existing policy revision	Residential & commercial construction & demolition	Assumes diversion increases to 50% new residential, 50% commercial, 65% demolition Assumes minimum $100/project review fee	Initial inter-department coordination & on-going enforcement required *Primary cost impacts to commercial projects* Potential revenue source from permit fees ($100)

Individual Zero Waste Initiative Impacts

INITIATIVE	TYPE	APPLICATION	KEY ASSUMPTIONS	OBSERVATIONS
Deconstruction			Assumes average deposit requirement of 2% of project valuation with $50k	& un-refunded deposits
Special Event Diversion	Existing policy expansion	Special events requiring permit from Parks & Recreation Department	Assumes diversion increases to 85%	Limited diversion expected although community awareness would be raised - includes $250 rebates
City Purchase of Locally-Produced Compost	Existing pur-chasing policy revision	City purchase of finished compost product	Based on Boulder County compost market study	Expected to create better markets for existing local composters & ultimately improve organics recovery economics *May increase city department expenditures for new product*
BCRC Improvements	City/County partnership expansion	Boulder County Recycling Center	Based on input from County's MRF operator	Expected to increase plastics & fiber sorting capacity while decreasing labor requirements
Existing Policy Enforcement				
PAYT Service to SFUs	Existing policy enforcement	Residential trash collection	Assumes multiple sized carts increase diversion	Limited diversion expected
50% MFU Recycling Service		MFU recyclables collection	Assumes MFU recycling approaches SFU recycling levels	Moderated diversion potential
Residential GBGP		New residential construction & demolition	Assumes diversion increases to 50% residential & 65% demolition	Duplication of impacts from Deposit Program for Construction/Deconstruction initiative
Special Events		Special events	Assumes diversion increases to 85%	Duplication of impacts from Special Events Diversion initiative

Individual Zero Waste Initiative Impacts

INITIATIVE:	**EVERY OTHER WEEK TRASH COLLECTION**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**EOW Trash**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Revise existing policy (BRC Chapter 6-12) to limit residential (individual container) trash collection to every-other-week (with hardship waivers)
	Includes decrease to every-other-week trash, increase to weekly organics (recycling stays every other week)
	Applies to existing accounts only (other increases such as those that would increase accounts are considered separately)
	Residential service applies to all homes with individual container service (assumed to be detached/attached single-family, townhomes, duplexes and triplexes) - defined in hauler reports as SFU service
FUTURE RECOMMENDATIONS	1) Obtain data on number/size of residential versus multi-family homes
DISCLAIMERS	Available data is limited to city demographic and hauler data (specific single-family service totals are not available) *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITIES ESTIMATIONS - EVERY OTHER WEEK RESIDENTIAL TRASH SERVICE FOR EXISTING ACCOUNTS

	TOTAL		TRASH		RECYCLABLES		ORGANICS		
	Generation Rate [a] (tons/hh-year)	Tons/ Year [b]	Generation Rate [a] (tons/hh-year)	Tons/Year [b]	Generation Rate [a] (tons/hh-year)	Tons/ Year [b]	Generation Rate [a] (tons/hh-year)	Tons/Year [b]	Waste Diversion Rate
STATUS QUO	1.34	25,499	0.71	13,511	0.40	7,612	0.23	4,377	47%
WITH PROPOSED ORDINANCE REVISION (TOTAL INCREASE)		**Tons**	**% Change**	**Tons**	**Assumed % Change [c]**	**Tons**	**Assumed % Change [c]**	**Tons**	
Low Diversion	1.34	25,499	81%	10,999	110%	8,373	140%	6,127	57%
High Diversion	1.34	25,499	63%	8,487	120%	9,134	180%	7,878	67%
DIFFERENTIAL INCREASE OVER EXISTING TONS									
Low Diversion	na			-2,512	na	761	na	1,751	na
High Diversion	na			-5,024	na	1,522	na	3,501	na

Individual Zero Waste Initiative Impacts

a Based on 2011 and 2012 reports from regular curbside haulers for SFU service

b Based on generator estimates in Homeowner Service worksheet, total SFU households = **19,029**

c Based on similar program change in Renton, WA (Greening Renton, March 2011) and Portland, OR (New Curbside Collection Service Year One Report, December 2012):

Renton (2009) moved to EOW trash, weekly organics (EOW recycling stayed the same) =	18% less trash, 27% more recyclables, 44% more organics
Portland (2001) moved to EOW trash and weekly organics (weekly recycling stayed the same) =	38% less trash, 279% more organics

2012 ESTIMATION OF ADDITIONAL CITY COSTS - EVERY OTHER WEEK RESIDENTIAL TRASH SERVICE

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				Revision of existing policy with significant change
Research	$115,300	0.04	$4,612	
Pilot Test [b] (for policy implementation only)	$77,700	0.05	$3,885	
Public, EAB & Council Meetings	$115,300	0.04	$4,612	
Promotion	$77,700	0.04	$3,108	
YEAR ONE COSTS		**0.17**	**$16,217**	

a Salaries based on senior staff ($115,300) and mid-level staff ($77,700)

b Assumes City will conduct 6-month test period to both evaluate implementation issues and provide phase-in/voluntary period for start-up

2012 ESTIMATION OF NEW RESIDENTIAL HOME COSTS DUE TO TIP FEES/REVENUES - EVERY OTHER WEEK RESIDENTIAL TRASH SERVICE

	TRASH			RECYCLABLES			ORGANICS			NET COST ($/hh-yr)
	Generation Rate (ton/hh-yr)	$/Ton Cost [a]	Change for EOW	Generation Rate (tons/hh-yr)	$/Ton Revenue [b]	Change for EOW	Generation Rate (tons/hh-yr)	$/Ton Cost [c]	Change for EOW	
EXISTING SYSTEM	0.71	$15	100%	0.4	$15	100%	0.23	$45	100%	$15.00
EOW - Low Diversion	0.71	$15	81%	0.4	$15	110%	0.23	$45	140%	$16.52
EOW - High Diversion	0.71	$15	63%	0.4	$15	120%	0.23	$45	180%	$18.14
POTENTIAL COST CHANGE TO RESIDENTIAL CUSTOMER FROM EXISTING SYSTEM										$2 to $3

a Front Range Landfill gate fee of $29/ton is expected to be closer to $15/ton for regular haulers

b Boulder County Recycling Center average hauler rebates for 2012 (Callahan, June 2013) - fluctuates widely (rebates were $5/ton in May 2013)

c Western Disposal current compost facility tip fees (Gary Horton, April 2013)

Individual Zero Waste Initiative Impacts

INITIATIVE:	**MULTI-FAMILY COMPOSTING**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**MFU Composting**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INTIATIVE DESIGN	Revise existing policy (BRC Chapter 6-12-4 (e) to require haulers to provide containers and service for organics collection to MFUs that request (voluntary programming)
	Customer cost will be in addition to trash and recycling service cost - will include individual kitchen pails
	Multi-family service applies to MFUs with common container service (assumed to include 3 or more units) - defined in hauler reports as MFU service but some MFU reporting may also be included under commercial
	Current barriers include lack of adequate signage, lack of appropriate enclosures for containers and inability to utilize parking space
FUTURE RECOMMENDATIONS	Expand to a mandate for property managers to provide organics collection (with hardship waivers for space issues) but realize that voluntary programming not likely to notably increase MFU organics diversion
DISCLAIMERS	Available data is limited to hauler reports for anticipated generation rates *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITY ESTIMATIONS - HAULER PROVISION OF ORGANICS COLLECTION SERVICE TO MULTI-FAMILY ACCOUNTS

		NEW ORGANICS GENERATION ESTIMATES	
TYPE	**MFU Accounts Served [a]**	**Total Tons/Year Diverted [b]**	**Generation Rate [a] (tons/account-year)**
STATUS QUO			
Total MFU Accounts Receiving Any Curbside Service	1,008	217	0.22
Accounts Diverting Organics (7% of total accounts)	82	217	2.65

Individual Zero Waste Initiative Impacts

WITH PROPOSED ORDINANCE REVISION [b] (TOTAL INCREASE)			
Low 20%	202	534	2.65
High 30%	302	800	2.65
DIFFERENTIAL INCREASE OVER EXISTING TONS			
Low 20%		317	
High 30%		583	

a Based on 2012 hauler reports from regular curbside haulers (note that some haulers consider all MFU accounts as commercial so estimates may be low)
note that there is an approximate average of 12 homes per MFU account

b Based on average 2011/2012 hauler reports

c Assumes MFUs that divert organics will increase from the current 8% (82 MFU accounts) to a range of 20-30% over first few years of implementation

2012 ESTIMATION OF ADDITIONAL CITY COSTS - HAULER PROVISION OF ORGANICS COLLECTION SERVICE TO MULTI-FAMILY

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				Revision of existing policy
Research	$115,300	0.04	$4,612	
Public, EAB & Council Meetings	$115,300	0.04	$4,612	
Promotion	$77,700	0.04	$3,108	
YEAR ONE COSTS		**0.12**	**$12,332**	

a Salaries based on senior staff ($115,300) and mid-level staff ($77,700)

2012 ESTIMATION OF NEW CUSTOMER COSTS - HAULER PROVISION OF ORGANICS COLLECTION SERVICE TO MULTI-FAMILY

	ORGANIC TONS/MFU ACCOUNT-YEAR [a]	ORGANIC CUBIC YARDS/WEEK [b]	MFU ACCOUNT/ MONTH for WEEKLY COLLECTION [c]		MFU HOME/ MONTH [d, e]	
			Low	High	Low	High
ON-GOING COLLECTION COSTS (for high diversion)	2.65	0.20	$30	$40	$3	$4
INDIVIDUAL KITCHEN PAILS (one-time purchase only) [f]	na	na	$0	$0	$15	$25

a Based on generation rate in 2012 Quantity Estimations table (above)

b Based on assumed 500 lbs/CY for combined organic waste

c Assumes one 64-gal cart/twice-weekly service would serve each 12-home MFU account (cart capacity is about 0.65 CY) which provides excessive capacity
- also based on hauler pricing reports inclusive of Trash Tax

Individual Zero Waste Initiative Impacts

d Assumes property managers may assess an administrative charge equal to approximately 20%

e Based on average number of homes per MFU account = **12**

f Based on individual pricing for kitchen compost pails with carbon filters (bulk pricing and recycled-content purchasing may change this price)

Individual Zero Waste Initiative Impacts

INITIATIVE:	**Take-Out Packaging**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Take-Out Packaging**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Develop campaign for food establishments to voluntarily replace take-out packaging with recyclable or compostable containers
	Applies to fast-food "limited service eating" places identified by NAICS code (American FactFinder, 2007 Economic Census) - i.e., establishments where customers order and pay before being served (includes eat-in, take-out and delivery service)
	Assumed existing entire inventory of polystyrene take-out packaging (primarily foam cups and food containers) are disposed of by customers
	Assumes local compost facilities will accept BPI- and ASTM-certified biodegradable materials for composting
FUTURE RECOMMENDATIONS	1) Obtain data on packaging quantities generated
DISCLAIMERS	Available data is limited to census data (restaurant numbers) and literature values for polystyrene in landfilled waste *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITIES ESTIMATIONS - RECYCLABLE/COMPOSTABLE TAKE-OUT PACKAGING

	TOTAL TRASH [a] (tons/year)	TOTAL PLASTICS [b] (tons/year)	POLYSTYRENE [b,c]	POTENTIAL NEW DIVERSION [d]	
				LOW 15% (tons/year)	HIGH 30% (tons/year)
RESIDENTIAL and MFU	25,831	2,841	85	13	26
COMMERCIAL	39,747	4,770	437	66	131
TOTAL	65,578	7,611	522	78	157

a Based on 2011 hauler reports

b Based on plastics waste composition findings in Vermont reported by DSM Environmental Services' What's In the Can (Resource Recycling, June 2013)

Residential total plastics (% by weight) = **11%**

Commercial total plastics (% by weight) = **12%**

Residential polystyrene (% of total plastics) = **3%**

c Based on multiple waste composition studies in City/County of Boulder (Western Disposal, Summary of Waste Sort Results, March 2013), commercial polystyrene (as % of total waste stream) = **1.1%**

d Assumed trash quantities are reduced by diversion quantities (further assume 25% of diverted tons are PET recyclable, 75% are compostable)

Individual Zero Waste Initiative Impacts

2012 ESTIMATION OF ADDITIONAL CITY COSTS - RECYCLABLE/COMPOSTABLE TAKE-OUT PACKAGING

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL PROGRAM DEVELOPMENT (first year only)				No policy setting
Research	$115,300	0.04	$4,612	
Public, EAB & Council Meetings	$115,300	0.02	$2,306	
Promotion	$77,700	0.08	$6,216	
YEAR ONE COSTS		**0.14**	**$13,100**	
ON-GOING IMPLEMENTATION				
LEAD Annual Tracking/Reporting	$77,700	0.02	$1,554	Assumes participating businesses will voluntarily report diversion efforts/costs so City can track/use to encourage additional participation
ON-GOING COSTS		**0.02**	**$1,554**	

a Salaries based on senior staff ($115,300) and mid-level staff ($77,700)

2012 ESTIMATION OF BUSINESS COSTS - RECYCLABLE/COMPOSTABLE TAKE-OUT PACKAGING

	TOTAL UNITS [a]			POLYSTY- RENE CUP PRICING [b]		POLYSTY-RENE CONTAINER PRICING [b]	TOTAL
STATUS QUO	20,898,372	na	na	$313,476	na	$940,427	$1,253,902

	TOTAL UNITS [a]	PRICING					TOTAL
		Cups			Containers		
		Recyclable [c]	Compostable [c]	Polystyrene	Compostable [c]	Polystyrene	
WITH PROPOSED ORDINANCE REVISION	20,898,372	na	na	na	na	na	na
Low Diversion 15%	na	$54,858	$117,553	$266,454	$297,802	$799,363	$1,536,030
High Diversion 30%	na	$109,716	$235,107	$219,433	$595,604	$658,299	$1,818,158

Individual Zero Waste Initiative Impacts

POTENTIAL COSTS TO INDIVIDUAL CUSTOMERS	Assume the average order includes the equivalent of 3 recyclable/compostable containers and the average individual places 1 order/week whether at home or at work - the price increase to households could be as much as $25-$70/year for a 2.3person household

a Assumed average weight of 0.8 ounce/unit (www.foodbizsupply.com/take-out-boxes)

b Assumed 50% cups, 50% containers - status quo polystyrene pricing

Based on website pricing for 16-oz foam cups (Dart, Uline) =	**$0.03**	per cup
Based on website pricing for 8" by 8" clamshell-style container (Dart, Genpak) =	**$0.09**	per container

c Assumed 50% cups (50% PET and 50% compostable) and 50% compostable containers - new pricing for recyclable/compostable containers

Based on website pricing for 16-oz PET recyclable/ASTM biodegradable insulated cups (Dart, Karat) =	**$0.07**	per cup
Based on website pricing for 12/16 oz ASTM biodegradable insulated cups (WorldArt, Solo Bare) =	**$0.15**	per cup
Based on website pricing for 6" by 6" clamshell-style containers (Bare, Instawares.com) =	**$0.19**	per container

Individual Zero Waste Initiative Impacts

INITIATIVE:	**HOMEOWNER COLLECTION SERVICE**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Homeowner Service**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Revise existing policy (BRC Chapter 6-3) similar to current requirement in 6-3-3 (b) which already requires services to MFU rental properties
	Require every residence (individual containers) and owner-occupied multi-family home (common containers) to subscribe to trash collection service - service must provide "sufficient trash hauling to accommodate the regular accumulation of trash" and "so that it does not cause putrid odors" on a weekly basis (consistent with current practice)
	Assumes diversion level/household for new homes will be same as diversion for homes currently serviced - most multi-family units currently have subscription service (BRC 6-3-3 (b) requires all owners of rental properties to provide collection service)
	Applies to existing service levels (i.e., weekly trash collection, EOW recyclables/organics collection (other increases such as EOW trash are considered separately)
	For multi-family homes, this requirement will be imposed on property owners/managers
	Customer costs pertain to new subscribers only and does not consider current self-haul costs currently incurred
FUTURE RECOMMENDATIONS	1) Obtain data on size/number/generation rates for multi-family homes (may require haulers to improve their MFU versus commercial account reporting), 2) Tie enforcement to other service City has control over (e.g., utility) - otherwise City will not have data for measuring compliance
DISCLAIMERS	Available data is limited to city demographic and hauler data - specific homeowner number, service totals are not available *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITY ESTIMATIONS FOR NEW HOMES - MANDATORY HOMEOWNER COLLECTION SERVICE

TYPE	TOTAL NUMBER of HOMES [a]	HOUSEHOLDS NOT CURRENTLY SERVED [b]	NEW MATERIALS GENERATION ESTIMATES FOR CURBSIDE COLLECTION [c,d,e]							
			TOTAL MATERIALS		TRASH		RECYCLABLES		ORGANICS	
			Generation Rate (tons/hh-year)	Tons/ Household-Year	Generation Rate [c] (tons/hh-year)	Tons/ Household-Year	Generation Rate [c] (tons/hh-year)	Tons/ Household-Year	Generation Rate [c] (tons/hh-year)	Tons/ Household-Year
RESIDENTIAL	30,532	11,503	1.34	15,414	0.71	8,167	0.40	4,601	0.23	2,646

Individual Zero Waste Initiative Impacts

MULTI-FAMILY HOMES [c,d]	13,085	654	1.22	798	0.95	622	0.23	150	0.04	26
TOTAL	**43,617**	**12,157**	**na**	**16,212**	**na**	**8,789**	**na**	**4,752**	**na**	**2,672**

a Based on Boulder Economic Council's Market Profile (January 2013), City of Department Community Planning and Sustainability emails (April, May 2013) including the Boulder County Property assessments - breakdown of multi-family/condo units not fully available, total homes in 2012 = **43,617**

Single-family detached/attached including townhomes = **70%** of total homes

Multi-family with 3 or more units = **30%** of total homes

b Difference between total homes and estimated current service (based on 2012 hauler reports)

	City Demographic Data	Western	Eco-Cycle	Republic	One Way	Total	Notes
Residential (single-family detached/ attached including townhomes)	30,532	18234	0	576	219	19029	Assume individual (not common) collection
Multi-Family Duplex & Triplex							Assume individual (not common) collection
Multi-Family > 3 Units (including condos, mobile homes)	13,085	1,006 (accounts)	2 (accounts)	0 (accounts)	0 (accounts)	1,008 (accounts)	Assume common collection (based on assumed 95% subscription service, there is an estimated 12 units/MFU account)

c Based on 2011 and 2012 reports from regular curbside haulers

d Assume 95% of multi-family properties currently have service

e While these tons may be "new" curbside materials, it is expected that some are already collected through drop-site collection

2012 ESTIMATION OF ADDITIONAL CITY COSTS - MANDATORY HOMEOWNER COLLECTION SERVICE

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				Revision of existing policy with significant change
Research	$115,300	0.04	$4,612	
Pilot Test (for policy implementation only) [b]	$77,700	0.05	$5,765	
Inter-Departmental Collaboration Planning & Development Services	$115,300	0.04	$4,612	

Individual Zero Waste Initiative Impacts

Public, EAB & Council Meetings	$115,300	0.04	$4,612	
Promotion	$77,700	0.04	$4,612	
YEAR ONE COSTS		**0.21**	**$24,213**	
ON-GOING ENFORCEMENT				
Enforcement	$60,000	0.05	$3,000	Based on random auditing
ON-GOING COSTS		**0.05**	**$3,000**	

a Salaries based on senior staff ($115,300), mid-level staff ($77,700) and compliance staff ($60,000)

b Assumes City will conduct 6-month test period to both evaluate implementation issues and provide phase-in/voluntary period for start-up

2012 ESTIMATION OF NEW CUSTOMER COSTS - MANDATORY HOMEOWNER COLLECTION SERVICE (rounded to nearest $100)

	TRASH TONS/ACCOUNT - YEAR [a]	TRASH CUBIC YARDS/WEEK [b]	$/MONTH for WEEKLY COLLECTION		$/HOUSHOLD-MONTH	
			Low	High	Low	High
RESIDENTIAL COLLECTION COSTS [c]						
Residential	0.71	0.09	$20	$25	$20	$25
MULTI-FAMILY COLLECTION COSTS [d]						
Trash [e]	11.40	1.46	$75	$115	$8	$12
Recycling/Organics [f]			$30	$40	$3	$4
MFU Total			$105	$155	$11	$16

a Based on number of homes per account (SFU = 1, MFU = 12) and average organics generation rate in 2012 QUANTITY ESTIMATES table (above)

b Based on assumed 300 lbs/CY for trash

c Assumes 32-gal cart weekly service with bundled recyclables and organics collection - based on hauler pricing reports inclusive of Trash Tax (average of three residential haulers

d Based on hauler pricing reports inclusive of Trash Tax - includes property managers' administrative charge equal to 20%

e Assumes one 3-CY trash dumpster/weekly service to serve each 12-home MFU account

f Assumes one 64-gal/twice-weekly service (recyclables and organics) to serve each 12-home MFU account

COSTS ARE FOR NEW SUBSCRIBERS ONLY AND DO NOT CONSIDER SELF-HAUL COSTS THAT MAY CURRENTLY BE INCURRED

Individual Zero Waste Initiative Impacts

INITIATIVE:	**COMMERCIAL RECYCLING**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2013$**
WORKSHEET TITLE:	**Commercial Recycling**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Develop new City policy (in tandem with food waste diversion policy)
	Original analysis analyzed requiring commercial generators with more than 10 employees to subscribe to recyclables collection - revised to target those employers who represent 90% of the City's total employees (this reflects very high participation levels for most commercial generators with exclusions for hardship conditions)
	Analysis considers only recycling - source reduction/reuse (e.g., Project C.U.R.E. participants such as the Boulder Community Hospital) and organics diversion are not included
FUTURE RECOMMENDATIONS	1) Obtain data on number/size/rate of commercial generators currently recycling - especially need information on generators by number of employees, 2) Tie enforcement to other service City has control over (business license through Finance Department is one-time only) otherwise City will not have data on/hammer for compliance, 3) Expand subscription requirement to all commercial generators, and 4) Make actual diversion of recyclables mandatory
DISCLAIMERS	Available data is limited to Boulder Economics' Council Market Profile (the City's Finance Department does not track City licenses), US Census data and published values for other communities *Analytical results are based on assumptions, estimates and data from other communities and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITIES ESTIMATIONS - COMMERCIAL RECYCLING REQUIREMENT

	TOTAL NUMBER OF EMPLOYERS [a]	TOTAL NUMBER OF EMPLOYEES [b]	TOTAL WASTE GENERATED (tons/year)	TOTAL RECYCLED MATERIALS (tons/year)	% DIVERSION FROM RECYCLING	POTENTIAL NEW DIVERSION ONLY [c] (tons/year)
STATUS QUO [d]	6,787	90,830	70,464	13,483	0.19	na
WITH PROPOSED NEW ORDINANCE						
Employers With >10 Employees [e]	1,357	17,646	14,093	na	na	na

So targeting the largest employees (with only

Individual Zero Waste Initiative Impacts

low - 30% of total waste diverted [e,f]	na	na	na	4,228	0.30	-9,255
high - 40% of total waste diverted [e,f]	na	na	na	5,637	0.40	-7,846
Employers with 90% of Total Employees [e]	6,288	81,747	63,418	na	na	na
low - 30% of total waste diverted [e,f]	na	na	na	19,025	0.30	5,542
high - 40% of total waste diverted [e,f]	na	na	na	25,367	0.40	11,884

breakdown available from City at 10 employees) is less than what is already happening (whether these are new tons or overlap is unknown) - we need to target smaller employers
Trial & error shows that targeting businesses that represent 90% of the City's total employees, however, begins to approach the total potential diversion level from recyclables (42% rate)

a Based on Boulder Economic Council's Market Profile (January 2013), total number of employers = **6,787** every "employer" is considered a commercial generator
Total employers with 10 or more employees = **20%**
Total employers with 50 or more employees = **2%**
b Boulder Economic Council's Market Profile (2013) total number of employees = **90,830** average number of employees/employer = **13**
c Assumes no other recycling tons from other commercial generators (unlikely, but quantities are unknown)
d Based on the City's 2011 Waste Tracking Sheet - includes all reported MSW (curbside, drop-site, CHaRM, HMMF, ReSource, transfer station recovery, government buildings, CU, etc.)
e Quantities are pro-rated based on actual tonnages from overall commercial sector
f Based on assumption that recyclables are 42% of total commercial waste stream

Commercial MSW	2011	Comments
Recyclables reported in City's 2011 Waste Tracking Sheet	13,483	
Recyclables in trash (WDS waste composition summary)	16,296	36% of 45,268 trash tons
Total potential recyclables	29,779	
Percent of total tons (70,464 tons)	42%	

2012 ESTIMATION OF ADDITIONAL COSTS TO CITY - COMMERCIAL RECYCLING REQUIREMENT

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				New policy
Research	$115,300	0.08	$9,224	
Pilot Test [b] (for policy implementation only)	$77,700	0.05	$3,885	
Inter-Departmental Collaboration	$115,300	0.04	$4,612	

Individual Zero Waste Initiative Impacts

Public, EAB & Council Meetings	$115,300	0.08	$9,224	
Promotion	$77,700	0.04	$3,108	
YEAR ONE COSTS		**0.29**	**$30,053**	
ON-GOING ENFORCEMENT				
Enforcement [c]	$60,000	0.17	$10,200	Based on random auditing
ON-GOING COSTS		**0.17**	**$10,200**	

a Salaries based on senior staff ($115,300), mid-level staff ($77,700) and compliance staff ($60,000)
b Assumes City will conduct 6-month test period to both evaluate implementation issues and provide phase-in/voluntary period for start-up
c Assumes enforcement through random auditing of 10% of all businesses/year (about 700) or approximately 7 hrs/week

2012 ESTIMATION OF NEW BUSINESS COSTS - COMMERCIAL RECYCLING REQUIREMENT

POLICY OPTION	RECYCLABLE QUANTITES PER BUSINESS		MONTLY COLLECTION COSTS PER BUSINESS [c]	
	Tons/Year [a]	Cubic Yards/Week [b]	Low	High
EMPLOYERS with > 10 EMPLOYEES				
low - 30% diversion [d]	3.11	0.30	$15	$25
high - 40% diversion [e]	4.15	0.40	$20	$30
EMPLOYERS WITH 90% of TOTAL EMPLOYEES				
low - 30% diversion [d]	3.03	0.30	$15	$25
high - 40% diversion [e]	4.03	0.40	$20	$30

a Based on estimated recyclables tonnages and business numbers in the 2012 QUANTITIES ESTIMATIONS table above
b Assumes a commercial recycling density of 400 lbs/CY
c Variations are likely to occur - the more conservative assumption of cart versus dumpster service has been estimated, however
- down-sizing of trash service would ideally lead to reduced trash collection costs (trash and recyclables collection may not be provided by the same hauler)
- where multiple businesses have combined service, this capacity would need to increase (some cost savings may occur)
- where service is provided by property managers, an additional administrative charge may be included
d Assumes one 64-gal cart/weekly service would serve each business (cart capacity is about 0.65 CY)
- also based on hauler pricing reports inclusive of Trash Tax
e Assumes one 95-gal cart/weekly service would serve each business (cart capacity is about 0.95 CY)
- also based on hauler pricing reports inclusive of Trash Tax

Individual Zero Waste Initiative Impacts

INITIATIVE:	**COMMERCIAL ORGANICS RECOVERY**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2013$**
WORKSHEET TITLE:	**Commercial Organics**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INPUT

INITIATIVE DESIGN	Develop new City policy (in tandem with commercial recycling requirement)
	Require food service establishments to subscribe to organics collection (allow hardship exemption for small employers with low tonnage) - note that total food establishments represent only 16% of total City employers
	Eliminate current, on-going compost subsidy
FUTURE RECOMMENDATIONS	1) Obtain data on number/size/rate of food waste establishments, 2) Tie enforcement to other City service, otherwise City will not have data on/hammer for compliance, 3) Expand subscription requirement to all establishments, and 4) Make actual diversion of organics mandatory
DISCLAIMERS	Available data is limited to Boulder Economics' Council Market Profile (American FactFinder database does not breakdown employment size for all sectors, the City's Finance Department does not track City licenses) - as a result, assumes every "employer" is a commercial generator *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITIES ESTIMATIONS - FOOD WASTE DIVERSION REQUIREMENT

TYPE	NAICS CODE (2007)	NO. OF TOTAL EMPLOYERS [a] (2007)	NO. OF EM-PLOYEES [a] (2007)	AVERAGE NO. OF EMPLOYEES IN 2012 [b]	ESTIMATED WASTE GENERATION (tons/year) [c]	POTENTIAL DIVERSION FROM ORGANICS DIVERSION [d]		NOTES
						Low - 30%	High - 50%	
Food Manufacturing	311	22	677	688	5,271	1,581	2,635	
Supermarket/Grocery	44511	18	1,852	1,882	10,259	3,078	5,130	Excludes convenience stores
Health Care & Social Services	62	575	7,560	7,684	8,376	2,513	4,188	
Full Service Restaurants	7221	139	4,072	4,139	11,216	3,365	5,608	Customers sit while being served
Limited Service Restaurants	7222	183	2,467	2,507	7,046	2,114	3,523	Customers order/pay before being served

Individual Zero Waste Initiative Impacts

Food Service Contractors	7223	15	179	182	428	128	214	Incl government, hospital, school cafeteria
TOTAL (including existing diversion)		952	16,807	17,083	42,595	12,779	21,298	
POTENTIAL NEW DIVERSION ONLY [e]						8,575	17,094	

[a] Based on American FactFinder search for City of Boulder industrial sectors at http://factfinder2.census.gov

[b] Escalated based on population data published in Boulder Economic Council's Market Profile (January 2013)

[c] Based on waste generation rates (tons/employee-year) from Wake County, NC's 2007 commercial waste study (completed by Kessler Consulting) and CIWMB's 2006 Waste Disposal and Diversion Findings for Selected Industry Groups (prepared by Cascadia Consulting Group)

[d] Based on finding that food waste generation for food establishments is 25-55% of total waste generation (CIWMB's 'Waste Disposal and Diversion Findings for Selected Industry Groups' by Cascadia, 2006) - averages about 40% when pro-rated by generated tons

estimate for all commercial generators show food waste equals 16% of total commercial waste stream

Commercial MSW	2011	Comments
Food waste reported in City's 2011 Waste Tracking Sheet	4,204	Assumed 75% curbside commercial and MFU, 50% CU
Food waste in trash (WDS waste composition summary)	6,790	15% of 45,268 trash tons
Total potential food waste	10,994	
Percent of total tons (70,464 tons)	16%	

[e] Based on the City's 2011 Waste Tracking Sheet organics currently diverted = **4,204** includes all reported MSW (curbside, drop-site, CHaRM, HHMF, ReSource, transfer station recovery, government buildings, CU, etc.

ESTIMATE OF TOTAL FOOD ESTABLISHMENT COMPARISON: Boulder County Health Department currently inspects 859 food establishments - the 952 analyzed above probably requires adjustment once better data is available - also note that 2011 data indicates about 5,300 tons of commercial organics was collected

2012 ESTIMATION OF ADDITIONAL COSTS TO CITY - FOOD WASTE DIVERSION REQUIREMENT

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				New policy
Research	$115,300	0.08	$9,224	
Pilot Test [b] (for policy implementation only)	$77,700	0.05	$3,885	
Inter-Departmental Collaboration	$115,300	0.04	$4,612	
Public, EAB & Council Meetings	$115,300	0.08	$9,224	
Promotion	$77,700	0.04	$3,108	
YEAR ONE COSTS		**0.29**	**$30,053**	
ON-GOING ENFORCEMENT				
Enforcement [c]	$60,000	0.09	$5,400	Based on random auditing
ON-GOING COSTS		**0.09**	**$5,400**	

Individual Zero Waste Initiative Impacts

SAVINGS FROM MODIFYING CURRENT SUBSIDY				
Change Current Subsidy to Few-Time Subscribers Only	na	na	*($78,500 savings)*	

a Salaries based on senior staff ($115,300), mid-level staff ($77,700) and compliance staff ($60,000)
b Assumes City will conduct 6-month test period to both evaluate implementation issues and provide phase-in/voluntary period for start-up
c Assumes enforcement through random auditing of 20% of all businesses/year (about 200) or approximately 4 hrs/week

2012 ESTIMATION OF NEW BUSINESS COSTS - FOOD WASTE DIVERSION REQUIREMENT

	ORGANICS QUANTITES PER BUSINESS		MONTHLY COLLECTION COSTS PER BUSINESS [c]	
	Tons/ Year [a]	Cubic Yards/Week [b]	Low	High
LOW - 30% diversion [d]	13.42	0.38	$30	$40
HIGH - 50% diversion [e]	22.37	0.63	$40	$50

a Based on estimated recyclables tonnages and business numbers in the 2012 QUANTITIES ESTIMATIONS table above
b Assumes a food waste density of 1,400 lbs/CY
c Variations are likely to occur - the more conservative assumption of cart versus dumpster service has been estimated, however
- down-sizing of trash service would ideally lead to reduced trash collection costs (trash and organics collection may not be provided by the same hauler)
- where multiple businesses have combined service, this capacity would need to increase (some cost savings may occur)
- where service is provided by property managers, an additional administrative charge may be included
- available commercial organics collection prices are limited

d Assumes one 64-gal cart/twice weekly service would serve each business (cart capacity is about 0.65 CY)
- also based on hauler pricing reports inclusive of Trash Tax

e Assumes one 95-gal cart/twice weekly service would serve each business (cart capacity is about 0.95 CY)
- also based on hauler pricing reports inclusive of Trash Tax

Individual Zero Waste Initiative Impacts

INITIATIVE:	**DEPOSIT CONSTRUCTION and DEMOLITION DEBRIS PROGRAM**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Construction and Demolition Diversion**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHOR:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Revise existing Green Building policy 1) Revise mandates in BRC Chapter 10-7.5-3 to include setting a threshold of $50,000 construction value for residential and commercial construction, 2) Maintain no threshold for deconstruction projects (all are applicable), 3) Add a 50% diversion requirement for new commercial construction, 4) Add deposit for any construction or deconstruction project valued at $50,000 or more, and 5) Revise voluntary Green Points (BRC 10-7.5-4) with increased levels
	Existing markets for aggregates, cardboard, clean wood, metals and plastics - previous City LEAD/ReSource research indicated that 50% residential construction & 65% residential deconstruction is feasible given local markets and waste composition for these projects (confirmed by 2000 Florida C&D waste composition data by sectors/project type)
	Establish required deposit equal to 2% of valuation for construction and 5% for deconstruction with a cap of $25,000 - refundable (less $100 for administrative costs) with proof of diversion of minimum diversion levels when Certificate of Occupancy is issued (similar to Glendale and San Jose, CA programs)
	Current Boulder mixed-C&D processing capacity is limited to Western's manual sorting system (several local markets exist for targeted materials in Boulder and neighboring counties) - decision to pay for sorting mixed loads or source-separate on-site to be determined by contractors
	Boulder County report (UHG 2012) indicated need for 7- to 12-acre facility to serve as transfer station for source-separated CDD materials generated county-wide
FUTURE RECOM-MENDATIONS	1) Evaluate value of basing diversion requirements of construction square footage may allow more-specific requirements (this data is not currently tracked by the City's Planning and Development Services Department), 2) Obtain diversion levels and costs specific to each type of construction/deconstruction to improve implementation feasibility (data specific to miscellaneous residential, multi-family and commercial construction not available, nor is commercial deconstruction) - the only data available for this analysis included projects valued at >$500k, and 3) Increase diversion level in future by increasing diversion requirements, lowering thresholds and increasing deposits
DISCLAIMERS	Available City-specific data is limited to residential deconstruction - generation rates for other obtained from national sources *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

Individual Zero Waste Initiative Impacts

2012 QUANTITIES ESTIMATION - CONSTRUCTION and DEMOLITON DIVERSION

TYPE	NUMBER OF PROJECTS [a]	AVERAGE VALUATION [a]	WASTE GENERATION (tons/year)	ESTIMATE OF CURRENT WASTE DIVERSION [b] (tons/year)			POTENTIAL ADDITIONAL DIVERSION [c] (total less current, tons/year)			TOTAL ADDITIONAL DIVERSION (tons/year)
				25%	30%	10%	50%	50%	65%	
NEW RESIDENTIAL CONSTRUCTION										
New Residential [d]	131	$681,237	524	131	na	na	131	na	na	131
New Multi-Family [e]	237	$215,587	711	178	na	na	178	na	na	178
Additions [f]	185	$59,547	740	185	na	na	185	na	na	185
NEW NON-RESIDENTIAL CONSTRUCTION										
New Construction [g]	21	$5,939,623	567	na	170	na	na	113	na	113
Additions [h]	103	$312,961	2,781	na	834	na	na	556	na	556
DEMOLITIONS/ RAZING [i]	162	$1,920	7,614	na	na	761	na	na	4,188	4,188
TOTAL	839	na	12,937	494	1,004	761	494	670	4,188	5,351

[a] From the City Planning and Development Services 2012 PMT Structural Permits Statistics

[b] Overall current diversion levels are unknown (data is not collected) - assumptions include:

Residential = 25% rate based on assumed 50% compliance with existing 50% GBGP requirement (Western observed an average diversion rate of 34% for mixed loads of new construction in 2011, 2012

Commercial = 30% based on high level of concrete (even with no GBGP requirements) - Florida DEQ's 2000 C&D study showed 82% concrete in new commercial construction waste

Deconstruction = 10% rate based on actual 625 tons of deconstruction materials managed by ReSource in 2012

[c] Assumptions for diversion levels with new (well-enforced) policy:

Residential = 50% to reflect full compliance with GBGP requirement

Commercial = 50% to reflect potential diversion with new requirement

Deconstruction = 65% to reflect full compliance with GBGP requirement

[d] Includes individual residential units in buildings <4 units and other residential buildings - waste generation based on the National Association of Home Builders' estimate of 4 tons/new home construction (for a 2,000-sf home)

[e] Includes individual residential units in buildings with 4 or more units - waste generation based on the National Association of Home Builders' estimate for a 2,000-sf home modified by the average multi-family 1,500-sf size in 2011 (from the City Planning and Development Services' break down of Individual Permits Issues for Construction Valued at $500,000 or More)

[f] Assumes one-third of residential Additions, Alterations and Conversions are additions (alterations and conversion may not generate waste that can be diverted in Boulder and reduce ability for compliance - these projects are currently excluded from GBGP) - assume residential additions generate 4 tons each (per NAHB)

[g] Includes residential non-housekeeping and non-residential buildings - waste generation based on Department of Natural Resources, NE Region's Building Green at DNR - NE Region Headquarters Construction Waste and Recycling estimate of 2-2.5 pounds/sf of commercial construction and average commercial project size of 24,000-sf in 2011 (from the City Planning and Development Services' break down of Individual Permits Issues for Construction Valued at $500,000 or More)

Individual Zero Waste Initiative Impacts

[r] Assumes one-third of commercial Additions, Alterations and Conversions are additions (alterations and conversion may not generate waste that can be diverted in Boulder and reduce ability for compliance - these projects are currently excluded from GBGP) - assume commercial additions generate 2.25 pounds/sf and addition size is 24,000-sf

[l] Assumes average 47 tons/home, based on the City of Boulder's 2007 The City of Boulder Building Deconstruction report (prepared by the ReUse People of America, January) - full deconstruction case studies #2 through #4, average home size 3,600-sf

ESTIMATE OF TOTAL C&D GENERATED COMPARISON: In 2011, the City reported a total of 12,200 tons of C&D reused, recycled and landfilled

2012 ESTIMATION OF ADDITIONAL COSTS TO CITY - CONSTRUCTION and DEMOLITION DIVERSION

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				Revised policy with significant change
Research	$115,300	0.05	$5,765	
Pilot Test [b]	$77,700	0.1	$7,770	
Collaboration with Planning & Development Services [c]	$115,300	0.1	$11,530	
Public, EAB & Council Meetings	$115,300	0.08	$9,224	
Promotion	$77,700	0.04	$3,108	
YEAR ONE COSTS		**0.37**	**$37,397**	
ON-GOING IMPLEMENTATION				
LEAD Audits [d]	$77,700	0.16	$12,432	Ideally, many LEAD/PDS activities would ultimately be contracted to CRC/ReSource given their expertise and experience
LEAD/PDS Reviews [e]	$77,700	0.80	$62,160	
City Accounting [f]	$77,700	0.40	$31,080	
LEAD Annual Tracking/Reporting [f]	$77,700	0.40	$31,080	
ON-GOING COSTS		**1.76**	**$136,752**	

Individual Zero Waste Initiative Impacts

REVENUE FROM DEPOSIT			
Non-Refundable $100/Project	na	na	$83,900
Unrefunded Deposits Due to Non-Compliance [f]	na	na	$116,179
POTENTIAL REVENUES		na	**$200,079**

Based on 839 projects estimated in 2012 Quantities Estimation table above
Assumes City will retain administrative fee of $100/project [f]
Assumes deposit schedule established to equal an average 2% (new) to 3% (demo) of project valuation with a cap of $50,000[g] - average project deposit therefore $7,000 new construction
Assumes only 2.5% of projects fail to comply or request refund (i.e., forfeits full deposit) [h]

a Salaries based on senior staff ($115,300) and mid-level staff ($77,700)
b Assumes City will conduct 12-month test period to both evaluate implementation issues and provide phase-in/voluntary period for start-up
c Assumes effort to track types of construction by square-footage, inter-departmental review and approval of contractor submittals
d Assumes annual audits on 10% of total projects at 4 hrs/project
e Assumes 2 hrs/project
f San Jose, CA program retains minimum 1 hour (at $100/project) for compliance review plus $100 for each additional hour
g City program may vary to allow lower deposits on residential, higher on commercial and demolition (Glendale, CA and San Jose, CA use tiered system)
h Glendale, CA caps deposits at $50,000

2012 ESTIMATION OF ADDITIONAL COSTS/PROJECT - CONSTRUCTION and DEMOLITION DIVERSION [a]

TYPE	TRADITIONAL CONSTRUCTION/ DEMOLITION COSTS PER PROJECT	GREEN BUILDING/ DECONSTRUCTION COST PER PROJECT (including GBGP deposit payments)	DIFFERENTIAL COST	NOTES
NEW CONSTRUCTION (all project types) [b]	$455,420	$478,191	$22,771	Includes GBGP deposit payment = 2% (approximately $7,000/project given $50,000 cap), refundable (less $100) if City requirements are met
DEMOLITION OR DECONSTRUCTION (for 3,600-sf house) [c]	$18,000	$37,080	$19,080	Includes GBGP deposit payment - extra deconstruction costs likely off-set by tax benefits associated with used building material/durable goods donation [d]

[a] Cost of construction/demolition and green building/deconstruction efforts vary widely with type/size of projects and available data

Individual Zero Waste Initiative Impacts

[b] Assumes green building is approximately 5% more than traditional construction including additional design and construction costs, 2% GBGP deposit payment, appraisal costs, etc based on estimates from www.nrdc.org/buildinggreen/factsheets/cost.asp. Green Building Cost and Financial Benefits (for the Massachusetts Technology Collaborative by Gregory Kats, 2003) and Building a Public Portfolio of LEED Projects: The City of Seattle Experience (Athens, et., al., 2002)
- estimate of traditional costs determined by pro-rating project value by ration of number of projects to total new construction projects

[c] Based on demolition costs of $5-$6/sf and deconstruction costs of $10-$12 exclusive of 3% GBGP deposit payment (the City's 2007 The City of Boulder Building Deconstruction report (prepared by the ReUse People of America, January)

[d] Net cost of demolition can be equal to mechanical deconstruction once the after-tax value of donations are earned (The ReUse People of America, www.thereusepeople.org/deconstruction) and the City's 2007 'City of Boulder and Building Deconstruction' report (ReUse) - also indicate that appraised donation values for deconstructed Boulder homes ranged from $35-$40/sf with after-tax cash values 25-30% (exclusive of state tax benefits) could be approximately $36,000 in the deconstruction example in the 2012 Estimation of Additional Costs/Project table above

Individual Zero Waste Initiative Impacts

INITIATIVE:	**SPECIAL EVENTS**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Special Events**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	No code revision (BRC Chapter 8-3) is already a requirement for events on City property - policy to be expanded to all events that require a City Special Events permit from Parks and Recreation Department
	Increase existing security deposit to cover staff auditing time (only required for those events that don't request rebate)
	Add auditing to verify compliance
FUTURE RECOMMENDATIONS	1) Obtain data on number of participants and waste generation
DISCLAIMERS	Estimate based on literature (widely divergent) values *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITIES ESTIMATIONS - ZERO WASTE AT ALL SPECIAL EVENTS

EVENT LOCATION	NUMBER OF EVENTS	NUMBER OF PARTICIPANTS [a]	WASTE GENERATION (tons)	DIVERSION [d] (rounded to nearest 100 tons)			NOTES
				Recyclables	Organics	Total	
CITY PROPERTY	12	3,600	na	na	na	na	Zero waste diversion required
OFF CITY PROPERTY	30	9,000	na	na	na	na	Approximate actual in 2012
Zero Waste Event	18	5,400	na	na	na	na	Zero waste diversion optional
Other	12	3,600	na	na	na	na	Zero waste diversion optional
SUBTOTAL	42	12,600	na	na	na	na	
Low Waste Generation [b]	na	na	5	1	3	4	
High Waste Generation [c]	na	na	15	3	10	13	

a Assumes an average 300 participants per event (Kelle Boumansour email June 5, 2013)

b Based on 0.75 lbs/participant (Northeast Recycling Council's 2006 Best Management Practices Guidebook for Special Event-Generated Waste in Rural Communities)

c Based on 2.44 pounds/visitor (CIWMB's 'Waste Disposal and Diversion Findings for Selected Industry Groups' by Cascadia, 2006)

ESTIMATE OF GENERATION RATES COMPARISON: Council for Responsible Sports cites an average 1.9 lbs/participant for 9 sporting events in 2011 and 2012 (Keith Peters email June 21, 2013)

Individual Zero Waste Initiative Impacts

d Assumes 85% diversion with 20% recyclables (pallets, cardboard, etc.) and 80% organics (service ware, food) - trash quantities reduced by recyclables, organics quantities

2012 ESTIMATION OF ADDITIONAL CITY COSTS - ZERO WASTE AT ALL SPECIAL EVENTS

TASK	STAFF			EXPENSES	TOTAL	NOTES
	Salary [a]	FTE	Cost			
INITIAL POLICY DEVELOPMENT (first year only)						
Research	$77,700	0.02	$1,554	$0	$1,554	Includes revising deposit structure and application packet
Collaboration with Parks and Recreation Dept	$77,700	0.04	$3,108	$0	$3,108	
Public, EAB & Council Meetings	$77,700	0.04	$3,108	$0	$3,108	
Promotion	$77,700	0.08	$6,216	$0	$6,216	
YEAR ONE COSTS		**0.18**	**$13,986**	**$0**	**$13,986**	
ON-GOING REVIEW AND AUDITING						
Review Permit Applications	$77,700	0.08	$6,216	$0	$6,216	Assumed additional 3 hrs/week average
Audit Events	$77,700	0.08	$6,216	$0	$6,216	Assumed 4 hrs/event for 42 events (visit site, document, report)
Rebate	na	na	$0	$5,250	$5,250	Assumes 50% of events above apply for full rebate on annual basis
ON-GOING COSTS		**0.16**	**$12,432**	**$5,250**	**$17,682**	

a Salaries based on mid-level staff ($77,700)

Individual Zero Waste Initiative Impacts

INITIATIVE:	**CITY USE OF LOCALLY-PRODUCED COMPOST**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**City Compost Use**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Revise existing Environmental Purchasing Policy (internal policy, not codified) to address use of USCC STA-certified, locally-produced compost when quantity and quality requirements are met (the BRC Chapter 10-7.5-4 Green Building Green Points program does award points for organic soil amendment and wood mulch)
	Currently only one (Class II) permitted facility operates locally (Western Disposal Services) and produces USCC-tested compost (yard debris and food waste) and 2" mulch (also 3" mulch for free public use) - *while this policy issue may be viewed as a way to create processing competition, actual city demand is low and policy could be viewed as preferential treatment of single vendor*
	While increased compost product demand may ultimately reduce facility tip fees for feedstock, this initiative does not directly add new diverted tons
	In 2012 Western received about 23,500 tons of mixed organics and produced about 13,700 tons finished compost (some inventory overlap with 2011/2013); received 2,500 tons of wood (assume produced same weight mulch)
	City's contract with Western Disposal for yard/wood waste drop-off services included a maximum sales price back to the City organization of $12.75/CY (based on most recent 1997 contract) - Western sells finished compost and 2" mulch for $16/CY and $5/CY, respectively
	Anecdotal reports from City identified 1) More actual maintenance (medians, parks, sports fields, flower beds) than new construction/transportation projects with disturbance or turf installation, 2) Small projects use fertilizer, topsoil (preserved or purchased), etc. while large projects don't specify compost use by contractors, 3) Generally a low need for wood mulch (need weed-free product for revegetation, not growth suppression) - Forestry Division produces own wood mulch (in some years production exceeds City use), and 4) Issues include quality (inconsistent product, visible contamination (plastic), fear of biosolids compost, etc.) and cost
FUTURE RECOMMENDATIONS	1) Obtain data from individual City departments (Public Works, Parks and Recreation, Open Space, etc.) pertaining to specific quantity and quality requirements on an average annual basis - *however, given generally low demand, this is probably a low priority* , 2) Educate departments on benefits over lower quality/less expensive products and possible mulch/compost substitutions for current products, 3) Provide means for applying compost (city- or privately-owned spreader that could be available with compost purchase), and 4) Evaluate adopting Boulder County's recommendation for 3 to 6 CY of soil amendment for every 1,000-sf disturbance or improvement (CDOT currently requires 1.5 CY/1,000 SF disturbance, which may translate to compost use on about 60% of projects)

Individual Zero Waste Initiative Impacts

DISCLAIMERS	Available current/future data is limited to 2012 Boulder County study, pro-rated for estimated City demand *Analytical results are based on assumptions, estimates and data from other communities and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

2012 QUANTITY ESTIMATIONS - CITY USE OF LOCALLY-PRODUCED COMPOST [a]

TYPE	CURRENT COMPOST USE (cubic yards)		POTENTIAL ADDITIONAL COMPOST USE [d] (cubic yards)		POTENTIAL ADDITIONAL COMPOST [e] (tons)	
	Low	High	Low	High	Low	High
LOCAL GOVTS IN BOULDER COUNTY [b]	8,325	10,275	5,570	7,100	na	na
CITY OF BOULDER [b,c]	930	1,710	2,228	2,840	1,560	1,988

a Assumed no notable increase in City consumption of wood mulch based on anecdotal reports of current use and availability of Open Space/Forestry mulch

b Based on Boulder County's July 2012 Compost Market Study (using 2011 CDPHE state compost facility reports, study prepared by SERA) - usage by local governments for general use, road construction and sports complexes

c Current usage estimate based on 6,000-ton use by the City of Louisville and pro-rating remainder by the City of Boulder based on 40% of incorporated area population in Boulder County

d Basis for estimating additional use not clearly defined in Boulder County's 2012 study (but assumed to include processor/end-market acknowledgement of general business opportunity

3 Based on assumed 1400 #/cy for finished compost

2012 ESTIMATION OF ADDITIONAL CITY COSTS - CITY USE OF LOCALLY-PRODUCED MULCH/COMPOST

TASK	PERSONNEL EXPENSES			NOTES
	Salary [a]	FTE	Cost	
INITIAL POLICY DEVELOPMENT (first year only)				Revision of existing policy (internal)
Research	$115,300	0.04	$4,612	
Collaboration with Purchasing Dept	$115,300	0.04	$4,612	
Public, EAB & Council Meetings	$115,300	0.04	$4,612	
Promotion	$115,300	0.04	$4,612	
YEAR ONE COSTS		**0.16**	**$18,448**	
ON-GOING OPERATIONAL COSTS		Low	High	
Increased Use of Compost [a]		$17,824	$22,720	For expanding current use by 4,040 to 5,240 CY
ON-GOING COSTS		**$17,824**	**$22,720**	

a Salaries based on senior staff ($115,300)

kessler consulting inc.
LBA Associates

Individual Zero Waste Initiative Impacts

[a] Assumes price of current materials is 50% of finished compost (based on Boulder County Transportation Department report of $8- $10/CY cost threshold and Western Disposal's current price of $16/CY)

Individual Zero Waste Initiative Impacts

INITIATIVE:	**BOULDER COUNTY RECYCLING CENTER IMPROVEMENTS**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**MRF Improvements**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

PROJECT DESIGN	Work with County and Eco-Cycle to implement BCRC upgrades that would enable more efficient processing of greater quantities of recyclables including 1) 2 optical sorters for plastics to automate plastics sorting, which would reduce labor on plastics line from 12 to 2-3, 2) de-inking screen or optical sorter for fiber to maintain high-quality #8 ONP while reducing labor, and 3) baler and facility modifications: Eco-Cycle also indicated a 3rd baler would eliminate processing bottleneck. Cardboard currently held and baled during 2nd shift. Baling cardboard during 1st shift would enable full processing line to operate during 2nd shift, thereby doubling existing capacity[a].
FUTURE RECOMMENDATIONS	1) City should explore partnership with County and private sector partners to achieve BCRC upgrades, and 2) City should negotiate revenue sharing inter-local agreement with County regarding BCRC
DISCLAIMERS	Facility upgrades should be concurrent with initiatives to increase commercial recycling *Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*

[a] Based on input from Boulder County's BCRC facility operator (phone conversation with Lou Perez on 6/25/13)

2012 ESTIMATIONS - FACILITY UPGRADES

	PROCESSING CAPACITY (tons/year)	NO. OF EMPLOYEES/ DAY	COMMENTS
STATUS QUO	48,000	62	1 shift (50), plus cardboard baling and maintenance on
WITH PROPOSED FACILITY UPGRADES	96,000	80	2 shifts (70) and maintenance on 3rd shift (10)
POTENTIAL NEW CAPACITY	48,000	na	
ESTIMATED COSTS OF UPGRADES	**Estimated Capital Cost**		
2 Optical Sorters	800,000		Includes associated conveyors and installation
De-inking screen	250,000		Includes associated conveyors and installation

Individual Zero Waste Initiative Impacts

Baler, Facility Upgrades, Conveyors & Installation	2,000,000	Based on quote obtained by Eco-Cycle and County
TOTAL	$3,050,000	

2012 ESTIMATION OF ADDITIONAL CITY COSTS - EXPANDED MATERIAL/PROCESSING CAPABILITIES AT BCRC (rounded to nearest $100)

TASK	EXPENSES / (REVENUES)			NOTES
	Salary [a]	FTE	Cost	
Coordination & Negotiation with Public/Private Partners - Development of City Position	$115,300	0.05	$5,765	
Investment in BCRC Upgrades	NA	NA	$152,500	City of Boulder contribution is unknown & will depend on results of dicsussions with public and private partners - for the sake of identifying some potential cost, a 5% contribution was used
Potential Recycling Revenue	NA	NA	NA	Depends on results of discussions with public and private partners
YEAR ONE COSTS		**0.05**	**$158,265**	

a Salaries based on senior staff ($115,300)

Individual Zero Waste Initiative Impacts

INITIATIVE:	**EXISTING POLICY ENFORCEMENT**
DATE:	**July-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Enforcement**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHOR:	**Kessler Consulting/LBA Associates**

INITIATIVE DESIGN	Identify responsible party(ies) and evaluate means and resources for enforcing existing policy for four programs	
		PAYT Service to Single-Family Homes (3 container volumes)
		Recycling Service to Multi-Family Homes (1/3 recycling container volume)
		Greenpoint Diversion Requirements for Single-Family Homes
		Zero Waste at Special Events on City Property
DISCLAIMERS	*Analytical results are based on assumptions, estimates, and data from other communities, and are subject to change as better information becomes available - accuracy should not be construed to more than the nearest 100 tons or $1,000*	

PAYT SERVICE TO SINGLE-FAMILY HOMES

This estimate is based on the anecdotal information that Republic (serves about 3% of residences) does not offer varying trash cart sizes and picks up trash/ diverted materials on different days - Republic chose not to provide verification for this study. If Republic only offers large trash containers, their customers may have little diversion incentive. It is reported by others that Republic instead offers multiple sizes of 32-gal carts - this case they may well be as great (or greater) incentive for diversion that balances out separate collection days

NUMBER OF RESIDENCES WITH INDIVIDUAL CONTAINERS CURRENTLY SUBSCRIBING FOR SERVICE [a]		EXISTING SYSTEM & ASSUMPTIONS		POTENTIAL FUTURE SYSTEM DIVERSION		
		DIVERSION RATE [b,c] (tons/hh-year)	DIVERSION (tons/year)	DIVERSION RATE [b,c] (tons/hh-year)	DIVERSION (tons/ year)	DIFFERENTIAL (tons)
All Residents	19,029	0.63	11,988	0.64	12,179	190
Residents with Multiple Cart Sizes	18,453	0.64	11,758	na	na	na
Residents with One Cart Size [d]	576	0.40	230	na	na	na

[a] From 2012 reports from regular curbside haulers and "Homeowner Service" worksheet - these residents include SFUs, duplexes and triplexes

Individual Zero Waste Initiative Impacts

[b] Existing diversion rate from 2011 and 2012 reports from regular curbside haulers
[c] Assumed lower diversion for residents with limited cart options (assumption is not verified)
[d] Total residences less Republic's 576 residential customers in 2012

RECYCLING SERVICE TO MULTI-FAMILY HOMES

This number of existing MFU property managers that support hauler-provision of recycling containers equal to half current trash capacity is unknown
Strengthening BRC Chapter 6-12-5 to specific property manager role in full compliance (with hardship waivers as needed) may be needed

NUMBER OF MULTI-FAMILY UNITS [a]		EXISTING SYSTEM		POTENTIAL FUTURE SYSTEM DIVERSION		DIFFERENTIAL (tons)
Accounts	Homes	Diversion Rate [b] (tons/hh-year)	Diversion [b] (tons/year)	Diversion Rate [c] (tons/hh-yr)	Diversion (tons/yr)	
1,008	13,085	0.23	2,779	0.32	4,187	1,408

[a] From 2012 reports from regular curbside haulers and Homeowner Service worksheet - note that haulers do not consistently differentiate MFU and commercial accounts
[b] Based on 2011 and 2012 reports from regular curbside haulers - not difference between annual reports - leads to slight discrepancy in calculated results
[c] Assumes full compliance with current regulation increases household diversion rates closer to that observed for SFUs (0.40 tons/hh-year)
NOTE: Compliance could be achieved by increasing recycling container sizes (depending on available space) OR increasing collection frequency

GREEN BUILDING GREEN POINTS DIVERSION REQUIREMENTS FOR RESIDENCES (see also the "C&D Diversion" worksheet)

This analysis assumes only partial compliance with BRC 10-7.5 - findings are already considered in "C&D Diversion" worksheet results (and are duplicative)

TYPE	NO. OF PROJECTS [a]	AVERAGE VALUATION [a]	WASTE GENERATION (tons/year)	ESTIMATED CURRENT WASTE DIVERSION [b] (tons/year)		POTENTIAL ADDITIONAL DIVERSION WITH FULL COMPLIANCE (total less current, tons/year)	
				25%	10%	50%	65%
NEW RESIDENTIAL CONSTRUCTION							
New Residential [c]	131	$681,237	524	131	na	131	na
New Multi-Family [d]	237	$215,587	711	178	na	178	na
Additions [e]	185	$59,547	740	185	na	185	na
DEMOLITIONS/ RAZING [f]	162	$1,920	7,614	na	761	na	4,188
TOTAL	715	na	9,589	494	761	494	4,188

Individual Zero Waste Initiative Impacts

[a] From the City Planning and Development Services 2012 PMT Structural Permits Statistics and the C&D Diversion worksheet

[b] Overall current diversion levels are unknown (data is not collected) - assumptions include:

Residential = 25% rate based on assumed 50% compliance with existing 50% GBGP requirement (Western observed an average diversion rate of 34% for mixed loads of new construction in 2011, 2012)

Deconstruction = 10% rate based on actual 625 tons of deconstruction materials managed by ReSource in 2012

[c] Includes individual residential units in buildings <4 units and other residential buildings - waste generation based on the National Association of Home Builders' estimate of 4 tons/new home construction (for a 2,000-sf home)

[d] Includes individual residential units in buildings with 4 or more units - waste generation based on the National Association of Home Builders' estimate for a 2,000-sf home modified by the average multi-family 1,500-sf size in 2011 (from the City Planning and Development Services' break down of Individual Permits Issues for Construction Valued at $500,000 or More)

[e] Assumes one-third of Additions, Alterations and Conversions are additions (alterations and conversion may not generate waste that can be diverted in Boulder and reduce ability for compliance - these projects are currently excluded from GBGP)

[f] Assumes average 47 tons/home, based on the City of Boulder's 2007 The City of Boulder Building Deconstruction report (prepared by the ReUse People of America, January) - full deconstruction case studies #2 through #4, average home size 3,600 square feet

ZERO WASTE AT SPECIAL EVENTS ON CITY PROPERTY (see also the "Special Events" worksheet)

This analysis assumes that all events on City property do not currently achieve zero waste diversion - findings are already considered in "Special Events" worksheet results (and are duplicative)

EVENT LOCATION	NUMBER OF EVENTS	NUMBER OF PARTICIPANTS [a]	WASTE GENERATION	DIVERSION [d] (rounded to nearest 100 tons)		
				Recyclables	Organics	Total
CITY PROPERTY	12	3,600	na	na	na	na
Low Waste Generation [b]	na	na	1	0	1	1
High Waste Generation [c]	na	na	4	1	3	4

[a] Assumes an average 300 participants per event (Kelle Boumansour email June 5, 2013)

[b] Based on 0.75 lbs/participant (Northeast Recycling Council's 2006 "Best Management Practices Guidebook for Special Event-Generated Waste in Rural Communities")

[c] Based on 2.44 pounds/visitor (Cascadia's 2006 "Waste Disposal and Diversion Findings for Selected Industry Groups")

ESTIMATE OF GENERATION RATES COMPARISON: Council for Responsible Sports cites an average 1.9 lbs/participant for 9 sporting events in 2011 and 2012 (Keith Peters email June 21, 2013)

[d] Assumes 85% diversion with 20% recyclables (pallets, cardboard, etc.) and 80% organics (service ware, food) - trash quantities reduced by recyclables, organics quantities

2012 ESTIMATION OF ADDITIONAL CITY COSTS - ENFORCE EXISTING POLICIES

TASK	STAFF			EXPENSES	TOTAL	NOTES
	Salary [a]	FTE	Cost			

Individual Zero Waste Initiative Impacts

PAYT SERVICE TO SFUs and RECYCLING SERVICE TO MFUs (combined)						Revise existing policy
Research	$115,300	0.02	$2,306	$0	$2,306	
Public, EAB & Council Meetings	$115,300	0.02	$2,306	$0	$2,306	
Promotion	$77,700	0.04	$3,108	$0	$3,108	
RESIDENTIAL RECYCLING ONE-TIME POLICY COSTS		**0.08**	**$7,720**	**$0**	**$7,720**	
GREEN BUILDING GREEN POINTS DIVERSION REQUIREMENTS FOR RESIDENCES						
LEAD Audits [b]	$77,700	0.15	$11,655	$0	$11,655	These costs duplicate those in "C&D Diversion" worksheet
LEAD/PDS Reviews [c]	$77,700	0.70	$54,390	$0	$54,390	
LEAD Annual Tracking/Reporting [d]	$77,700	0.35	$27,195	$0	$27,195	
GBGP ENFORCEMENT ON-GOING COSTS		**1.20**	**$93,240**	**$0**	**$93,240**	
ZERO WASTE AT SPECIAL EVENTS						
Review Permit Applications [e]	$77,700	0.03	$2,331	$0	$2,331	These costs duplicate those in "Special Events" worksheet
Audit Events [f]	$77,700	0.02	$1,554	$0	$1,554	
Rebate [g]	na	na	$0	$1,500	$1,500	
ZERO WASTE EVENT ON-GOING COSTS		**0.05**	**$3,885**	**$1,500**	**$5,385**	

a Salaries based on senior staff ($115,300), mid-level staff ($77,700) and compliance staff ($60,000)
b Assumes annual audits on 10% of total projects at 4 hrs/project
c Assumes 2 hrs/project
d Assumes 1 hr/project
e Assumes an additional 1 hr per week
f Assumes 4 hours/event (12 events)
f Assumes 50% of events apply for full rebate

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

ZERO WASTE SCENARIO	DIVERSION (rounded to nearest 100 tons)					CITY COSTS (REVENUES) (rounded to nearest $1000)			CUSTOMER COSTS ($/month)	GHGS (nearest 100 $mtCO_2e$)			
	2020		2027			Initial	On-Going ($/year)			2020		2027	
	Low	High	Low	High	% Diver-sion [a]		2020	2027	2020 & 2027	Low	High	Low	High
GREATEST DIVERSION													
Every Other Week Trash Collection	13,400	28,800	25,300	50,000	79.0%	$105,000	($44,700)	($73,600)	$2 to $3	(13,600)	(37,800)	(31,700)	(71,100)
Homeowner Collection Service									$11 to $25				
Commercial Recycling									$15 to $30				
Commercial Organics Recovery									$30 to $50				
CDD Deposit Program									$13,800 per project				
LOWEST CITY COSTS													
Every Other Week Trash Collection	4,000	5,900	9,800	14,300	51.9%	$92,000	($58,700)	($72,000)	$2 to $3	(4,400)	(6,200)	(10,600)	(15,100)
Homeowner Collection Service									$11 to $25				
MFU Composting									$3 to $4				
Take-Out Packaging									$2 to $6				
CDD Deposit Program									$13,800 per project				
LOWEST CUSTOMER COSTS													
Every Other Week Trash Collection	10,900	26,100	19,300	43,100	73.8%	$80,000	$7,000	$2,000	$2 to $3	(10,800)	(34,800)	(24,700)	(63,300)
MFU Composting [b]									$3 to $4				
Take-Out Packaging									$2 to $6				
Commercial Recycling									$15 to $30				
Commercial Organics Recovery									$30 to $50				

[a] Calculated for 2027 high tons only - based on 54,100 tons diverted/131,00 tons reported by the City in 2011 (Annual Waste Inventory)

[b] Also includes $15 to $25 start-up cost for kitchen composting pail

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

SCENARIO:	**GREATEST DIVERSION & GREATEST GREENHOUSE GAS EMISSION REDUCTIONS**
DATE:	**August-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Greatest Diversion & Greatest GHG Reductions - Bundled Scenario**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

ZERO WASTE SCENARIO COMPONENTS (INDIVIDUAL ANALYSES)	Every other week residential trash collection (see EOW Trash worksheet in Attachment D)
	Homeowner collection service (see Homeowner Service worksheet in Attachment D)
	Commercial recycling (see Commercial Recycling worksheet in Attachment D)
	Commercial organics recovery (see Commercial Organics worksheet in Attachment D)
	Deposit CDD program (see Construction and Demolition Diversion worksheet in Attachment D)

PROJECT DIVERSION QUANTITY INCREASES OVER PLANNING PERIOD

INITIATIVES	POTENTIAL DIVERSION from INDIVIDUAL ANALYSIS (NEW TONS ONLY)						POTENTIAL DIVERSION from BUNDLED ANALYSIS (NEW TONS ONLY)											
							Projected for Year 2020 [a]						Projected for Year 2027					
	Low		High		na		Low		High		na		Low		High		na	
EVERY OTHER WEEK COLLECTION																		
Recyclables	110%	761	120%	1,522	na	na	105%	491	110%	982	na	na	110%	1,210	120%	2,421	na	na
Organics	140%	1,751	180%	3,501	na	na	120%	1,129	140%	2,259	na	na	140%	2,784	180%	5,567	na	na
HOMEOWNER COLLECTION SERVICE [c]							*Assume 1.2% (2020) to 1.4% (2027) increase in service area (included in EOW collection above)*											
COMMERCIAL RECYCLING [d]																		
	30%	5,542	40%	11,884	na	$105,000	25%	2,550	35%	9,368	na	na	30%	6,295	45%	17,098	na	na
COMMERCIAL ORGANICS RECOVERY [d]																		
	30%	8,575	50%	17,094	na	na	25%	6,929	40%	13,799	na	na	30%	9,738	50%	19,414	na	na
TOTAL NON-C&D TONS	**na**	**16,629**	**na**	**34,001**	**na**	**na**	**na**	**11,099**	**na**	**26,408**	**na**	**0**	**na**	**20,027**	**na**	**44,500**	**na**	**na**
	Residential Construction		**Non-Residential Construction**		**Demolition**		**Residential Construction**		**Non-Residential Construction**		**Demolition**		**Residential Construction**		**Residential Construction**		**Demolition**	
DEPOSIT CDD PROGRAM																		
	50%	494	50%	670	65%	4,188	35%	212	40%	360	35%	2,047	50%	561	50%	760	65%	4,756

[a] 2020 quantities increased by the ratio of 2020 projected/2012 actual population = **1.08** based on the Boulder Economic Council's Market Profile (January 2013)

[b] 2027 quantities increased by the ratio of 2027 projected/2012 actual population = **1.14** based on the Boulder Economic Council's Market Profile (January 2013)

[c] If all of unsubscribed homeowners subscribed, 40% more homes would receive curbside trash, recyclables and organics collection (most non-subscribers are assumed to be residential)

[d] Assumes commercial diversion programs may achieve higher successes earlier in the planning period

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APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

PROJECTED GREENHOUSE GAS EMISSION REDUCTIONS OVER PLANNING PERIOD

	ON-GOING ANNUAL REDUCTIONS - 2020				ON-GOING ANNUAL REDUCTIONS - 2027			
	Tons		$mtCO_2E$		Tons		$mtCO_2E$	
	low	high	low	high	low	high	low	high
MIXED RECYCLABLES	3,041	10,350	(9,365)	(31,879)	7,505	19,519	(23,115)	(60,118)
MIXED ORGANICS								
Yard debris	565	1,129	(62)	(124)	1,392	2,784	(153)	(306)
Food waste	7,494	14,928	(1,574)	(3,135)	11,130	22,198	(2,337)	(4,661)
MIXED C&D DEBRIS								
New Construction	572		(571)	(571)	1,321		(1,317)	(1,317)
Demolition	2,047		(2,041)	(2,041)	4,756		(4,742)	(4,742)
TOTAL REDUCTIONS	na	na	**(13,613)**	**(37,750)**	na	na	**(31,664)**	**(71,144)**

PROJECTED CITY COSTS OVER PLANNING PERIOD (in 2012$)

	INITIAL DEVELOPMENT (one time investment)		ON-GOING ANNUAL COSTS - 2020			ON-GOING ANNUAL COSTS - 2027			NOTES
	Personnel [a]		Personnel [a]		Other	Personnel [a]		Other	
	FTEs	Cost	FTEs	Cost	(Revenues)	FTEs	Cost	(Revenues)	
EVERY OTHER WEEK COLLECTION	0.30	$28,950	0.00	$0	$0	0.00	$0	$0	Combine development
HOMEOWNER COLLECTION SERVICE			0.05	$3,000	$0	0.00	$0	$0	
COMMERCIAL RECYCLING	0.40	$38,600	0.17	$10,200	$0	0.00	$0	$0	Combine development
COMMERICAL ORGANICS RECOVERY			0.09	$5,400	$0	0.00	$0	$0	
DEPOSIT CDD PROGRAM [b]	0.37	$37,397	1.76	$136,752	($200,002)	0.88	$68,376	($141,948)	2027 staffing & unrefunded deposits reduced by 50%
TOTAL CITY COSTS	na	**$104,947**	na	**$155,352**	**($200,002)**	na	**$68,376**	**($141,948)**	

[a] Where program staffing is combined, costs are based on 50% FTEs at $115,300 annual salary, 50% on $77,700

[b] Some of these costs may ultimately be shifted to ReSource (especially auditing, reviewing and reporting)

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

PROJECTED CUSTOMER COSTS OVER PLANNING PERIOD (in 2012$)

	PAYEE	INITIAL DEVELOPMENT (one time investment)	ON-GOING ANNUAL COST INCREASE - 2020 [a]	ON-GOING ANNUAL COST INCREASE - 2027
EVERY OTHER WEEK COLLECTION	Residential homeowner	$0	$2 to $3/month	$2 to $3/month
HOMEOWNER COLLECTION SERVICE				
Residential	Residential homeowner	$0	$20 to $25/month	$20 to $25/month
Multi-family	Multi-family homeowner	$0	$11 to $16/month	$11 to $16/month
COMMERCIAL RECYCLING	Businesses	$0	$15 to $30/month	$15 to $30/month
COMMERCIAL ORGANICS RECOVERY	Food establishments	$0	$30 to $50/month	$30 to $50/month
DEPOSIT CDD PROGRAM [b]				
New construction	Project owners	$0	$13,763/project	$13,763
Demolition [c]	Project owners	$0	$0	$0

[a] Assumes 2020/2027 service levels and costs based on mature participation levels (i.e., no reduced service levels at mid-year point)

[b] Assumes deposits are refunded less $100 administrative fee

[c] Assumes costs off-set by donations

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

SCENARIO:	**LOWEST CITY COSTS**
DATE:	**August-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Lowest City Costs - Bundled Scenario**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

ZERO WASTE SCENARIO COMPONENTS (INDIVIDUAL ANALYSES)	Every other week residential trash collection (see EOW Trash worksheet in Attachment D)
	Homeowner collection service (see Homeowner Service worksheet in Attachment D)
	Multi-family composting (see MFU Composting worksheet in Attachment D)
	Take-out packaging (see Take-Out Packaging worksheet in Attachment D)
	Deposit CDD program (see Construction and Demolition Diversion worksheet in Attachment D)

PROJECT DIVERSION QUANTITY INCREASES OVER PLANNING PERIOD

INITIATIVES	POTENTIAL DIVERSION from INDIVIDUAL ANALYSIS (NEW TONS ONLY)						POTENTIAL DIVERSION from BUNDLED ANALYSIS (NEW TONS ONLY)											
							Projected for Year 2020 [a]						Projected for Year 2027					
	Low		High		na		Low		High		na		Low		High		na	
EVERY OTHER WEEK COLLECTION																		
Recyclables	110%	761	120%	1,522	na	na	105%	491	110%	982	na	na	110%	1,210	120%	2,421	na	na
Organics	140%	1,751	180%	3,501	na	na	120%	1,129	140%	2,259	na	na	140%	2,784	180%	5,567	na	na
HOMEOWNER COLLECTION SERVICE [c]							*Assume 1.2% (2020) to 1.4% (2027) increase in service area (included in EOW collection above)*											
MFU COMPOSTING																		
	20%	317	30%	583	na	na	10.0%	53	15%	197	na	na	20%	359	30%	662	na	na
TAKE-OUT PACKAGING																		
	15%	78	30%	157	na	na	7.5%	42	15%	84	na	na	15%	89	30%	178	na	na
TOTAL NON-C&D TONS	**na**	**2,907**	**na**	**5,764**	**na**	**na**	**na**	**1,716**	**na**	**3,522**	**na**	**na**	**na**	**4,442**	**na**	**8,828**	**na**	**na**
	Residential Construction		**Residential Construction**		**Demolition**		**Residential Construction**		**Residential Construction**		**Demolition**		**Residential Construction**		**Residential Construction**		**Demolition**	
DEPOSIT CDD PROGRAM																		
	50%	494	50%	670	65%	4,188	35%	212	40%	360	35%	2,047	50%	561	50%	760	65%	4,756

[a] 2020 quantities increased by the ratio of 2020 projected/2012 actual population = **1.08** based on the Boulder Economic Council's Market Profile (January 2013)

[b] 2027 quantities increased by the ratio of 2027 projected/2012 actual population = **1.14** based on the Boulder Economic Council's Market Profile (January 2013)

[c] If all of unsubscribed homeowners subscribed, 40% more homes would receive curbside trash, recyclables and organics collection (most non-subscribers are assumed to be residential)

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

PROJECTED GREENHOUSE GAS EMISSION REDUCTIONS OVER PLANNING PERIOD

	ON-GOING ANNUAL REDUCTIONS - 2020				ON-GOING ANNUAL REDUCTIONS - 2027			
	Tons		$mtCO_2E$		Tons		$mtCO_2E$	
	low	high	low	high	low	high	low	high
MIXED RECYCLABLES	512	1,024	(1,577)	(3,155)	1,255	2,510	(3,865)	(7,729)
MIXED ORGANICS								
Yard debris	565	1,129	(119)	(137)	1,392	2,784	(292)	(585)
Compostable packaging	21	42	(4)	(9)	45	89	(9)	(19)
Food waste	618	1,326	(130)	(279)	1,751	3,446	(368)	(724)
MIXED C&D DEBRIS								
New construction	572		(571)	(571)	1,321		(1,317)	(1,317)
Demolition	2,047		(2,041)	(2,041)	4,756		(4,742)	(4,742)
TOTAL REDUCTIONS	**na**	**na**	**(4,442)**	**(6,192)**	**na**	**na**	**(10,593)**	**(15,116)**

PROJECTED CITY COSTS OVER PLANNING PERIOD (in 2012$)

	INITIAL DEVELOPMENT (one time investment)		ON-GOING ANNUAL COSTS - 2020			ON-GOING ANNUAL COSTS - 2027			NOTES
	Personnel [a]		Personnel [a]		Other	Personnel [a]		Other	
	FTEs	Cost	FTEs	Cost	(Revenues)	FTEs	Cost	(Revenues)	
EVERY OTHER WEEK COLLECTION	0.30	$28,950	0.00	$0	$0	0.00	$0	$0	Combine development
HOMEOWNER COLLECTION SERVICE			0.05	$3,000	$0	0.00	$0	$0	
MFU COMPOSTING	0.12	$12,332	0.00	$0	$0	0.00	$0	$0	
TAKE-OUT PACKAGING	0.14	$13,100	0.22	$1,554	$0	0.22	$1,554	$0	
DEPOSIT CDD PROGRAM [b]	0.37	$37,397	1,76	$136,752	($200,002)	0.88	$68,376	($141,948)	2027 staffing & unrefunded deposits reduced by 50%
TOTAL CITY COSTS	**na**	**$91,779**	**na**	**$141,306**	**($200,002)**	**na**	**$69,930**	**($141,948)**	

[a] Where program staffing is combined, costs are based on 50% FTEs at $115,300 annual salary, 50% on $77,700

[b] Some of these costs may ultimately be shifted to ReSource (especially auditing, reviewing and reporting)

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APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

PROJECTED CUSTOMER COSTS OVER PLANNING PERIOD (in 2012$)

	PAYEE	INITIAL DEVELOPMENT (one time investment)	ON-GOING ANNUAL COST INCREASE - 2020 [a]	ON-GOING ANNUAL COST INCREASE - 2027
EVERY OTHER WEEK COLLECTION	Residential homeowner	$0	$2 to $3/month	$2 to $3/month
HOMEOWNER COLLECTION SERVICE				
Residential	Residential homeowner	$0	$20 to $25/month	$20 to $25/month
Multi-family	Multi-family homeowner	$0	$11 to $16/month	$11 to $16/month
MFU COMPOSTING	Multi-family homeowner	$15 to $25 (kitchen pail)	$3 to $4/month	$3 to $4/month
TAKE-OUT PACKAGING	Homeowner (equivalent)	$0	$2 to $6/month	$2 to $6/month
DEPOSIT CDD PROGRAM [b]				
New construction	Project owners	$0	$13,763/project	$13,763
Demolition [c]	Project owners	$0	$0	$0

[a] Assumes 2020/2027 service levels and costs based on mature participation levels (i.e., no reduced service levels at mid-year point)
[b] Assumes deposits are refunded less $100 administrative fee
[c] Assumes costs off-set by donations

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

SCENARIO:	**LOWEST CUSTOMER COSTS (WASTE GENERATOR COSTS)**
DATE:	**August-13**
COST ESTIMATE BASIS:	**Conceptual Estimate, 2012$**
WORKSHEET TITLE:	**Lowest Customer Costs - Bundled Scenario**
PROJECT:	**City of Boulder Zero Waste Evaluation Study**
AUTHORS:	**Kessler Consulting/LBA Associates**

ZERO WASTE SCENARIO COMPONENTS (INDIVIDUAL ANALYSES)	Every other week residential trash collection (see EOW Trash worksheet in Attachment D)
	Multi-family composting (see MFU Composting worksheet in Attachment D)
	Take-out packaging (see Take-Out Packaging worksheet in Attachment D)
	Commercial recycling (see Commercial Recycling worksheet in Attachment D)
	Commercial organics recovery (see Commercial Organics worksheet in Attachment D)

PROJECT DIVERSION QUANTITY INCREASES OVER PLANNING PERIOD

INITIATIVES	POTENTIAL DIVERSION from INDIVIDUAL ANALYSIS (NEW TONS ONLY)				POTENTIAL DIVERSION from BUNDLED ANALYSIS (NEW TONS ONLY)							
					Projected for Year 2020 [a]				Projected for Year 2027 [b]			
	Low		High		Low		High		Low		High	
EVERY OTHER WEEK COLLECTION												
Recyclables	110%	761	120%	1,522	105%	409	110%	818	110%	864	120%	1,729
Organics	140%	1,751	180%	3,501	120%	941	140%	1,882	140%	1,988	180%	3,977
MFU COMPOSTING												
	20%	317	30%	583	10.0%	53	15%	197	20%	359	30%	662
TAKE-OUT PACKAGING												
	15%	78	30%	157	7.5%	42	15%	84	15%	89	30%	178
COMMERCIAL RECYCLING [c]												
	30%	5,542	40%	11,884	25%	2,550	35%	9,368	30%	6,295	45%	17,098
COMMERCIAL ORGANICS RECOVERY [c]												
	30%	8,575	50%	17,094	25%	6,929	40%	13,799	30%	9,738	50%	19,414
TOTAL NEW TONS	**na**	**17,024**	**na**	**34,741**	**na**	**10,925**	**na**	**26,149**	**na**	**19,334**	**na**	**43,058**

APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

[a] 2020 quantities increased by the ratio of 2020 projected/2012 actual population = **1.08** based on the Boulder Economic Council's Market Profile (January 2013)
[b] 2027 quantities increased by the ratio of 2027 projected/2012 actual population = **1.14** based on the Boulder Economic Council's Market Profile (January 2013)
[c] Assumes commercial diversion programs may achieve higher successes earlier in the planning period

PROJECTED GREENHOUSE GAS EMISSION REDUCTIONS OVER PLANNING PERIOD

	ON-GOING ANNUAL REDUCTIONS - 2020				ON-GOING ANNUAL REDUCTIONS - 2027			
	Tons		$mtCO_2e$		Tons		$mtCO_2e$	
	low	high	low	high	low	high	low	high
MIXED RECYCLABLES	2,980	10,229	(9,178)	(31,504)	7,204	18,916	(22,187)	(58,262)
MIXED ORGANICS								
Yard debris	471	941	(99)	(198)	994	1,988	(209)	(418)
Compostable packaging	21	42	(4)	(9)	45	89	(9)	(19)
Food waste	7,453	14,937	(1,565)	(3,137)	11,092	22,065	(2,329)	(4,634)
TOTAL REDUCTIONS	**10,925**	**26,149**	**(10,846)**	**(34,848)**	**19,334**	**43,058**	**(24,734)**	**(63,333)**

PROJECTED CITY COSTS OVER PLANNING PERIOD (in 2012$)

	INITIAL DEVELOPMENT (one time investment)		ON-GOING ANNUAL COSTS - 2020			ON-GOING ANNUAL COSTS - 2027			NOTES
	Personnel [a]		Personnel [a]		Other	Personnel [a]		Other	
	FTEs	Cost	FTEs	Cost	(Revenues)	FTEs	Cost	(Revenues)	
EVERY OTHER WEEK COLLECTION	0.17	$16,217	0.00	$0	$0	0.00	$0	$0	
MFU COMPOSTING	0.12	$12,332	0.00	$0	$0	0.00	$0	$0	
TAKE-OUT PACKAGING	0.14	$13,100	0.22	$1,554	$0	0.22	$1,554	$0	
COMMERCIAL RECYCLING	0.40	$38,600	0.17	$0	$0	0.00	$0	$0	Combine development
COMMERICAL ORGANICS RECOVERY			0.09	$5,400	$0	0.00	$0	$0	
TOTAL CITY COSTS	**na**	**$80,249**	**na**	**$6,954**	**$0**	**na**	**$1,554**	**$0**	

[a] Where program staffing is combined, costs are based on 50% FTEs at $115,300 annual salary, 50% on $77,700

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APPENDIX E

ZERO WASTE SCENARIO (BUNDLED INITIATIVES) IMPACTS SUMMARY TABLE

PROJECTED CUSTOMER COSTS OVER PLANNING PERIOD (in 2012$)

	PAYEE	INITIAL DEVELOPMENT (one time investment)	ON-GOING ANNUAL COST INCREASE - 2020 [a]	ON-GOING ANNUAL COST INCREASE - 2027
EVERY OTHER WEEK COLLECTION	Residential homeowner	$0	$2 to $3/month	$2 to $3/month
MFU COMPOSTING	Multi-family homeowner	$15 to $25 (kitchen pail)	$3 to $4/month	$3 to $4/month
TAKE-OUT PACKAGING		$0	$2 to $6/month	$2 to $6/month
COMMERCIAL RECYCLING	Businesses	$0	$15 to $30/month	$15 to $30/month
COMMERCIAL ORGANICS RECOVERY	Food establishments	$0	$30 to $50/month	$30 to $50/month

[a] Assumes 2020/2027 service levels and costs based on mature participation levels (i.e., no reduced service levels at mid-year point)

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (EXISTING PROGRAMS)[1] (MTCO2e/Ton of Material Collected)[2]

MIXED RECYCLABLES (BVSD/Community Gardens and Boulder County Hazardous Materials Management Facility Programs)

	Emissions (+) or Reductions (-)		Mixed Recyclables					
		Avoided Disposal	BVSD/Community Gardens		County Hazardous Materials Mgmt Facility		City Gov't Diversion Collection (employees - med)[4]	
ICLEI's Material Categories[2]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Tons	$mtCO_2e$	Tons	$mtCO_2e$	Tons	$mtCO_2e$
Mixed recyclables	-2.8	-0.28	10	-32	71	-219	124	-382

ORGANICS DIVERSION (Commercial Compost Subsidies, Yard/Wood Waste Drop Sites and City Government Collection Programs)

	Emissions (+) or Reductions (-)		Assumptions for Organics programs' organics composition, in %, with Tons/year and $mtCO_2e$ by material type[5]											
		Avoided Disposal	Composting Subsidy (business - medium)			Yard Waste DOC (trips - medium)			Wood Waste DOC (trips - medium)			City Govt Diversion Collection (employees - medium)[6]		
ICLEI's Material Categories[3]	Fertilizer production displacement credit	Landfill with gas collection & energy recovery	Assumed composition	Tons	$mtCO_2e$	Assumed composition	Tons	$mtCO_2e$	Assumed composition	Tons	$mtCO_2e$	Assumed composition	Tons	$mtCO_2e$
Food Waste	-0.03	-0.21	60%	2,812	-675	0%	0	0	0%	0	0	75%	57	-14
Yard Trimmings	-0.03	-0.11	40%	1,874	-262	75%	5,989	-838	0%	0	0	25%	19	-3
Grass	-0.03	-0.1	0%	0	0	15%	1,198	-156	0%	0	0	0%	0	0
Leaves	-0.03	-0.08	0%	0	0	10%	799	-88	0%	0	0	0%	0	0
Branches	-0.03	-0.17	0%	0	0	0%	0	0	100%	1,980	-396	0%	0	0
			100%	4,686	-937	100%	7,985	-1,082	100%	1,980	-396	100%	76	-16

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APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (EXISTING PROGRAMS)[1] (MTCO2e/Ton of Material Collected)[2]

HARD-TO-RECYCLE- MATERIALS (CHaRM Facility Program)

	Emissions (+) or Reductions (-)								
		Avoided Disposal							
ICLEI's Material Categories [2]	Recycled v. virgin inputs	Landfill with gas collection & energy recovery	Tons [7]	$mtCO_2e$	Allocation of CHaRM's material categories[4]				
Mixed Recyclables	-2.8	-0.28	43	-132	Single-stream materials				
Polystyrene	NA	-0.04	11	-0.4	Polystyrene foam				
Food Waste [5]	N/A	-0.21	7.4	-2	Food scraps drop-off; Cooking oil				
Textbooks	-3.11	-0.58	55	-202	Books				
Dimensional Lumber	-2.46	-0.21	33	-89	Wood pallets				
Mixed Paper (office)	-3.59	-0.34	10	-38	Shredding				
Mixed Metals	-3.97	-0.04	276	-1,107	Bikes & bike parts; Fire extinguishers; Metals (scrap)				
Mixed Plastics	-0.98	-0.04	35	-36	Yoga mats, durable plastic, plastic bags, pallet wrap				
Tires	-0.39	-0.04	3	-1	Bike tires/tubes				
Carpet	-2.37	-0.04	14	-34	Textiles & shoes				
Personal Computers	-2.35	-0.04	238	-569	Electronics; Cell phones & cartridges				
Concrete	-0.01	-0.04	21	-1	Porcelain				
			747	**-2,212**					

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (EXISTING PROGRAMS)[1] (MTCO2e/Ton of Material Collected)[2]

USED BUILDING MATERIALS (RESOURCE CENTER CUSTOMER SERVICE and 6400 ARAPAHOE OPERATIONS PROGRAMS)

	Emissions (+) or Reductions (-)		Total Ts:	1554						
		Avoided Disposal								
ICLEI's Material Categories [2]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Assumed composi-tion [8]	Tons	$mtCO_2e$	Material assump-tions				
Glass	-0.28	-0.04	1.0%	16	-5					
Dimensional Lumber	-2.46	-0.21	19.0%	295	-788	Includes wood pallets, treated wood, and untreated wood				
Medium-Density Fiberboard	-2.47	-0.21	2.0%	31	-83	Estimation				
Mixed Paper (general)	-3.52	-0.34	1.3%	20	-78					
Mixed Metals	-3.97	-0.04	6.2%	96	-386	Includes small appliances				
Mixed Plastics	-0.98	-0.04	1.1%	17	-17					
Carpet	-2.37	-0.04	1.6%	25	-60	Includes furniture/bulky				
Personal Computers	-2.35	-0.04	0.1%	2	-4					
Concrete	-0.01	-0.04	16.5%	256	-13					
Asphalt Concrete	-0.08	-0.04	16.5%	256	-31					
Asphalt Shingles	-0.09	-0.04	14.0%	218	-28					
Drywall	0.03	-0.07	10.0%	155	-6					
Fiberglass Insulation	NA	-0.04	0.2%	3	-0.1					
Vinyl Flooring	NA	-0.04	1.0%	16	-0.6	Estimation				
Wood Flooring	NA	-0.02	0.5%	8	-0.1					
Yard Trimmings [3]	NA	-0.11	3.0%	47	-7					
Inert materials	NA	0	6.0%	93	0	Dirt/sand (no GHG impacts) included here				
			100.0%	1,554	**-1,508**					

[1] From Sec. 3, "Recycling and Composting Emissions Protocol, For Estimating Greenhouse Gas Emissions and Emissions Reductions Associated with Community Level Recycling and Composting" (v1.0 July 2013, ICLEI-Local Governments for Sustainability USA) from www.icleiusa.org/tools/ghg-protocol/recycling-and-composting-emissions-protocol

[2] Draws from Table 3.2 from ICLEI report for recycling [ibid]

[3] Draws from Table 3.3 from ICLEI report for composting [ibid]

[4] Mixed recyclables are calculated as 62% of the 200 Tons/Year collected from City Government Diversion operations

[5] Assumptions for breakdown of organics materials, for programs that include any percent of Organics diversion

[6] Organics are calculated as 38% of the 200 Tons/Year collected from City Government Diversion operations

[7] For Hard-to-Recycle Materials, used "2012 CHaRM Report," and its material categories, from Eco-Cycle, based on City of Boulder customers only

[8] Assumed percentages for UBM composition from *Boulder County's* "Construction and Demolition Infrastructure Study", December 2011, by UHG Consulting

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (FUTURE INITATIVES)[1] (MTCO2e/Ton of Material Collected)[2]

MIXED RECYCLABLES

	Emissions (+) or Reductions (-)			Mixed Recyclables											
		Avoided Disposal		Every-Other-Week Residential Trash Collection		Mandatory Homeowner Collection Service		Zero Waste at All Special Events		Enforce Existing Policies: PAYT Service to SFUs		Enforce Existing Policies: Recycling Service to MFUs		Commercial Recycling Requirement[7]	
ICLEI's Material Categories[3]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Diversion Level	Tons	$mtCO_2e$	Tons	$mtCO_2e$	Tons	$mtCO_2e$	Tons[4]	$mtCO_2e$	Tons	$mtCO_2e$	Tons	$mtCO_2e$
Mixed recyclables	-2.8	-0.28	Low	761	-2,344	4,752	-14,635	1	-2	127	-391	1,408	-4,337	5,542	-17,070
			High	1,522	-4,689			3	-8					11,884	-36,603

ORGANICS DIVERSION

	Emissions (+) or Reductions (-)			Assumptions for Organics programs' organics composition, in %, with Tons/year and MTCO2e by material type[5]																	
		Avoided Disposal		Every-Other-Week Residential Trash Collection[6]			Hauler Provision of Organics Collection to MF Accounts			Mandatory Homeowner Collection Service			Commercial Food Waste Diversion Requirement			Zero Waste at All Special Events			Enforce Existing Policies: PAYT Service to SFUs		
ICLEI's Material Categories[2]	Fertilizer production displacement credit	Landfill with gas collection & energy recovery	Diversion Level	Assumed compos-ition	Tons	$mtCO_2e$	Assumed compos-ition	Tons	$mtCO_2e$	Assumed compos-ition	Tons	$mtCO_2e$	Assumed compos-ition	Tons	$mtCO_2e$	Assumed compos-ition	Tons	$mtCO_2e$	Assumed compos-ition	Tons	$mtCO_2e$
Food Waste	-0.03	-0.21	Low	50%	875	-184	50%	158	-33	50%	1,336	-281	100%	8,575	-1,801	100%	3	-1	50%	32	-7
			High		1,751	-368		292	-61					17,094	-3,590		10	-2			
Yard Trimmings	-0.03	-0.11	Low	50%	875	-96	50%	158	-17	50%	1,336	-147	0%	0	0	0%	0	0	50%	32	-3
			High		1,751	-193		292	-32												
Grass	-0.03	-0.1		0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0
Leaves	-0.03	-0.08		0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0
Branches	-0.03	-0.17		0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0	0%	0	0
TOTALS			Low	100%	1,751	-280	100%	317	-51	100%	2,672	-427		8,575	-1,801		3	-1	100%	63	-10
			High	100%	3,501	-560	100%	583	-93				100%	17,094	-3,590	100%	10	-2			

USE OF RECYCLABLE OR COMPOSTABLE TAKE-OUT PACKAGING

	Emissions (+) or Reductions (-)				
		Avoided Disposal			
ICLEI's Material Categories[2]	Recycled v. virgin inputs	Landfill with gas collection & energy recovery	Diversion Level	Tons[7]	$mtCO_2e$
Polystyrene	NA	-0.04	Low	78	-3.1
			High	157	-6.3

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (FUTURE INITATIVES)[1] (MTCO2e/Ton of Material Collected)[2]

CONSTRUCTION & DEMOLITION DIVERSION

				Construction & Demolition / Deconstruction Diversion (Deposit Program)						Enforce Existing Policies: Green Building / Green Points Diversion Req'ts for SFUs				
	Emissions (+) or Reductions (-)			New Residential Construction		New Non-Residential Construction		Deconstruction		New Residential Construction		Deconstruction		
		Avoided Disposal		Tons/ year:	494	Tons/ year:	670	Tons/ year:	3,046	Tons/ year:	494	Tons/ year:	4,188	Material assumptions
ICLEI's Material Categories [2]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Assumed composi-tion [8]	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	
Glass	-0.28	-0.04	1.0%	5	-1.6	7	-2.1	30	-9.7	5	-1.6	42	-13.4	
Dimensional Lumber	-2.46	-0.21	19.0%	94	-250.5	127	-339.7	579	-1,545.0	94	-250.5	796	-2,124.4	Includes wood pallets, treated wood, and untreated wood
Medium-Density Fiberboard	-2.47	-0.21	1.0%	5	-13.2	7	-17.9	30	-81.6	5	-13.2	42	-112.2	Estimation
Mixed Paper	-3.52	-0.34	1.3%	6	-24.8	9	-33.6	40	-152.8	6	-24.8	54	-210.1	
Mixed Metals	-3.97	-0.04	6.2%	31	-122.8	42	-166.5	189	-757.2	31	-122.8	260	-1,041.1	Includes small appliances
Mixed Plastics	-0.98	-0.04	1.1%	5	-5.5	7	-7.5	34	-34.2	5	-5.5	46	-47.0	
Carpet	-2.37	-0.04	2.0%	10	-23.8	13	-32.3	61	-146.8	10	-23.8	84	-201.8	Includes furniture/bulky
Personal Computers	-2.35	-0.04	1.5%	7	-17.7	10	-24.0	46	-109.2	7	-17.7	63	-150.1	
Concrete	-0.01	-0.04	0.0%	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	Combined with asphalt concrete
Asphalt Concrete	-0.08	-0.04	33.0%	163	-19.6	221	-26.5	1,005	-120.6	163	-19.6	1,382	-165.8	
Asphalt Shingles	-0.09	-0.04	14.0%	69	-9.0	94	-12.2	426	-55.4	69	-9.0	586	-76.2	
Drywall	0.03	-0.07	10.0%	49	-2.0	67	-2.7	305	-12.2	49	-2.0	419	-16.8	
Fiberglass Insulation	NA	-0.04	0.3%	1	-0.1	2	-0.1	9	-0.4	1	-0.1	13	-0.5	
Vinyl Flooring	NA	-0.04	0.9%	4	-0.2	6	-0.2	27	-1.1	4	-0.2	38	-1.5	Estimation
Wood Flooring	NA	-0.02	0.7%	3	-0.1	5	-0.1	21	-0.4	3	-0.1	29	-0.5	
Yard Trimmings [3]	NA	-0.11	3.0%	15	-1.6	20	-2.2	91	-10.1	15	-1.6	126	-13.8	
Inert materials	NA	0	5.0%	25	0.0	33	0.0	152	0.0	25	0.0	209	0.0	Dirt/sand (no GHG impacts)
		TOTALS	100.0%	494	-492	670	-668	3,046	-3,037	494	-492	4,188	-4,175	

[1] From Sec. 3, "Recycling and Composting Emissions Protocol, For Estimating Greenhouse Gas Emissions and Emissions Reductions Associated with Community Level Recycling and Composting" (v1.0, July 2013, ICLEI-Local Governments for Sustainability USA) from www.icleiusa.org/tools/ghg-protocol/recycling-and-composting-emissions-protocol

[2] Draws from Table 3.2 from ICLEI report for recycling [ibid]

[3] Draws from Table 3.3 from ICLEI report for composting [ibid]

[4] PAYT tons are calculated as 66% mixed recyclables and 33% organics.

[5] Assumptions for breakdown of organics materials, for programs that include any percent of Organics diversion

[6] Organics are calculated as approximately 50% Yard Trimmings and 50% Food Waste, based on "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2011," US EPA, May 2013, EPA530-F-13-001, p. 5, Figure 5.

[7] Assumed generated commercial recyclables would be classified as mixed recyclables

[8] Assumed percentages for UBM composition from *Boulder County's* "Construction and Demolition Infrastructure Study", December 2011, by UHG Consulting, 2015 C&D Waste Stream Estimates

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (FUTURE INITATIVES)[1] (MTCO2e/Ton of Material Collected)[2]

SUMMARY OF GHG SAVINGS BY INITIATIVE		
INITIATIVE	GHG SAVINGS in MTCO2e	
	LOW DIVERSION	HIGH DIVERSION
Every-Other-Week Residential Trash Collection	**-2,624**	**-5,249**
Hauler Provision of Organics Collection to MF Accounts	**-51**	**-93**
Recyclable, Compostable Take-Out Packaging	**-3**	**-6**
Mandatory Homeowner Collection Service	**-15,063**	**-15,063**
Commercial Recycling Requirement	**-17,070**	**-36,603**
Commercial Food Waste Diversion Requirement	**-1,801**	**-3,590**
Construction & Demolition / Deconstruction Diversion (Deposit Program)		
New Construction (Residential plus non-Residential)	**-1,160**	**-1,160**
Deconstruction	**-3,037**	**-3,037**
Special Event Diversion	**-3**	**-10**
City Purchase of Locally-Produced Mulch/Compost	**N/A**	**N/A**
Boulder County Recycling Center Improvements	**N/A**	**N/A**
Enforce Existing Policies		
PAYT Service to SFUs	**-401**	**-401**
50% MFU Recycling Service	**-4,337**	**-4,337**
Residential GBGP plus Demolitions/Razing	**-4,668**	**-4,668**
ZW at all Special Events	*same as Special Events, above*	
TOTALS	**-50,217**	**-74,216**

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (BUNDLED INITATIVES)[1] (MTCO2e/Ton of Material Collected)[2]

MIXED RECYCLABLES

				Mixed Recyclables											
	Emissions (+) or Reductions (-)			Greatest Diverted Ts & Greatest GHG Emission Reductions				Lowest City Costs (Initial Development & Annual Costs)				Lowest Customer Costs			
		Avoided Disposal		2020		2027		2020		2027		2020		2027	
ICLEI's Material Categories [2]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Diversion Level	Tons	$mtCO_2e$	Tons	$mtCO_2e$	Tons	$mtCO_2e$	Tons[4]	$mtCO_2e$	Tons	$mtCO_2e$	Tons	$mtCO_2e$
Mixed recyclables	-2.8	-0.28	Low	3,041	-9,365	7,505	-23,115	512	-1,577	1,255	-3,865	2,980	-9,178	7,204	-22,187
			High	10,350	-31,879	19,519	-60,118	1,024	-3,155	2,510	-7,729	10,229	-31,504	18,916	-58,262

ORGANICS DIVERSION

				Assumptions for Organics programs' organics composition, in %, with Tons/year and MTCO2e by material type [5]																	
	Emissions (+) or Reductions (-)			Greatest Diverted Ts & Greatest GHG Emission Reductions						Lowest City Costs (Initial Development & Annual Costs)[4]						Lowest Customer Costs					
		Avoided Disposal		2020			2027			2020			2027			2020			2027		
ICLEI's Material Categories [3]	Fertilizer production displacement credit	Landfill with gas collection & energy recovery	Diversion Level	Assumed compo-sition	Tons	$mtCO_2e$	Assumed compo-sition	Tons	$mtCO_2e$	Assumed compo-sition	Tons	$mtCO_2e$	Assumed compo-sition	Tons	$mtCO_2e$	Assumed compo-sition	Tons	$mtCO_2e$	Assumed compo-sition	Tons	$mtCO_2e$
Food Waste	-0.03	-0.21	Low	100%	7,494	-1,574	100%	11,130	-2,337	100%	618	-130	100%	1,751	-368	100%	7,453	-1,565	100%	11,092	-2,329
			High		14,928	-3,135		22,198	-4,661		1,326	-279		3,446	-724		14,937	-3,137		22,065	-4,634
Compostable Packaging[4]	-0.03	-0.21	Low	0%	0	0	0%	0	0	100%	21	-4	100%	45	-9	100%	21	-4	100%	45	-9
			High								42	-9		89	-19		42	-9		89	-19
Yard Trimmings	-0.03	-0.11	Low	100%	565	-62	100%	1,392	-153	100%	565	-119	100%	1,392	-292	100%	471	-99	100%	994	-209
			High		1,129	-124		2,784	-306		1,129	-237		2,784	-585		941	-198		1,988	-418
TOTALS			Low	100%	8,059	-1,636	100%	12,522	-2,490	100%	1,204	-253	100%	3,188	-669	100%	7,945	-1,668	100%	12,131	-2,547
			High		16,058	-3,259		24,981	-4,968		2,498	-525		6,319	-1,327		15,920	-3,343		24,142	-5,070

APPENDIX F

GREENHOUSE GAS EMISSION REDUCTIONS

FUTURE ZERO WASTE SCENARIOS (BUNDLED INITATIVES)[1] (MTCO2e/Ton of Material Collected)[2]

CONSTRUCTION & DEMOLITION DIVERSION

				Greatest Diverted Ts & Greatest GHG Emission Reductions								Lowest City Costs (Initial Development & Annual Costs)								
				2020				2027				2020				2027				
	Emissions (+) or Reductions (-)			New Construction		Demolition		New Construction		Demolition		New Construction		Demolition		New Construction		Demolition		
		Avoided Disposal		Tons/ year:	572	Tons/ year:	2,047	Tons/ year:	1,321	Tons/ year:	4,756	Tons/ year:	572	Tons/ year:	2,047	Tons/ year:	1,321	Tons/ year:	4,756	
ICLEI's Material Categories [2]	From using recycled inputs instead of virgin	Landfill with gas collection & energy recovery	Assumed composition [6]	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Tons	MTCO2e	Material assumptions
Glass	-0.28	-0.04	1.0%	6	-1.8	20	-6.5	13	-4.2	48	-15.2	6	-1.8	20	-6.5	13	-4.2	48	-15.2	
Dimensional Lumber	-2.46	-0.21	19.0%	109	-290.3	389	-1,038.2	251	-670.3	904	-2,412.8	109	-290.3	389	-1,038.2	251	-670.3	904	-2,412.8	Includes wood pallets, treated wood, and untreated wood
Medium-Density Fiberboard	-2.47	-0.21	1.0%	6	-15.3	20	-54.8	13	-35.4	48	-127.5	6	-15.3	20	-54.8	13	-35.4	48	-127.5	Estimation
Mixed Paper	-3.52	-0.34	1.3%	7	-28.7	27	-102.7	17	-66.3	62	-238.7	7	-28.7	27	-102.7	17	-66.3	62	-238.7	
Mixed Metals	-3.97	-0.04	6.2%	35	-142.3	127	-508.8	82	-328.5	295	-1,182.5	35	-142.3	127	-508.8	82	-328.5	295	-1,182.5	Includes small appliances
Mixed Plastics	-0.98	-0.04	1.1%	6	-6.4	23	-23.0	15	-14.8	52	-53.4	6	-6.4	23	-23.0	15	-14.8	52	-53.4	
Carpet	-2.37	-0.04	2.0%	11	-27.6	41	-98.6	26	-63.7	95	-229.2	11	-27.6	41	-98.6	26	-63.7	95	-229.2	Includes furniture/bulky
Personal Computers	-2.35	-0.04	1.5%	9	-20.5	31	-73.4	20	-47.4	71	-170.5	9	-20.5	31	-73.4	20	-47.4	71	-170.5	
Concrete	-0.01	-0.04	0.0%	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	Combined with asphalt concrete
Asphalt Concrete	-0.08	-0.04	33.0%	189	-22.7	675	-81.0	436	-52.3	1,570	-188.3	189	-22.7	675	-81.0	436	-52.3	1,570	-188.3	
Asphalt Shingles	-0.09	-0.04	14.0%	80	-10.4	287	-37.2	185	-24.0	666	-86.6	80	-10.4	287	-37.2	185	-24.0	666	-86.6	
Drywall	0.03	-0.07	10.0%	57	-2.3	205	-8.2	132	-5.3	476	-19.0	57	-2.3	205	-8.2	132	-5.3	476	-19.0	
Fiberglass Insulation	NA	-0.04	0.3%	2	-0.1	6	-0.2	4	-0.2	14	-0.6	2	-0.1	6	-0.2	4	-0.2	14	-0.6	
Vinyl Flooring	NA	-0.04	0.9%	5	-0.2	18	-0.7	12	-0.5	43	-1.7	5	-0.2	18	-0.7	12	-0.5	43	-1.7	Estimation
Wood Flooring	NA	-0.02	0.7%	4	-0.1	14	-0.3	9	-0.2	33	-0.6	4	-0.1	14	-0.3	9	-0.2	33	-0.6	
Yard Trimmings	NA	-0.11	3.0%	17	-1.9	61	-6.8	40	-4.4	143	-15.7	17	-1.9	61	-6.8	40	-4.4	143	-15.7	
Inert materials	NA	0	5.0%	29	0.0	102	0.0	66	0.0	238	0.0	29	0.0	102	0.0	66	0.0	238	0.0	Dirt/sand (no GHG impacts) included here
		TOTALS	100.0%	572	-571	2,047	-2,041	1,321	-1,317	4,756	-4,742	572	-571	2,047	-2,041	1,321	-1,317	4,756	-4,742	

[1] From Sec. 3, "Recycling and Composting Emissions Protocol, For Estimating Greenhouse Gas Emissions and Emissions Reductions Associated with Community Level Recycling and Composting" (v1.0, July 2013, ICLEI-Local Governments for Sustainability USA) from www.icleiusa.org/tools/ghg-protocol/recycling-and-composting-emissions-protocol

[2] Draws from Table 3.2 from ICLEI report for recycling [ibid]

[3] Draws from Table 3.3 from ICLEI report for composting [ibid]

[4] Compostable packaging is assumed to have the same GHG impact as Food Waste (there is no ICLEI category for compostable packaging)

[5] Assumptions for breakdown of organics materials, for programs that include any percent of Organics diversion

[6] Assumed percentages for UBM composition from *Boulder County's* "Construction and Demolition Infrastructure Study," December 2011, by UHG Consulting, 2015 C&D Waste Stream Estimates

APPENDIX G

JOB CREATION FACTORS
(per 1,000 tons of material managed)

	PUBLISHED VALUES					BOULDER VALUES [f]				SUGGESTED APPLICATION FOR CITY OF BOULDER
RECYCLING ACTIVITY	TELLUS/ SRM [a]	NERC [b]	CRI [c] (containers only)	ILSR [d]	ILSR [e]	WESTERN DISPOSAL	ECO-CYCLE	BOULDER COUNTY	RESOURCE	
Collection										
General	1.67		2.30							
Public collection		2.01								
Private collection		1.18				(all materials)	(all materials)			1.8
Paper/Container Processing										
General	2.00									
MRF		0.62	0.64	1.00				1.29		1.0
Organics Processing										
Composting		0.92		0.40						
Processing organics (mulching & composting)	0.50				0.41	0.55				0.5
Retail Used Merchandise Sales		4.6 employees/ business							20 (includes other services)	
Pavement Mix Producers (asphalt & aggregate)		0.15								
average										
Disposal										
trash collection	0.56		1.17							
landfilling	0.10		0.04	0.10	0.22					

[a] "More Jobs, Less Pollution: Growing the Recycling Economy in the U.S.," prepared by the Tellus Institute and Sound Resource Management (no publication date - assume 2011), based on 2008 baseline data (hybrid analysis of several job creation documents including the NERC 2009 report and ISLR estimates)

[b] "Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania Final Report," prepared by DSM Environmental and MSW Consultants, 2009 (based on 2007 data)

[c] "Returning to Work - Understanding the Domestic Jobs Impacts from Different Methods of Recycling Beverage Containers," prepared by Jeffrey Morris and Clarissa Morawski for the Container Recycling Institute, December 2011 (pertains to container recycling only)

[d] "Recycling Means Business," prepared by Institute of Local Self-Reliance in 1997

[e] "Pay Dirt - Composting in Maryland to Reduce Waste, Create Jobs, and Protect the Bay," prepared by Institute of Local Self-Reliance in May 2013

[f] Data provided directly by Western Disposal Services, Eco-Cycle, Boulder County (Eco-Cycle operator) and ReSource

APPENDIX H

HAULER FINANCIAL INCENTIVES

Typically, waste haulers are paid based on the number of households serviced or the cubic yard capacity of commercial containers serviced. Many communities across the country have experimented with altering this system of payment to allow haulers to make more money from diverting waste rather than from disposal.

A commonality between all incentive programs reviewed for this study is that some form of contractual or franchise relationship exists between the local government and the haulers, with the hauler bearing any financial burden or reward. These communities most commonly utilize a contract or franchise strategy. Although Boulder currently uses neither approach, examples of innovative hauler incentives aimed at increasing diversion are provided for consideration as the City evaluates its ability to achieve zero waste:

1. San Jose, CA - San Jose contracts with a single hauler for residential and commercial waste collection. The hauler must reach a 75 percent diversion goal. If the hauler falls short, it is charged liquidated damages of $25,000 for every percentage point below 75 percent. The hauler must tally tonnage information and calculate the diversion rate on a monthly basis and report to the city quarterly. The diversion goal is set to increase to 80 percent on January 1, 2014.
2. Seattle, WA - Seattle retroactively rewards its contracted waste haulers for successful recycling and waste prevention efforts. Baseline tons are initially established during the first contract year. In subsequent years, haulers are rewarded $10 per ton of reduced residential and commercial garbage tons compared to the initial contract year, and $5 per ton of reduced residential recycling or compostable tons. This incentive phases out after the first five years of the contract unless both parties agree to renew it.
3. Monrovia, CA - Monrovia has a non-exclusive commercial franchise system. Haulers must provide their service rates when applying for a franchise and are only allowed to change these rates annually based on a consumer price index. The city charges haulers a franchise fee based on whether the materials they collect are disposed or recovered. Each month, haulers complete an online form to report tons disposed and diverted, and service fees. Based on what they report, haulers are charged a franchise fee of $28/ton for material landfilled and $5/ton for material that is diverted. Residuals that go to disposal are charged $28/ton (if the residuals go on to a waste-to-energy facility, they are only charged $5/ton). The city will audit the haulers annually for compliance.
4. Santa Clara, CA - Santa Clara also has a non-exclusive franchise system for collecting waste in the industrial area of the city. To encourage more recycling, the city uses a tiered franchise fee system that charges 3 percent of gross billings for recycling services (if less than 5 percent contamination), 16 percent of gross billings for garbage collection, and 10 percent of gross billings for mixed loads that contains 30 to 90 percent garbage. The city conducts an audit every three years.

The KCI Team considered various approaches to applying these incentives within the City's open market collection system, including the following:

1. Tiered or Tonnage-Based Trash Tax - The Trash Tax could potentially be re-structured to create an incentive to haulers to increase waste diversion. For example, a tiered Trash Tax could provide discounts to haulers for achieving diversion rates of 50 percent, 60 percent, 70 percent, etc. Alternatively, a tonnage-based Trash Tax could be based on tons of waste disposed or recovered, similar to Monrovia, CA, rather than on households serviced or commercial cubic yards. Neither approach appears feasible in Boulder because service fees are not currently established or controlled, and haulers would simply pass this cost on to the customer. Additional impediments include the fact that the City needs all Trash Tax revenues it currently receives to support ongoing programs and increasing the Trash Tax amount or structure would require voter approval.
2. Waste Diversion Fee - Also considered was the establishment of a new hauler fee, separate from the Trash Tax. The fee could be based on the tons of waste disposed or success in meeting defined diversion goals. As noted above, however, this is not likely to be effective in Boulder as haulers could simply pass this fee on to their customers.
3. Program-Specific Incentive - The City could consider a financial incentive program established on an initiative-specific basis where haulers would receive a rebate for each ton diverted. The rebate would need to be large enough to provide an incentive to haulers. At the same time, the City would need to identify a funding source for this program.

Based on the evaluations summarized in Section 3, the voluntary multi-family composting initiative would likely be the most suitable for an incentive component as it is expected to initially be a voluntary program that is dependent on hauler collection. As this initiative is expected to divert fairly low tonnages, however, it may be more effective to invest in education and outreach - perhaps targeting existing obstacles to multi-family composting (such as enclosures, use of parking space, signage) and paving the way for its maturation into a mandatory program.[1]

[1] Even if a hauler incentive for MFU composting increased participation to 80 percent of all MFU accounts and paid haulers $10/diverted ton, the available rewards would be less than $20,000/year for all collections.