



Partnering for Change

Larimer County
Solid Waste Infrastructure
Master Plan

Larimer County, Colorado

October 25, 2018

*ADOPTED BY
LARIMER COUNTY
DECEMBER 19, 2018*

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- Memo A: Task 3 – Emerging Technologies Technical Memorandum
- Memo B: Task 3 – Solid Waste Management Practices Memo
- Memo C: Task 5 – Solid Waste Volumes Memo (with attachments)
- Memo D: Analysis of Infrastructure Options (with attachments)
- Memo E: Potential Local Government Options and Policies (with attachments)
- Memo F: Disposal Site Options – Advantages and Disadvantages (with attachments)

VOLUME III: APPENDICES

- Appendix A: Colorado Integrated Solid Waste & Materials Management Plan
- Appendix B: Final Report – Phase 1 Regional Wasteshed Planning Study
- Appendix C: Stakeholder Presentations (1-7)

Acronyms and Abbreviations

AD	Anaerobic Digestion
BCR	Benefit-Cost Ratio
C&D	Construction and Demolition
CAA	Clean Air Act
Coalition	North Front Range Regional Wasteshed Coalition
COBRA	Co-benefit Risk Analysis
eGRID	Emissions & Generation Resource Integrated Database
EPA	U.S. Environmental Protection Agency
HHW	Household Hazardous Waste
LF	Landfill
MMRF	Multi-Materials Recovery Facility
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
NHSM	Non-Hazardous
PAC	Policy Advisory Committee
Plan	Solid Waste Infrastructure Master Plan
RDF	Refuse Derived Fuel
SROI	Sustainable Return on Investment
TAC	Technical Advisory Committee
TBL	Triple Bottom Line
TS	Transfer Station
VMT	Vehicle Miles Traveled
Wasteshed	North Front Range Regional Wasteshed
WTE	Waste to Energy
WWTF	Waste Water Treatment Facility
YW	Yard Waste

Executive Summary

Background

Responsible solid waste management has long been a shared goal of the governing agencies within Larimer County. The Larimer County Landfill began operations in the late 1960s. In 1972, the cities of Fort Collins and Loveland and Larimer County collaborated when the jointly owned landfill was established to ensure that environmental regulations and citizen needs could be met for waste disposal in the Wasteshed. With the inevitable upcoming closure of the Larimer County landfill (expected around 2025) and predictions of continued regional population growth, these partners, plus the neighboring community of Estes Park, worked together to evaluate waste management needs and develop guidance plans to manage waste for the region into the future. The result of that effort is this Master Plan.

The North Front Range Regional Wasteshed Coalition (Coalition) was formed in 2015 to address the future of solid waste management. The Coalition includes a Policy Advisory Committee (PAC) made up of elected officials from Fort Collins, Loveland, Estes Park, and Larimer County, a Technical Advisory Committee (TAC) made up of staff members from the same entities and a Stakeholder Advisory Group consisting of representatives from local businesses, community groups, educational institutions, regional governance and all eight municipalities within Larimer County. The charter of the Coalition is to responsibly address the current solid waste management and resource recovery needs of the region, while considering infrastructure and policy that will meet community needs in the future.

Although the current solid waste infrastructure in the Wasteshed is working well, significant portions of the waste stream are recoverable and challenges are foreseeable in the near future. These challenges include the closure of the Larimer County Landfill (which is expected to reach capacity in 2025 and is the primary asset of the current infrastructure system) the need to address population growth and additional future waste, infrastructure capacity, sustainability, and other related issues, while paying close attention to financial constraints and responsibilities.

In 2016, the Coalition initiated the first phase of the process. A Regional Wasteshed Report was developed through public engagement that included four public forums in September 2016 focused on the issues of resource recovery and materials management. This report formed the basis for further evaluation of infrastructure options developed to address current and future solid waste demands within the Wasteshed.

The Coalition initiated the second phase of its multi-year Regional Wasteshed Planning Study in 2017, and retained the firm of HDR Engineering, Inc., to further identify a road map for the continued efficient, economical, and environmentally responsible handling of waste generated within the Wasteshed. To further identify and analyze options for developing the future regional waste infrastructure system, this North Front Range Regional Wasteshed Coalition Solid Waste Infrastructure

Master Plan (Plan) reviews and recommends potential infrastructure options based on established goals and objectives, population and waste projections, resource needs, capital and operational costs, and sustainable return on investment analyses.

Goals of the Plan

Through active collaboration and feedback from stakeholders and community members, the Coalition developed the following goals to assist in guiding the Wasteshed to a sustainable and achievable future regional solid waste infrastructure system. The shared goals are as follows:

Goal #1: Establish a comprehensive, regional solid waste materials management system by 2025 that is implemented in an economically, environmentally, and socially sustainable manner.

Goal #2: Create a comprehensive solid waste materials management plan and implement programs and facilities that reflect the needs and desires of users.

Goal #3: Develop a set of waste diversion/reduction goals that are adopted and implemented by all jurisdictions in the Wasteshed.

Goal #4: Develop a strong public education and outreach program that is consistent throughout the Wasteshed.

Phase 2 Study Stakeholder Engagement

To ensure alignment with the needs and expectations of the local businesses and communities, the Coalition actively developed and engaged a Stakeholder Advisory Group comprised of 88 representatives from throughout the Wasteshed including: regional governments/agencies, boards and commissions, educational institutions, solid waste industry, business/industry, and various associations. The Stakeholder Advisory Group was key in reviewing and providing consensus with the findings and recommendations presented by the TAC throughout the study process.

A total of seven (7) stakeholder meetings were held throughout Phase 2; each meeting covered specific topics discussed in the sections of this Plan and included progress updates of the infrastructure evaluations. Prior to each meeting, an email invitation was sent to the entire members of the Stakeholder Advisory Group to inform them of the meeting date, time, location, and topic. A website was established specific to the stakeholders that housed documents shared with the stakeholders and provided a forum for submitting comments in the event they missed a meeting.

Infrastructure Options Considered

Through a collaborative effort with the Coalition's TAC, stakeholders, and community partners, 11 potential solid waste infrastructure options were chosen to further refine, identify, and analyze. The options selected for further evaluation were:

- Status Quo
- Central Transfer Station

- New County Landfill or Alternate Disposal Site
- Material Recovery Facility (Clean)
- Yard Waste Organic Processing Facility
- Construction and Demolition Debris Processing Facility
- Energy From Waste Facility – Direct Combustion
- Mixed Waste Processing (Dirty Material Recovery Facility [MRF])
- Static Aerated Composting including Food Waste
- Anaerobic Digestion
- Refuse Derived Fuel Processing

Upon completion of the individual infrastructure options evaluation, the Coalition's TAC carefully considered the impacts, costs, and benefits of a complete and comprehensive solid waste infrastructure system. This proposed comprehensive solid waste infrastructure system was presented to the Stakeholders and the PAC, for their concurrence and eventual selection as the recommended option to proceed forward as the future solid waste management infrastructure for the Wasteshed. Table ES-1 outlines the tiered infrastructure options selected with the Sustainable Return on Investment (SROI) ranking, a potential schedule for siting approval, permitting and design, construction and year to be placed in service. The TAC chose not to eliminate technologies from future consideration, in the event that in the future they became more viable, so instead ranked them in a tiered approach given the current status of each technology.

Table ES-1. Tiered Infrastructure Options				
Tier Recommendations	Potential Schedule			
	Local Siting Approval	Permitting/ Design	Construction	In Service
<u>Tier 1</u>				
Central Transfer Station	2019	2020	2021	2022
New County Landfill	2019	2020	2022	2023
Yard Waste Open Windrow Composting	2020	2021	2022	2022
Construction & Demolition Waste Processing	2020	2021	2022	2022
Food Waste Composting – Static Aerated Bin	2021	2021	2023	2024

Table ES-1. Tiered Infrastructure Options

Tier Recommendations	Potential Schedule			
	Local Siting Approval	Permitting/ Design	Construction	In Service
<u>Tier 2</u>				
Clean Material Recovery Facility /Upgrade	Assessed Annually Moving Forward			
Anaerobic Digestion /Pre-Processing - WWTP				
<u>Tier 3</u>				
Waste to Energy (Direct Combustion)	Possible Future Consideration			
Refuse Derived Fuel Processing				
<u>Not Considered Viable</u>				
Mixed Waste Processing - Dirty MRF	Not Currently Viable			
Status Quo				

The New County Landfill infrastructure option was initially evaluated as a publicly owned and operated facility. Subsequent to the initial evaluation, the TAC considered further evaluating an alternative disposal site or privately owned and operated facility for the landfill infrastructure option as a result of an unsolicited private disposal option. Based on this further evaluation the recommendation was made to move forward with the option of a publicly owned and operated landfill.

As the New County Landfill infrastructure option moves forward, additional investigation of the site owned by the County will need to be initiated to ensure suitability for construction and operation of a landfill facility. If the property is not suitable for a landfill, the TAC and the PAC will reconvene and re-evaluate disposal options.

Process Controls and Risk Management

The TAC considered potential regulations and policies to be adopted that would support the business model of the infrastructure options chosen for the regional solid waste management system. This included an assessment of associated risks, advantages and disadvantages for each process control. During the TAC's evaluation of process controls options, consideration was given to the implications for the public, commercial industry, private haulers, solid waste industry, and elected officials. Each of the controls evaluated have been previously implemented in some manner throughout the region or elsewhere in the country.

Key findings resulting from review of potential local process controls options and policies included:

- Currently, there are limited controls, policies and regulations in place in the Wasteshed to guarantee that waste is directed to infrastructure that supports the goals and objectives that the Coalition has established to enhance waste reduction and diversion.
- It is common practice for municipalities and local government to employ some method of regulatory control, whether it be through ordinances, policies or procedures to ensure waste is handled in an environmentally responsible manner.
- Due to the competitive nature of the waste industry in the region, more specifically the low cost of burying waste, local governments can be subject to the risk of rising costs if regulatory control is not established for waste reduction and diversion purposes.
- Regulatory control protects the health, safety and the welfare of the community by providing greater control and oversight of solid waste management activities and protects natural resources by allowing the municipalities to designate disposal and recycling sites that meet required environmental standards or assist with achieving diversion goals.

Phase 2 Study Public Outreach

The Coalition held a series of four public meetings around Larimer County for members of the public to learn more about the future of solid waste in the region and to provide feedback on the draft regional master plan concepts for waste recovery and disposal. The meetings were held in an open-house format, displaying 11 informational boards throughout the room and included project overview presentations. Comment forms were provided for attendees to submit written feedback.

More than 100 participants attended the public meetings and provided valuable feedback to the Coalition members.

Phase 2 Study Recommendations

Building on the vision, goals, and objectives established by the Coalition, stakeholders, and community members, and their recommendations for

infrastructure facilities, an implementation schedule was established that outlines the 7-year plan for moving forward with the recommended actions. Table ES-2 outlines the recommendations and implementation schedule for the Coalition to put in to action prior to the closure of the Larimer County Landfill.

Table ES-2. Implementation Schedule

Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
Infrastructure								
The Coalition and stakeholders recommend that the Tier 1 Infrastructure be approved, built and in service prior to the closure of the Larimer County Landfill in 2025. Recommended Tier 1 facilities are:	Larimer County							
• Central Transfer Station (Jan 2019–Jan 2023)			✓	✓	✓	✓		
• New County Landfill ¹ (Jan 2019–Jan 2024)			✓	✓	✓	✓	✓	
• Yard Waste Open Windrow Composting (Jan 2020–Jan 2023)				✓	✓	✓		
• Construction and Demolition Waste Processing (Jan 2020–Jan 2023)				✓	✓	✓		
• Food Waste Composting – Static Aerated Bin (Oct 2021–Feb 2025)						✓	✓	✓
The Tier 2 Infrastructure will be reviewed on an annual basis by the Coalition for possible implementation at a later date.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Ongoing						

Table ES-2. Implementation Schedule

Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
Policy and Process Controls								
Draft policy language will be developed through a collaborative process by the TAC for process controls, waste bans and hauler licensing that will yield specific results associated with waste diversion, reductions and recycling while achieving consistency amongst the Coalition members. Once drafted, the policies/codes should be vetted through each of the Coalition’s government entities for comments.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Q4	-	-	-	-	-	
An Intergovernmental Agreement for Solid Waste handling will be drafted by the Coalition members and adopted by each of the Coalition’s government entities.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	-	Q1	-	-	-	-	
Administration and Education								
The Coalition members will work cooperatively to establish a public education and outreach program to educate the citizens and stakeholders on upcoming changes to the waste management system in the Wasteshed.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Ongoing						

Table ES-2. Implementation Schedule

Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
Upon adoption of the Intergovernmental Agreements, an Advisory Board should be established which consists of Coalition members, stakeholders and members of the public to advise on solid waste management issues.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	-	Q3	-	-	-	-	-

¹The recommendation will require an initial site evaluation to determine if the County owned site is suitable for landfill infrastructure.

1 Introduction

1.1 Purpose of the Master Plan

This plan is intended to be a guide for the responsible management of solid waste to achieve the goals and objectives set forth by the North Front Range Regional Wasteshed Coalition (Larimer County, City of Fort Collins, City of Loveland, and Town of Estes Park) through the year 2050.

Although the current solid waste infrastructure system in the Wasteshed is working well, it faces some significant challenges in the near future. These challenges include the closure of the current Larimer County Landfill, which is forecast to reach capacity in 2025 and is the primary asset of the current infrastructure system, the need to address population growth and thus waste generation projections, infrastructure capacity, sustainability, and other related issues, while paying close attention to financial constraints and responsibilities.

1.2 Importance of Planning

1.2.1 The Need for Solid Waste Planning

To ensure that solid waste is collected, handled, recycled, and disposed of in an environmentally sound manner that protects public health and contributes recovered resources to the regional economy, Larimer County and the cities of Fort Collins, Loveland and Town of Estes Park are working together to evaluate waste management needs and develop guidance to manage waste and build infrastructure in the region. In 2015, the North Front Range Regional Wasteshed Coalition (Coalition) was formed, inclusive of the above jurisdictions, to address the future of solid waste management in the region.

Building on that foundation, this Solid Waste Infrastructure Master Plan:

- provides an opportunity to evaluate and refine existing programs, activities and infrastructure;
- identifies policies that will help implement the recommended programs and practices;
- supports the goals and objectives identified by the Coalition;
- provides a road map for how the County will handle solid waste issues in the future; and
- identifies infrastructure needs for waste and material handling in the future.

1.2.2 North Front Range Regional Wasteshed Coalition

In the North Front Range region, responsible solid waste management has long been a shared goal of the governing agencies within Larimer County. The cities of

Loveland and Fort Collins collaborated with the County to manage a jointly owned landfill (5887 S. Taft Hill Road) in 1972 to ensure environmental regulations can be met for trash disposal in the region. In 1975, Larimer County assumed operation and management of the landfill as an enterprise function pursuant to an intergovernmental agreement dated November 21, 1974.

With an anticipated closure date for the Larimer County landfill approaching in 2025, these partners plus the neighboring community of the Town of Estes Park are once again working together to evaluate waste management needs and develop guidance plans into the next 25-50 years.

The Coalition was formed in 2015 to address the future of solid waste management in light of the upcoming Larimer County landfill closure and adopted the following Charter:

“As stewards of the public trust, the charter and charge of the North Front Range Regional Wasteshed Coalition is to responsibly address current solid waste management and resource recovery needs of the region, while considering infrastructure and policy that will meet community needs in the future.”

The Coalition includes a Policy Advisory Committee (PAC) made up of elected officials from Fort Collins, Loveland, Estes Park, and Larimer County. The objectives of the PAC include:

1. Define the Coalition objectives and provide strategic direction.
2. Establish attainable goals for solid waste, recycling and household hazardous waste management.
3. Establish unified vision for future solid waste practices and infrastructure. Current members of the Wasteshed Coalition's PAC are shown in Table 1-1.

Table 1-1. PAC Members

Jurisdiction	PAC Member
City of Loveland Councilmember	Leah Johnson, Chair
City of Fort Collins Mayor	Wade Troxell, Co-Chair
City of Fort Collins Councilmember	Ross Cuniff
Town of Estes Park Mayor Pro Tem	Wendy Koenig (Ken Zornes)
Larimer County Commissioner	Steve Johnson

The TAC is made up of staff members from the same entities and has the following objectives:

1. Evaluate existing and future Wasteshed service demands.
2. Collect and review technical and financial data.

3. Identify potential alternatives for solid waste management.
4. Conduct studies and prepare summary reports.
5. Provide technical and financial recommendations to the PAC.

The current members of the Wasteshed Coalition's TAC are shown in Table 1-2.

Table 1-2. TAC Members	
Jurisdiction	TAC Member
City of Fort Collins	Susie Gordon, Environmental Program Manager Caroline Mitchell, Senior Environmental Planner Honore Depew, Environmental Planner
City of Loveland	Mick Mercer, Public Works Operations Manager Tyler Bandemer, Solid Waste Superintendent
Town of Estes Park	Frank Lancaster, Town Administrator
Larimer County	Todd Blomstrom, Director of Public Works Stephen Gillette, Solid Waste Director Ron Gilkerson, Solid Waste Project Director
Colorado State University	Martin Carcasson, Ph.D.

The term “wasteshed” is used to describe an area where waste, much like water or air, does not adhere to normal boundaries. The regional wasteshed of Colorado's North Front Range is an area in and around Larimer County, including all solid waste generated by residents and businesses from the cities, towns, and unincorporated areas. Figure 1-1 below depicts the boundaries for the Coalition's planning area.

A Stakeholder's Advisory Group was identified with the assistance of each member of the Coalition, and was comprised of 88 representatives that included general businesses throughout the Wasteshed, government and agency representatives, advisory groups, education sector, solid waste industry sector, business/industry sector, and various associations. Each of the eight municipalities were invited to participate in the Stakeholder Advisory Group, with a seat reserved for a representative from each municipality. A complete list of Stakeholders can be found in Volume III – Appendices, Section C.

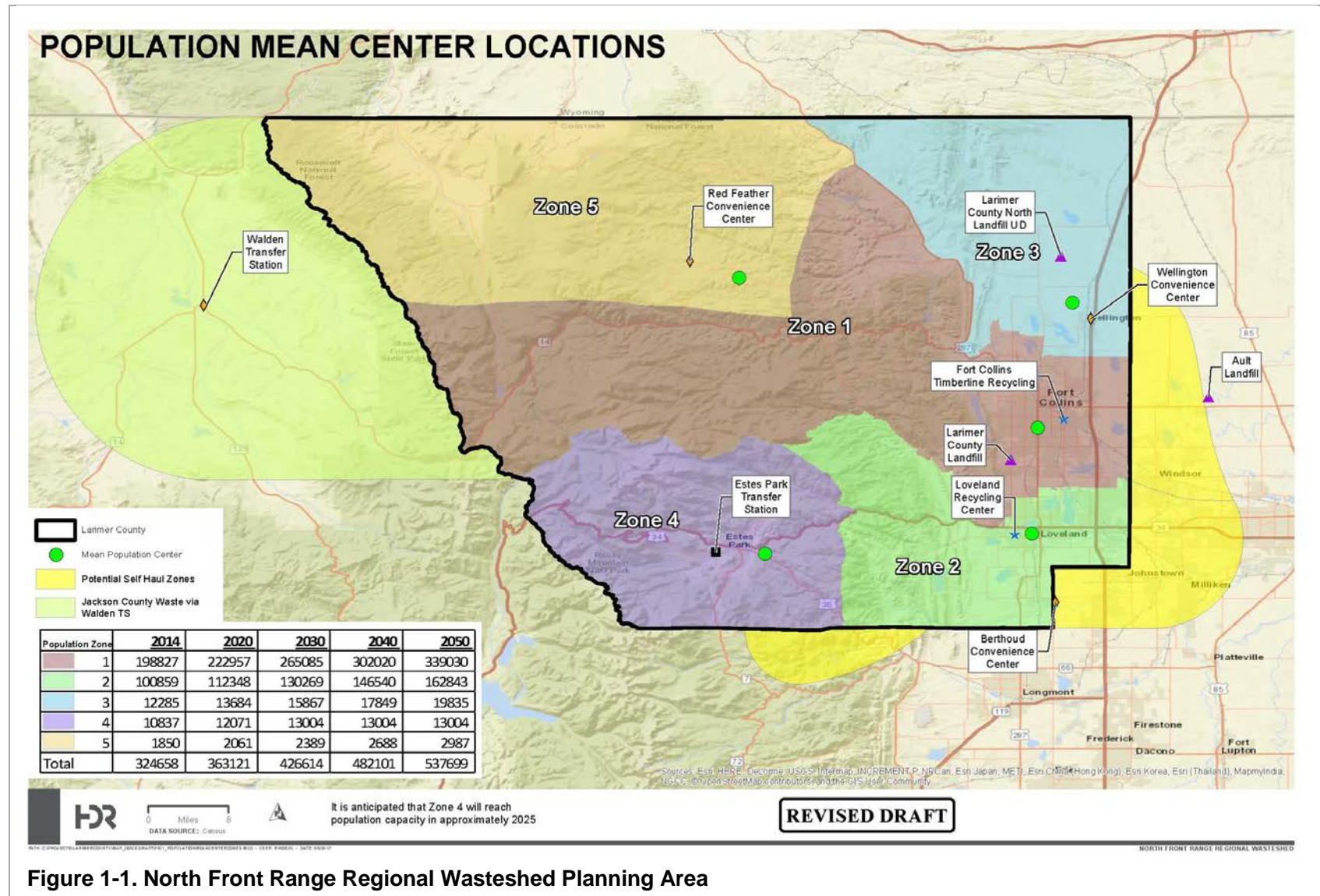


Figure 1-1. North Front Range Regional Wasteshed Planning Area

1.2.3 Relationship to Other Documents

This Plan utilizes data from the Larimer County Comprehensive Master Plan, 2016 Waste Composition and Characterization Analysis by Sloan Vazquez MacAfee, the Phase 1 Regional Waste Shed Planning Report by R3 Consulting Groups, Inc., the 2016 Colorado Integrated Solid Waste and Materials Management Plan, and the City of Fort Collins Waste Reduction and Recycling Plan: On the Road to Zero Waste for planning background information.

Other related plans include land use plans, associated zoning codes, and solid waste ordinances and codes for the area.

1.3 Organization of this Plan

1.3.1 Goals and Objectives for the Plan

Through active collaboration and feedback from stakeholders and community members, the Coalition developed goals and objectives to help determine a sustainable and achievable future regional solid waste infrastructure system. These goals and objectives are the underlying concept for this Plan as outlined in Table 1-3.

Table 1-3. Goals and Objectives

Goal	Objectives
Goal #1: Establish a comprehensive, regional solid waste materials management system by 2025 that is implemented in an economically, environmentally, and socially sustainable manner	A. Upon completion of the Phase 2 Planning Study in 2018, the Coalition has identified and documented specific options for programs and facilities, taking into consideration the balance between economic, environmental and social costs and benefits.
	B. The proposed solid waste system addresses future customer service demands in the region over the next 40 years or more, and provides long-term funding to address capital and operating costs.
	C. Coalition members are prepared to begin implementing programs and constructing facilities by January 2020.
Goal #2: Create a comprehensive solid waste materials management plan and implement programs and facilities that reflect the needs and desires of users.	A. The development of programs and facilities shall take a comprehensive, systems-based approach for materials management to conserve resources, manage costs, and minimize environmental impacts.
	B. The next generation of materials management programs and facilities provides services at competitive rates that are in alignment with the solid waste industry in the U.S.

Table 1-3. Goals and Objectives

Goal	Objectives
	C. New programs and facilities result in the increasing application of proven, innovative technologies for reuse, recycling, and disposal to substantially reduce the amount of material being landfilled.
	D. New programs and facilities are convenient and accessible for citizens, customers, businesses, and waste haulers in the Wasteshed.
Goal #3: Develop a set of waste diversion/reduction goals that are adopted and implemented by all jurisdictions in the Wasteshed.	A. The Coalition establishes consistent definitions and methods for measuring solid waste diversion/reduction within the Wasteshed by the year 2019 that are supported by streamlined and consistent data.
	B. Solid waste diversion/reduction measurements will be evaluated on a 3-year recurring cycle beginning in 2020 to identify potential program adjustments.
	C. Jurisdictions implement policy and regulatory measures to support waste reduction, reuse and recycling efforts, by the year 2024.
Goal #4: Develop a strong public education and outreach program that is consistent throughout the Wasteshed.	A. Public education and outreach programs convey a clear, consistent message and effectively influence the behavior of citizens regarding the reduction, reuse and recycling of materials that would otherwise be destined for disposal.
	B. Public education materials convey shared guidelines for recycling and other information on reuse and reduction within all jurisdictions.
	C. Municipal and solid waste representatives meet on a routine basis to coordinate solid waste educational programs and outreach efforts and to resolve any questions about recycling guidelines.

1.3.2 Structure of this Plan

This Plan consists of this document, which provides background information and a summary of recommendations, and a series of memorandums, reports, and appendices that address specific topics in detail. A more detailed description of the three parts of this Plan is provided below.

Volume I

Volume I is this part of the document which contains the Solid Waste Infrastructure Master Plan which includes a narrative summary of background information, policies and recommended strategic infrastructure options.

Volume II

Volume II is a series of memorandums and reports that address specific aspects of the solid waste system. Each document supports one or all of the overarching goals of the Coalition and contain background information on each topic, near and long-term planning issues and possible alternatives on how to address future infrastructure needs, policies and service gaps.

Volume III

Volume III (Appendices) contains background information on specific topics and parts including the Phase 1 Planning Study, stakeholder engagement, and other information such as a glossary and references.

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2 Current System

2.1 Introduction

The management of solid waste in the Wasteshed has evolved over time based on population growth, regulatory changes, and cultural changes. In 1974, when Larimer County began operating the landfill, the County's population was 120,595. In 2016, that population had almost tripled to 339,993. This growth, coupled with the imminent closure of the current Larimer County landfill anticipated in 2025, will require a significant investment in facilities and services to ensure adequate accessibility and availability to all users.

The amounts and types of wastes have also grown and changed over the years, requiring more facilities with new capabilities to responsibly manage these wastes. Many items that were formerly disposed of are now part, or will become part, of diversion programs that recycle or reuse them.

2.2 Waste Disposal History

Prior to the nineteenth century, very little household waste was produced and very little of what was produced was permanently disposed of. Most of it was organic, such as food scraps, and was fed to livestock or rendered and remade into other products. The majority of waste produced at this time was ash from industrial processes.

With the advent of the industrial revolution came the rapid increase of disposable items and the association of these items with wealth and progress. Suddenly there was an ever-growing selection of products to choose from.

From napkins to watches, people were able to purchase inexpensive items and toss them out at the end of their life. This was associated with increased product marketing and a continual need to develop new and improved "things."

With the ongoing growth of consumerism, local jurisdictions began to pass ordinances and regulations for managing waste. Entire departments and divisions were established to handle the growing volumes of waste.

By the end of the twentieth century, waste management had become a combination of science and art. New technologies are constantly being tried to find the best way to dispose of or recycle wastes. Landfills win awards for becoming parks and open spaces, as well as becoming alternative sources of energy. In addition, the idea of waste and how much we produce is being pushed to the forefront of the consumer's mind more than ever before. Today, an individual



Figure 2-1. Early Waste Disposal

shopping at a store faces the decision of buying a product that is packaged with or without recycled material or of determining before they throw something out whether the object is reusable, recyclable, compostable, garbage, or a household hazardous waste. And whether or not that item can be recovered at the end of its useful life depends on available, nearby infrastructure.

2.3 Larimer County Solid Waste History

Historically, the solid waste disposal needs for the Wasteshed have been satisfied by the Larimer County Landfill located at 5887 S Taft Road, Fort Collins, Colorado.

The Larimer County Landfill, which is the cornerstone of current solid waste services provided to the community partners in the North Fort Range Regional Wasteshed, began operations in the late 1960s. In 1972, to ensure environmental regulations were being met for trash disposal in the region, the cities of Fort Collins and Loveland collaborated with the County on joint ownership of the Larimer County Landfill. The County has been the sole operator of the facility since a 1974 agreement.

The governing agencies have continued their collaborative effort with the continued expansion of facilities for the collection and disposal of waste within the Wasteshed. With the opening of the Estes Park Transfer Station in 1984, which is owned by the Town of Estes Park and operated by Waste Management, Inc., under contract with Larimer County, the Coalition partners have continued to expand facilities and programs for waste handling. Larimer County owns and operates the Wellington, Berthoud, and Red Feather Convenience Centers, the Recycling Center, and the Household Hazardous Waste Collection facility. The City of Fort Collins owns and operates the Timberline Recycling Center, and the City of Loveland owns and operates the Loveland Recycling Center.

In 2006, recognizing the capacity limitations of the current landfill, the County purchased a 640-acre section of property at the intersection of County Road 76 East and County Road 11 North as a potential future landfill site.

Larimer County retained Sloan Vazquez MacAfee to perform the 2016 Waste Composition and Characterization Analysis on waste being disposed at the Larimer County Landfill. Waste volume disposed at the landfill in 2016 was 350,736 tons. Figure 2-2 illustrates the percentages, by weight, of all wastes delivered to the landfill. “Other” waste on Figure 2-2 includes construction and demolition debris and other materials.

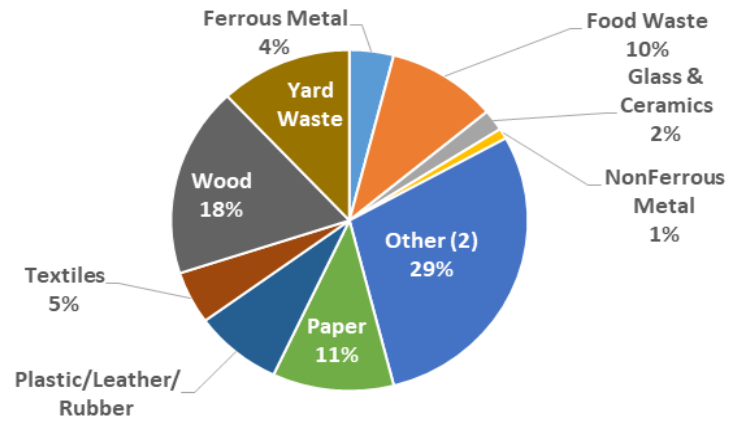


Figure 2-2. 2016 Wastes Delivered to Larimer County Landfill (weight, by percent)

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3 Regional Wasteshed Planning

3.1 Phase 1 Study

In 2015, the North Front Range Regional Wasteshed Coalition formed as a collaborative partnership including the Town of Estes Park, Larimer County, and the cities of Fort Collins and Loveland to take a regional approach moving from solid waste disposal to resource recovery and materials management.

Beginning in May 2015, the Coalition began work to outline a long-term planning process for the Wasteshed that will help the region achieve new levels of responsible materials management. To begin planning activities, the Coalition commissioned R3 Consulting Group, Inc., to prepare a high-level study focused on describing current solid waste handling conditions, quantifying the amount of solid waste currently handled, gap analyses, feasible solid waste handling options, and various funding approaches, with the specific objectives of:

- Describing current solid waste handling conditions, policy, collection operations, and infrastructure for transferring, disposing of, and processing solid waste materials;
- Quantifying the amount of solid waste currently handled and projecting the amount of each solid waste type that will need to be handled in the future;
- Identifying gaps between how much waste will be generated in the future and how much waste current infrastructure can handle;
- Identifying and describing the feasible options that the Coalition might consider as opportunities for future handling of solid waste; and
- Describing the various funding approaches that could be considered for funding capital and operating expenses for additional solid waste infrastructure.

The Phase 1 Study outlined the following feasible infrastructure options be further considered by the Coalition in planning for the closure of the Larimer County Landfill:

- Status Quo (No Action Taken Upon Closure of the Landfill)
- Central Transfer Station
- New County Landfill
- Materials Recovery Facility (Clean MRF)
- Organics Composting Facility
- Construction and Demolition (C&D) Processing Facility
- Energy from Waste Facility (Direct Combustion) The R3 Phase 1 Study can be found in Volume III.

3.2 Phase 2 Study

The Coalition initiated the second phase of its multi-year Regional Wasteshed Planning Study and retained HDR Engineering, Inc. (HDR), to further refine, identify, and analyze options for developing a future regional solid waste infrastructure system. The Phase 2

Planning Study, also referred to as the North Front Range Coalition Solid Waste Infrastructure Master Plan (Plan), reviews and recommends potential infrastructure options through established goals and objectives, population and waste projections, resource needs, capital and operational costs, and a sustainable return on investment analyses with the following specific objectives:

- Assist in the formation of unified goals and objectives for the Wasteshed that consider waste stream management, educational strategies, incentive mechanisms, regulatory mechanisms, and infrastructure mechanisms.
- Identify appropriate emerging technology, management practices, and industry trends that may be replicated in the Wasteshed that affect waste generation rates, facility designs, and other factors.
- Quantify the amount of solid waste currently handled in the Wasteshed inclusive of garbage, recyclables, organics, and C&D and project the amount of each solid waste stream that will be handled in the future in the Wasteshed.
- Complete an analysis of infrastructure options that could be implemented in the Wasteshed that includes how each option contributes to the goals and objectives, approximate size/land area, capacity, process components, and number of facilities to meet the service demands of the Wasteshed through 2050 inclusive of existing private solid waste infrastructure, identify basic resources required, summarize regulatory and permitting requirements, and prepare a triple bottom line accounting framework (sustainable return on investment) that documents the environmental and financial impacts for each option.
- Quantify the financial viability of the infrastructure options by estimating the extent of anticipated future waste stream volumes based on market demand, service costs, location, and service alternatives in the region and provide a preliminary cost estimate for each infrastructure option that includes an estimated monthly household cost.
- Review of potential regulations, policies, and process controls for consideration within the Wasteshed including advantages and disadvantages of each option and the challenges with implementation.
- Provide the opportunity for stakeholder engagement, public participation, outreach, and education.

The following sections provide an overview of each task completed for the Phase 2 Study. Memorandums and reports for each task can be found in Volume II.

3.3 Phase 2 Study – Management Practices, Industry Trends, and Emerging Technology

3.3.1 Solid Waste Management Practices and Industry Trends

The TAC reviewed successful management practices that might be replicated in the Wasteshed to aid in solid waste diversion and long-term financial sustainability. Five jurisdictions were selected for their management practices:

- Simcoe County, Ontario Canada
- Lancaster County Solid Waste Management Authority, Pennsylvania
- Monterey Regional Waste Management District, California
- Yakima County, Washington
- Wake County, North Carolina

These jurisdictions were selected based on a combination of factors, including:

- Population
- Annual Tons of Waste Generated
- Method of Disposal
- Diversion and Education Programs
- Waste Management Strategy Including Public/Private Partnerships
- Funding Model

Table 3-1 presents a comparison of solid waste management trends and practices, including facility types, programs, partnerships, flow control practices, and fee models.

Table 3-1. Comparison of Solid Waste Management Trends

Criteria	Simcoe County, Ontario Canada	Lancaster County SWMA, Pennsylvania	Monterey Regional Waste Management District, California	Yakima County, Washington	Wake County, North Carolina
Population	304,172	533,320	435,232	247,687	907,314
Tons Disposed	153,249	325,000	370,376	239,272	910,034
Tons Per Capita	.50	.61	.85	.96	1.00
1. Facilities					
Landfills	4	1	1 Municipal Solid Waste (MSW)	2 MSW 2 C&D (Private)	1 MSW 4 C&D (Private) 4 Land Clearing and Inert Debris (Private)
Transfer Stations	4	1	0	3	1 2 (Private)
Recycling/MRF	Materials Management Facility/Organics - Under Construction 1 MRF 5 Composting	1 C&D 1 MRF/Transfer Station (TS) 8 Public Compost 3 Private Compost	1 MRF 2 Compost 1 Dry Fermentation AD for Organics Last Chance Mercantile	1 MRF (Private)	2 MRF (Private) 11 Collection Centers 2 Multi-Materials Recovery Facility
Household Hazardous Waste (HHW)	4	1	1	3	2
Waste to Energy	0	1	0	0	0
Renewable Energy	Landfill Gas to Energy	0	Landfill (LF) Gas to Energy AD Biogas to Energy	0	Solar/Wind LF Gas to Energy

Table 3-1. Comparison of Solid Waste Management Trends

Criteria	Simcoe County, Ontario Canada	Lancaster County SWMA, Pennsylvania	Monterey Regional Waste Management District, California	Yakima County, Washington	Wake County, North Carolina
2. Diversion Programs					
Types of Waste Diversion Programs	Yardwaste Household Organics (food waste) Recycling HHW Electronics Appliances/Metal Tires C&D Mattresses/Textiles	Recycling HHW Electronics Tires	Yardwaste Wood Waste Recycling Appliances/Metal HHW Electronics Tires Mattresses Last Chance Mercantile	Yardwaste Wood Waste Recycling Tires Appliances/Metal HHW Electronics Fluorescent Bulbs	Yardwaste Food Waste Recycling Tires Appliances/Metal HHW Electronics
3. Educational Programs					
Types of Educational Programs	Website Media School Recycling Mobile Education Unit Special Event Recycling Organics Education Waste Heroes Green Teams	Website Media Tours Newsletter Compost Workshops	Website Media School Education Organics Education Community Events Booth Artist in Residence	Website Media Tours Public Event Recycling School Recycling Business Recycling Organics Education Youth Environmental Summit Community Event Booths	Website Media Tours Anti-Litter Feed the Bin School Recycling Business Recycling Organics Education Reduce Waste at Home Community Event Booths Hotline

Table 3-1. Comparison of Solid Waste Management Trends

Criteria	Simcoe County, Ontario Canada	Lancaster County SWMA, Pennsylvania	Monterey Regional Waste Management District, California	Yakima County, Washington	Wake County, North Carolina
4. Public/Private Partnerships					
Types of Public/Private Partnerships	Non-Profit	Sales of Generated Electricity WTE Operations Hauler Agreements Composting	AD Facility Compressed Natural Gas Facility	Composting Non-Profit	Landfill Operation/permit/d esign by Operator County owns land responsible for closure/post closure Non-Profit
5. Flow Control Practices					
Flow Control Model	Flow Control through the Provincial Municipal Act for residential. No Flow control for commercial/industrial	Flow Control through Solid Waste Management Authority Hauler Agreements and Ordinances	N/A	Flow Control through Interlocal Agreements with all 14 Municipalities	Interlocal Agreements with 11 of 12 Municipalities for acceptance of curbside waste Commercial waste disposal based on market conditions
6. Interlocal Agreements					
Type of Agreement	N/A	Solid Waste Management Authority with Board of Directors	N/A	Interlocal Agreements with all 14 Municipalities	Interlocal Agreements with 11 of 12 Municipalities

Table 3-1. Comparison of Solid Waste Management Trends

Criteria	Simcoe County, Ontario Canada	Lancaster County SWMA, Pennsylvania	Monterey Regional Waste Management District, California	Yakima County, Washington	Wake County, North Carolina
7. Funding Model					
Model	MSW \$155.00 per ton System funded through recovery of net costs (after revenue sources like the sale of recyclables) through municipal property taxes	MSW \$73.00 per ton YW \$30.00 per ton	MSW \$51.75 per ton YW \$30.00 per ton	MSW \$34.00 per ton YW \$17.00 per ton Grants and recyclable revenues	MSW \$32.00 LF MSW \$41.00 TS \$20.00 annual household fee, grants and recyclable revenues
Type of Fund	Enterprise	Enterprise	Enterprise	Enterprise	Enterprise

Key themes that emerged from the TAC analysis are:

- **Flow Control** – Flow control practices vary by jurisdictions based on the needs and objectives of each jurisdiction.
- **Public/Private Partnerships** – Successful public/private partnership were executed in all of the jurisdictions, which included private non-profit agreements for recycling, and other facility operations.
- **Planning** – All jurisdictions had comprehensive waste planning strategies that were inclusive of municipalities within their boundaries.
- **Funding** – The jurisdictions used Enterprise funds to account for revenues and expenditures. Tip fees were the most relied upon funding source, with additional funds coming from sale of materials, household taxes, property taxes, or grants.
- **Educational Programs** – Each of the jurisdictions reviewed takes the lead for developing and implementing educational programs within their jurisdictions in order to send a single comprehensive message to the system users.
- **Diversion Programs** – The jurisdictions had comprehensive diversion programs to eliminate waste from their landfills and/or Waste-to-Energy (WTE) facilities. Vigorous diversion programs saw a corresponding per capita reduction in waste flowing to landfills, in particular for yard debris, construction debris, and food waste.

Additional information on this subject can be found in Volume II – Memo B, Solid Waste Management Practices Memo.

3.3.2 Emerging Technologies

The TAC researched relevant existing information on emerging and alternative technologies that may affect waste generation rates, facility design and other factors within the Wasteshed and reviewed additional infrastructure options that HDR recommended for consideration as part of the Analysis of Infrastructure Options.

The waste processing and conversion technology options were grouped into the following main classes:

- Thermal Technologies
 - Direct Combustion (various forms of traditional waste-to-energy)
 - Gasification
 - Plasma Arc Gasification
 - Pyrolysis

- Biological Technologies
 - Aerobic Composting
 - Anaerobic Digestion with biogas production for electricity or fuel generation
- Chemical Technologies
 - Hydrolysis
 - Catalytic and Thermal Depolymerization
- Mechanical Technologies
 - Autoclave/Steam Classification
 - Advanced Materials Recovery
 - Refuse Derived Fuel (RDF) Production

There are also waste conversion technologies that are a combination of two or more technology classes. For example, Mechanical Biological Treatment technologies combine mechanical separation and treatment with biological processing, while Waste-to-Fuel Technologies combine mechanical pre-processing with thermal and chemical conversion processes.

Benefits and obstacles for each technology were reviewed and HDR's technical memo noted that a number of potential alternatives had previously been identified for future waste management in the Phase 1 Study. One of those alternatives was a Waste-to-Energy Facility or Alternative Technology Facility. HDR's findings from evaluation of the alternative technologies indicate that some technologies appear to be less feasible than others, mostly due to the time to construct, the capability to process MSW as feedstock, and economic feasibility – or all three. The Wasteshed schedule for completion of infrastructure for future waste handling is 2025 due to the projected closure of the Larimer County Landfill at that time. Permitting a waste combustion facility is a long and arduous process. Typical timelines often anticipate about 10 years from initial concept to a commissioned facility. It was determined that this type of facility could not be in place and operational due to the timeline for locating this type of facility, permitting, and contracting.

The Waste-To-Energy technologies which are the least developed and therefore not recommended for further consideration include:

- Plasma Arc Gasification
- Pyrolysis
- Waste to Fuels
- Hydrolysis
- Catalytic and Thermal Depolymerization
- Autoclaving

HDR also concluded that some of the remaining technologies are considered to have limitations with respect to the types of feedstock they can process. For

example, biological technologies such as anaerobic digestion and composting can only affect the organic portion of the non-recyclable discards. These types of technologies achieve much less diversion unless they are coupled with another technology that addresses other parts of the waste stream. There are also a few technology categories where some suppliers may have developed a technology but the process is not viable due to the relatively high cost. For example, gasification is used in a few facilities in Japan and other countries but has not become economically feasible in North America. As such, it was found that while some technologies are not suited to process the entire spectrum of waste discards, the use of Mechanical Biological Treatment in waste management systems raise the possibility to develop feedstock materials that are subsets of MSW which may create opportunities for alternative technologies that are otherwise not commercially viable (e.g., certain types of Gasification). The combination of technologies does however increase complexity of the solution as well as capital and operating costs. Technologies that are not recommended for further consideration for these reasons include:

- Gasification
- Anaerobic Digestion
- Mechanical Biological Treatment

In HDR's opinion, the best emerging and alternative technologies to meet Larimer County's future needs include:

- Mixed Waste Processing
- Aerobic Composting
- RDF Processing
- Direct Combustion

These technologies have the best promise of being developed, having been successfully implemented elsewhere in North America, have the potential for significant solid waste diversion, and potentially provide a long-term financial solution, although all of these alternatives would likely be more expensive than sending waste to regional landfills or construction of a new landfill.

A few key points to consider for each of these alternatives are addressed below. The capital and operating costs provided are considered typical and are highly dependent on the specific project. The County could also construct and operate; however, special skills would be necessary for more complicated technologies, and generally the construction and operation is contracted to a private firm.

Mixed Waste Processing – Mixed Waste Processing could be implemented to increase diversion. The facility can be used to recover plastic containers, metal, and paper commodities captured at a single-stream MRF; however, the quantity and quality of the recovered materials would not likely be cost effective. If the facility could focus on C&D wastes extracting wood, metal, film plastic sheeting, concrete, and other construction related material. Recovery of these materials can significantly increase the waste tonnage diverted but these materials often are low

value unless there are specific markets available. The metal and cardboard removed may have markets. Removal of these bulky materials, however, may allow for better recovery of fines and organics and improve access to single-stream containers. A facility could be built with the ability to change the recovered material mix, adapting by season or identified markets.

Mixed waste processing facilities would require solid waste permitting similar to that required by other MRFs and transfer stations. Capital cost for a mixed waste MRF will vary based upon the size, type of processing, site constraints or other issues but would likely be in the \$20 million to \$40 million range.

Aerobic Composting – This should remain as an option that was previously identified to be included in the evaluation of Infrastructure Options; however, at this time aerobic composting is the best alternative due to continued development of anaerobic digestion operating practices. This technology is best applied to mixed green waste and yard waste, which can be a significant percentage of the waste stream, particularly at certain times of the year. If an effective food waste collection system is developed, diversion can be increased further although additional measures are needed for odor control.

Solid waste permits would be required for a composting operation. An aerobic composting operation may require about \$5 million to \$10 million set up and an operating fee of about \$50 to \$75 per ton processed.

RDF Processing – An RDF processing system prepares MSW by using separation, shredding, screening, air classifying and other equipment to produce a fuel product for either on-site thermal processing, off site thermal processing, or use in another conversion technology that requires a prepared feedstock.

Benefits include the preparation of the MSW into a feedstock that is acceptable by other processes, allowing them to be more effective and efficient, removal of recyclable and reusable materials for beneficial use. A drawback is that RDF facilities will have some air emissions directly from the processing (dust) as well as from the combustion of the RDF. An economic drawback of RDF is that it produces a solid fuel similar to coal. So, production of the RDF product presumes a local appetite for a coal-substitute to be economically viable. A long term contract to accept the RDF is required to justify the construction of the RDF production facility. Fugitive particulates from the process must be controlled. In addition, other environmental impacts must be mitigated, such as noise and odor. Economics for this type of facility are largely based on the revenues garnered from sale of the RDF product.

An RDF Processing Facility would require solid waste permits and will have some other permitting requirements for wastewater and possibly air emissions control permitting if drying or certain other requirements are needed. Facility capital cost may be in the range of \$50 million to \$100 million. The operating cost may be in the range \$35 to \$100 per ton of MSW processed. These values could vary depending on the specific technologies used.

Direct Combustion – Direct combustion of much of the waste stream with mass burn waste-to-energy technology could be completed. Of these alternatives, this option would result in the largest diversion and could have the least pre-processing requirements for the waste stream. Economics are heavily driven by the recovered energy markets. Most facilities produce electricity, but if a steam customer could be identified, usually steam sales offer better economics. For the combustible portions of the waste stream, about an 80 percent reduction in weight is possible with recovery of metal and required disposal of ash and residues.

A mass burn facility will require solid waste, Title V air emission permits and will have some other permitting requirements for wastewater and possibly certain other requirements. Facility capital cost may be in the range of \$300,000 to \$450,000 per ton per day of capacity. In other words, a 750 tpd facility would likely have a capital cost between \$225 million and \$338 million. The operating cost may be in the range \$80 to \$120 per ton of MSW processed.

Additional information on this subject can be found in Volume II – Memo A, Emerging Technologies Technical Memorandum.

3.4 Phase 2 Study – Projected Waste Generation and Composition

In order to properly size infrastructure, the current waste managed in the Wasteshed need to be quantified based on material categories and projected over a 25-year period, taking into consideration estimated population growth within Larimer County. As such the projected quantities of waste generated was determined on a per capita basis.

The Phase 1 Planning Study provided an overall summary of amounts of waste managed and tracked in the Wasteshed, but gaps in solid waste volume reporting were noted. In Phase 2, the TAC and the waste haulers worked diligently to provide a summary of waste managed and tracked in the Wasteshed. Table 3-2 summarizes total tons managed for recycling and disposal by type, over a three-year period.

Table 3-2. Total Wasteshed Tons Managed

North Front Range Regional Wasteshed Total Waste Stream (In Tons)		Year		
		2014	2015	2016
Solid Waste	Larimer County Landfill	211,069	222,219	216,311
	Other Landfills	52,365	44,495	40,663
	Subtotal	263,434	266,714	256,974

Table 3-2. Total Wasteshed Tons Managed

North Front Range Regional Wasteshed Total Waste Stream (In Tons)		Year		
		2014	2015	2016
C & D	Larimer County Landfill	155,004	138,173	119,168
	Other Facilities	31,660	29,999	28,055
	Subtotal	186,664	168,172	147,223
Yard Waste	Larimer County Landfill-Disposed	16,053	14,646	15,257
	Other Facilities-Recycled	34,389	42,572	42,876
	Subtotal	50,442	57,218	58,133
Recycled/ Recovered Materials	Larimer County Recycling Facility (Curbside collection/ /Drop-off Centers) ¹	39,724	39,588	38,995
	Other Facilities (Recovered Materials) ²	209,310	146,954	111,074
	Subtotal	249,034	186,542	150,069
Total Disposed & Recycled		749,574	678,646	612,399

¹ Traditional curbside recyclables.

² Includes asphalt, concrete, scrap metal, e-waste and other recoverable materials.

In the Wasteshed, the per capita disposal and recycling measurement is not easily calculated, as waste streams are going to multiple landfills and recycling facilities and should therefore be considered a best estimate. The primary purpose of the per-capita waste generation measurement is to forecast future waste generation volumes for evaluating future programs and infrastructure development options. Table 3-3, Annual Per Capita Waste Generation, summarizes the per capita generation rate, in tons, based on population by waste stream. Per capita waste generation rates for the State of Colorado and the State of Washington are shown for comparison.

Table 3-3. Annual Per Capita Waste Generation (In Tons per Person per Year)						
North Front Range Regional Wasteshed						
	2014	2015	2016	3-Year Average	State of Washington	State of Colorado
Population	324,657	333,577	339,993	332,742	6,968,170	5,541,000
Material Disposed:						
Solid Waste	0.81	0.80	0.76	0.79	1.01	1.42
C & D	0.56	0.51	0.43	0.50	0.37	N/A
Yard Waste	0.05	0.04	0.04	0.04	N/A	N/A
Materials Recycled/Recovered:						
Yard Waste	0.12	0.13	0.14	0.13	0.08	N/A
Single-stream/Drop Box	0.12	0.12	0.11	0.12	0.54	0.33
Scrap Metal/E-Waste	0.11	0.09	0.09	0.10	0.15	N/A
Concrete/Asphalt	0.54	0.35	0.24	0.38	0.38	N/A
Total Annual Per Capita Generation Rate (In Tons)	2.31	2.04	1.81	2.06	2.49	1.75
Total Annual Per Capita Disposal Rate (In Tons)	1.42	1.35	1.23	1.33	1.38	1.42

The Wasteshed was separated into five zones based on geographic location, population and solid waste infrastructure currently available. Figure 3-1 identifies the five zones with their associated population projections through 2050.

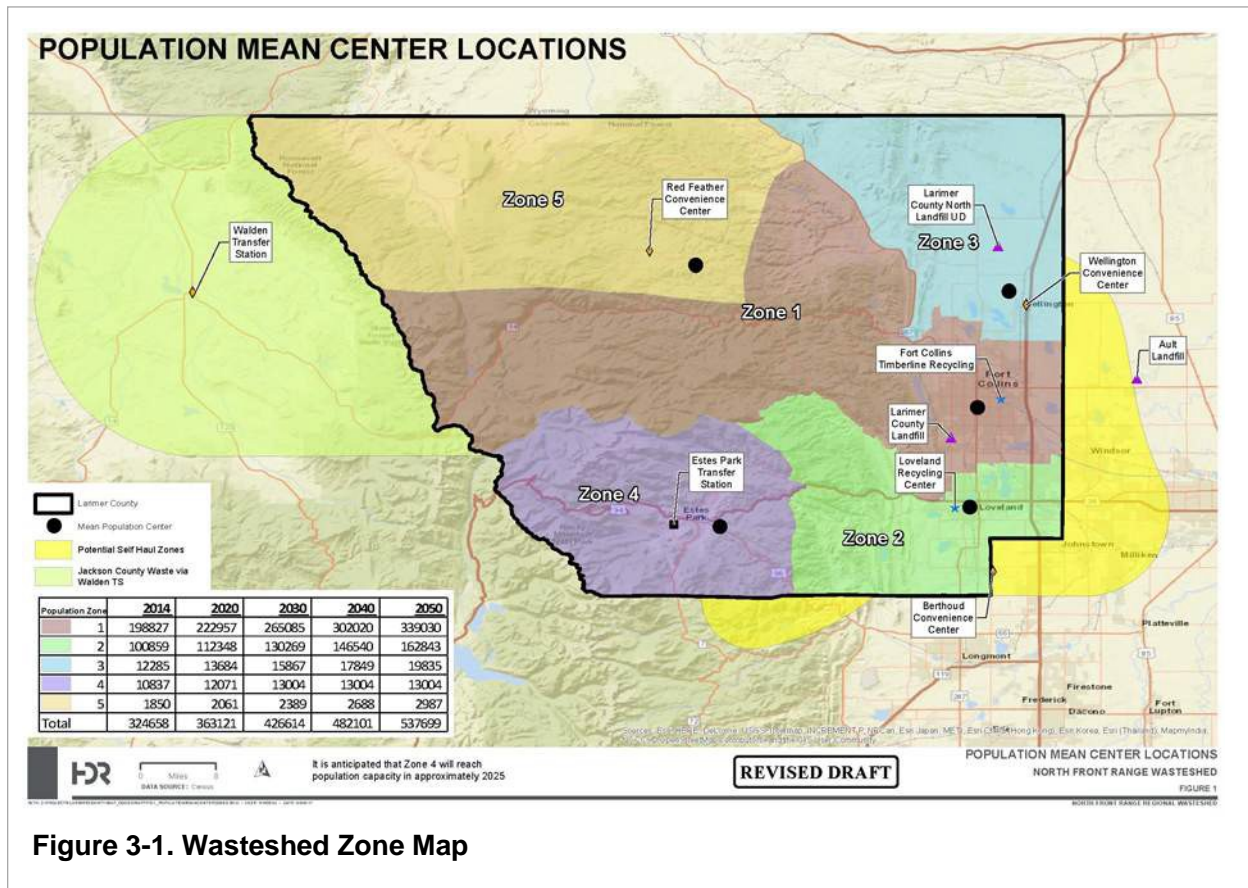


Figure 3-1. Wasteshed Zone Map

Waste per capita was calculated for each of the established zones for solid waste, C&D, yard waste and recyclables for 2014 and estimated for 2050 as shown in the illustrations below. The year 2014 was chosen as the base year for calculating waste per capita due to the availability of population density information from the State of Colorado. These waste-per-capita calculations were then utilized in the Analysis of Infrastructure Options report as a base line for sizing future facilities.

Waste Per Capita 2014

<u>ZONE 1</u>		<u>ZONE 2</u>		<u>ZONE 3</u>	
Solid Waste:	157,483	Solid Waste:	79,736	Solid Waste:	11,735
C&D:	108,877	C&D:	55,126	C&D:	8,113
Yardwaste:	31,108	Yardwaste:	15,570	Yardwaste:	2,318
Recyclables:	163,316	Recyclables:	82,690	Recyclables:	12,170
Total generated:	460,784	Total generated:	233,302	Total generated:	34,336
Total disposed:	297,458	Total disposed:	150,612	Total disposed:	22,166

<u>ZONE 4</u>		<u>ZONE 5</u>		<u>TOTAL ALL ZONES</u>	
Solid Waste:	10,737	Solid Waste:	3,281	Solid Waste:	262,972
C&D:	7,423	C&D:	2,268	C&D:	181,807
Yardwaste:	2,121	Yardwaste:	648	Yardwaste:	51,945
Recyclables:	11,124	Recyclables:	3,402	Recyclables:	272,712
Total generated:	31,415	Total generated:	9,599	Total generated:	769,436
Total disposed:	20,281	Total disposed:	6,197	Total disposed:	497,724

Estimated Waste Per Capita by 2050

<u>ZONE 1</u>		<u>ZONE 2</u>		<u>ZONE 3</u>	
Solid Waste:	262,218	Solid Waste:	125,561	Solid Waste:	18,480
C&D:	165,961	C&D:	79,469	C&D:	11,696
Yardwaste:	56,427	Yardwaste:	27,019	Yardwaste:	3,977
Recyclables:	222,387	Recyclables:	106,488	Recyclables:	15,673
Total generated:	706,993	Total generated:	338,537	Total generated:	49,826
Total disposed:	484,606	Total disposed:	232,049	Total disposed:	34,153

<u>ZONE 4</u>		<u>ZONE 5</u>		<u>TOTAL ALL ZONES</u>	
Solid Waste:	16,907	Solid Waste:	5,166	Solid Waste:	428,332
C&D:	10,701	C&D:	3,270	C&D:	271,097
Yardwaste:	3,638	Yardwaste:	1,111	Yardwaste:	92,172
Recyclables:	14,339	Recyclables:	4,381	Recyclables:	363,268
Total generated:	45,585	Total generated:	13,928	Total generated:	1,154,869
Total disposed:	31,246	Total disposed:	9,547	Total disposed:	791,601

Additional information can be found in Volume II – Memo C, Solid Waste Volumes Technical Memo.

3.5 Phase 2 Study - Analysis of Infrastructure Options

As briefly discussed in Section 3.2, following completion of the Phase 1 Study, the Coalition initiated the second phase of its multi-year Regional Wasteshed Planning Study to further refine, identify, and analyze options for development of a future regional solid waste infrastructure system.

Eleven potential infrastructure options were selected through a collaborative effort with the Coalition's TAC and the stakeholders. The options selected for further evaluation were:

- Status Quo
- Central Transfer Station
- New County Landfill
- Material Recovery Facility (Clean MRF)
- Yard Waste Organic Processing Facility
- C&D Processing Facility
- Energy From Waste Facility – Direct Combustion
- Mixed Waste Processing (Dirty MRF)
- Static Aerated Composting including Food Waste
- Anaerobic Digestion
- Refuse Derived Fuel Processing

The criteria by which each option was evaluated included each facility's needs (sizing), financial impacts (capital costs, operations and maintenance costs), programmatic impacts, regulatory and permitting requirements, and risks/barriers. Additional information evaluated included implementation schedules and public-private partnership opportunities. Each option was also ranked based on a cost-benefit analysis or sustainable return on investment (SROI).

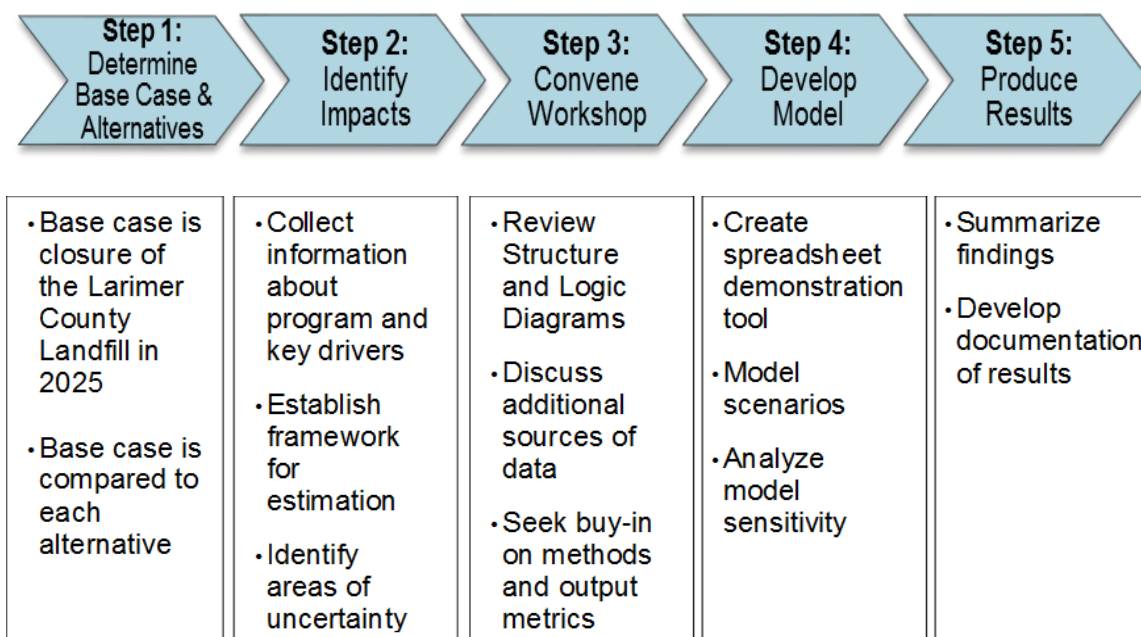
3.5.1 Sustainable Return on Investment

SROI is a proven, approach based on cost-benefit analysis used to assist in making planning and budgeting decisions, which provides a full range of possible outcomes using state-of-the-art risk analysis techniques. It further includes a sustainable value methodology developed to provide a thorough, transparent alternatives analysis that considers a wide range of goals and incorporates triple bottom line (TBL) aspects and outcomes that are more difficult to quantify. The

SROI approach assigns dollar values to benefit categories that are difficult to monetize and compares value directly with cost.

Results of this analysis include monetized benefits and costs, net present value and benefit-cost ratio (BCR).

SROI Process

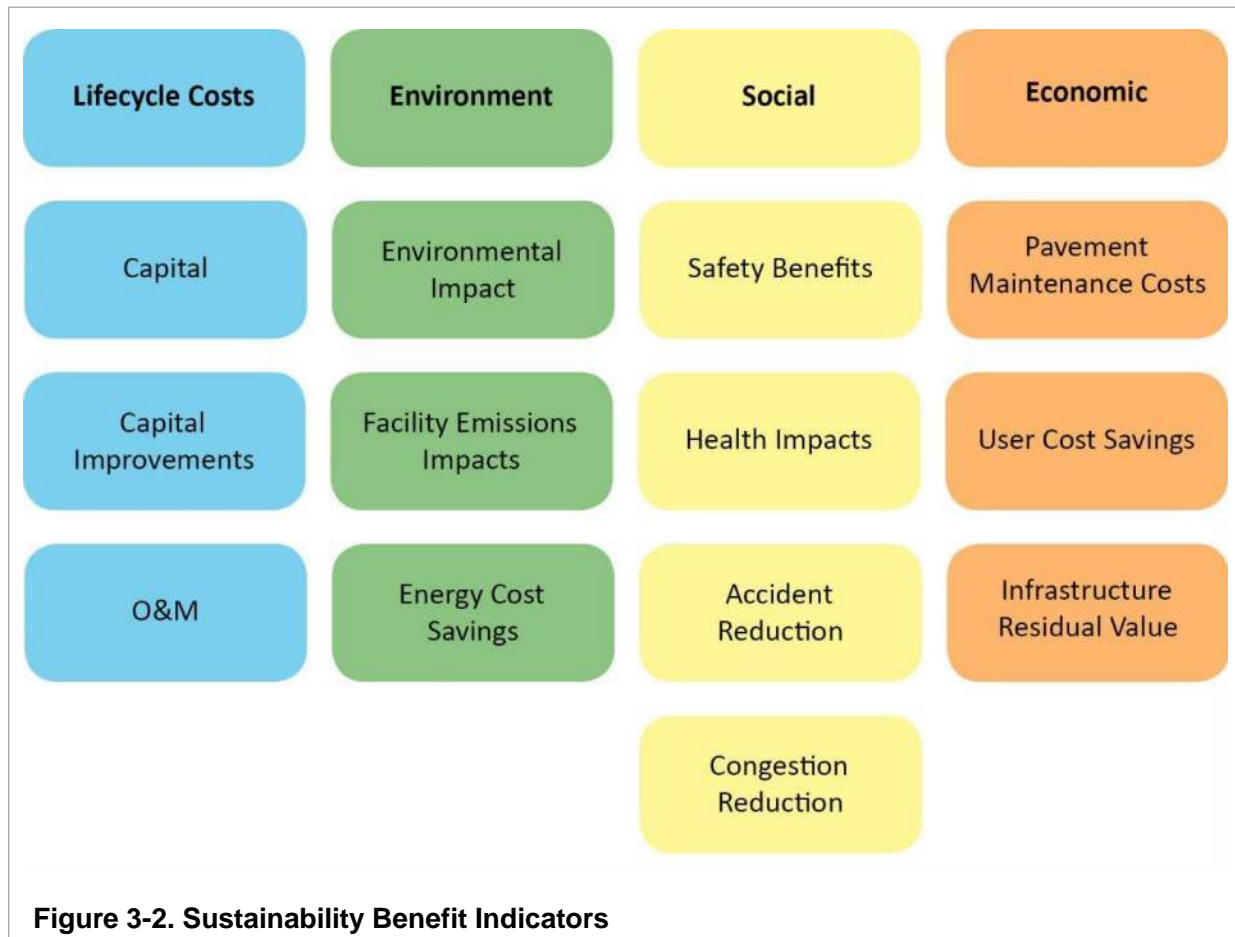


SROI Net Present Value

In the analysis, the net present value reflects the time value of money, calculated using undiscounted benefits and costs and a discount rate of 4 percent. The benefit-cost ratio indicates what a \$1 investment in a particular facility may generate in terms of societal benefits. For example, a BCR of 1.5 means that a \$1 investment in a facility is expected to generate \$1.50 in public benefits. This information, combined with financial and other considerations, can be used as a tool in decision making by providing an estimate of which facility or facilities is most likely to generate a positive environmental and social return to the public. A BCR value of more than one indicates a triple-bottom-line net benefit to investment, a value of less than one indicates the opposite.

Sustainability Benefit Factors

Potential benefits captured in the SROI model are grouped into environmental, economic, and social impacts and are represented in Figure 3-2.



- Pavement maintenance cost, safety benefits, accident reduction, congestion reduction, and environmental impact were all calculated based on the change in vehicle miles traveled (VMT) with the different facility alternatives. The estimation of these impacts is consistent with United States Department of Transportation and other federal guidance related to the estimation and monetization of these benefits.
- Facility emissions impact was calculated based on the change in energy demand (in kilowatt-hours per ton) between the base scenario and each alternative and the Emissions & Generation Resource Integrated Database (eGRID), provided by the EPA. This database provides annual total output emissions rates by state for various pollutants.
- Health impact benefits were estimated by running the facility emissions impact in tons through the EPA's co-benefit risk analysis (COBRA) tool. This tool provides a low and high estimate of total health benefit (\$) as a present value, using a 7 percent discount rate. For this analysis, an average of the low and high estimates was used.

- Following the closure of the Larimer County Landfill (the base case), the overall user cost for waste disposal is expected to increase. For this analysis, it was assumed to be an increase of \$2 per ton. This is primarily due to the reduction in the supply of landfills that are proximate to the existing landfill and likely to serve existing Larimer County Landfill customers. Under both the Central Transfer Station and New County

Landfill alternatives, it is assumed that the user cost would return to the pre-closure landfill cost once operational. The total impact of user cost savings associated with this alternative is captured by comparing the difference between the base case and the New Landfill and Transfer Station alternatives. Specifically, total tonnage is multiplied by the reduction in cost of \$2 per ton from the base scenario.

- The period of analysis is 25 years, starting in 2025 and following the existing landfill's closure. The study analysis period ends in 2050.
- The benefits and costs are presented in their present values using a discount rate of 4 percent, which is considered equal to the bonding rate.
- SROI benefit cost ratio results can be found in Table 3-4 and Table 3-5.

3.5.2 Geographic Location Considerations

Approximate geographic locations for new waste management infrastructure were considered, with the intent that they will be socially acceptable, maximize efficiencies, and minimize costs for haulers and customers.

Figure 3-1 above included the population zones with populations projected out to 2050. Figure 3-3 is a Population Hotspot Map, which shows areas where population is growing the fastest. This information is the basis for determining approximate areas where new facilities would be most appropriate. The recommended area may vary according to the infrastructure option.

For example, a new county landfill would likely be sited on property located in Zone 3 on the Population Zone Map (Figure 3-1). Facilities such as a central transfer station, yardwaste organic processing facility and construction and demolition debris processing facility would likely be centrally sited near the Population Hot Spots at the current Larimer County Landfill site. A potential facility site layout is included in Figure 3-4.

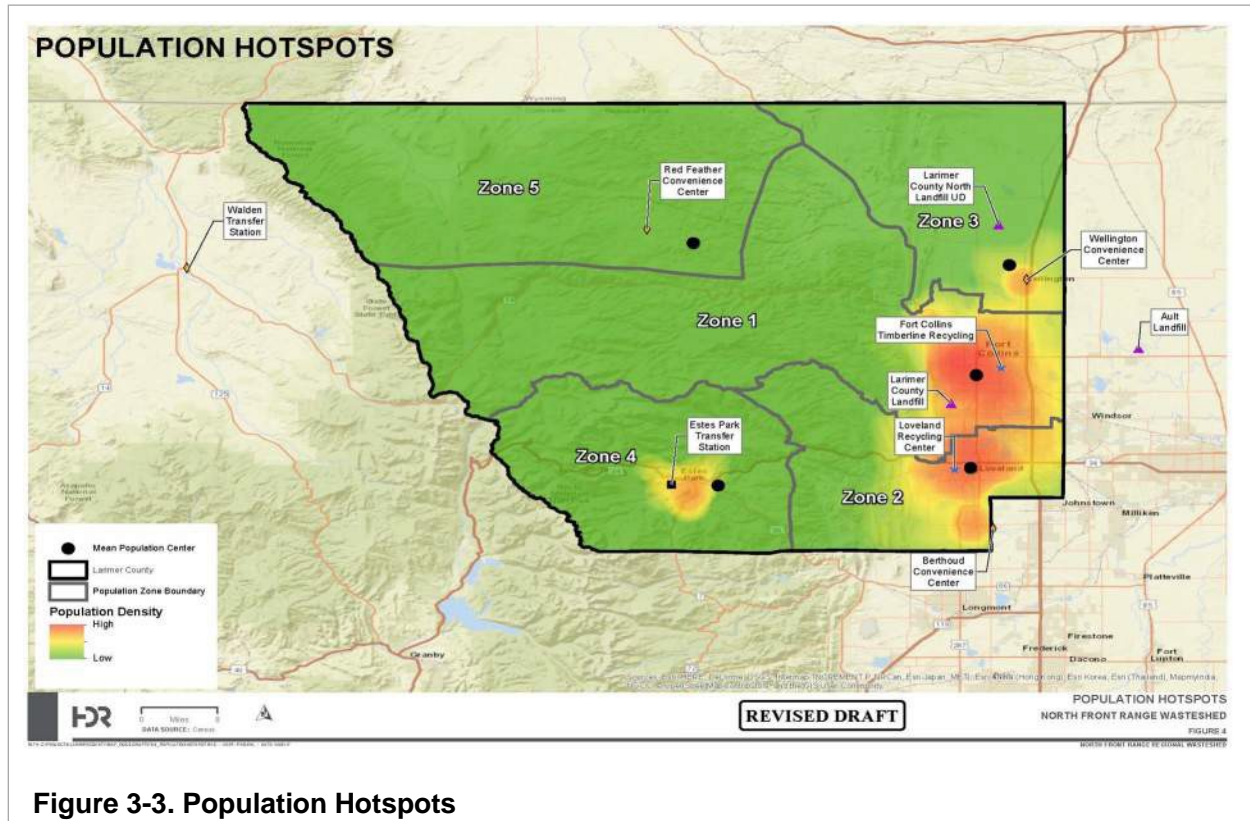
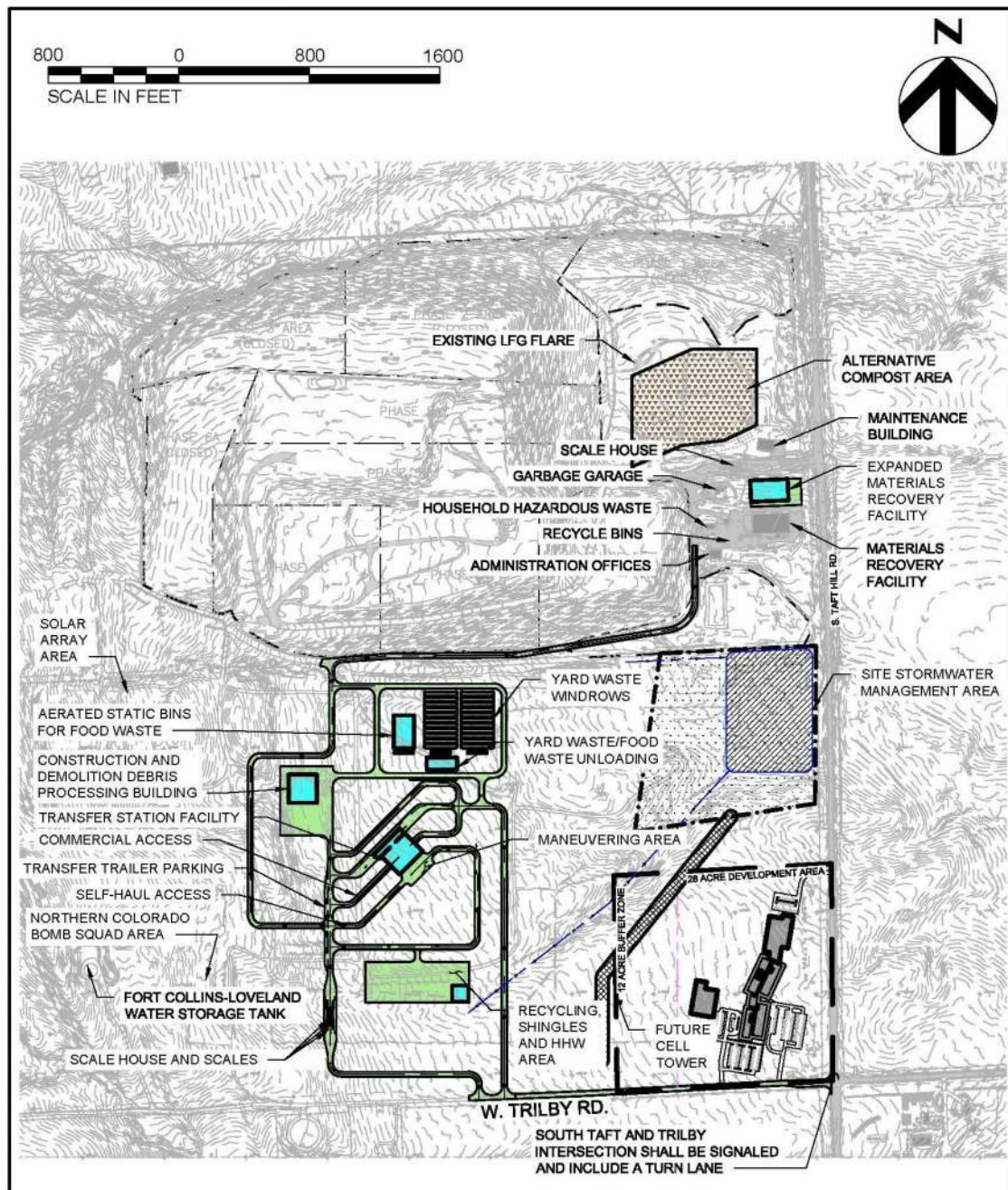


Figure 3-3. Population Hotspots



LARIMER COUNTY SOLID WASTE AND BEHAVIORAL HEALTH

PRELIMINARY SITE LAYOUT

DATE
9-28-18

FIGURE
1

Figure 3-4. Potential Site Layout Map

3.5.3 Summary of Infrastructure Options Considered

Table 3-4 outlines the eleven (11) infrastructure options considered by the Coalition and includes estimated capital costs, estimated cost per ton for waste handling, the BCR as calculated through the SROI process (see Section 3.5.1) and the estimated monthly household cost associated with each infrastructure option. The estimated monthly household cost was calculated based on the annual operational costs for each facility, the EPA estimate that 50% of waste disposed is residential in nature and the number of households in Larimer County. Information provided below is based solely on a technical evaluation, as if each facility were a standalone facility, and does not include additional overhead costs such as subsidizing programs such as Household Hazardous Waste, recycling, education, solid waste administration, and reserve replacement funds.

Table 3-4. Infrastructure Options for Consideration

Infrastructure Option	Estimated Capital Costs	Estimated Cost Per Ton	Benefit Cost Ratio	Estimated Monthly Household Cost
Status Quo	N/A	\$22.00/Ton	N/A	N/A
Central Transfer Station	\$14.3M	\$41/Ton	1.11	\$1.50 - \$3.01
New County Landfill	\$13.6M (1 st Phase)	\$22/Ton	2.13	\$1.76 - \$3.51
Materials Recovery Facility – Clean	\$23.7M	(\$6)/Ton – (\$12)/Ton	2.25	\$0.00
Yard Waste Organic Processing Facility	\$10.6M	\$31/Ton - \$35/Ton	5.89	\$0.32 - \$0.64
C&D Processing Facility	\$13.7M	\$35/Ton	2.05	\$0.059 - \$1.18
Energy From Waste – Direct Combustion	\$313.8M	\$110/Ton	0.47	\$7.12 - \$14.24
Mixed Waste Processing – Dirty MRF	\$47.2M	\$57/Ton - \$61/Ton	0.75	\$1.33 - \$2.67
Aerobic Composting Including Food Waste	\$10.6M	\$36/Ton - \$43/Ton	3.94	\$0.55 - \$1.10
Anaerobic Digestion	\$11.9M	\$77/Ton - \$82/Ton	8.48	\$0.55 - \$1.10
RDF Processing	\$322.9M	\$126 / Ton	0.42	\$8.13 - \$16.26

3.5.4 Summary of Tiered Infrastructure Options Considered

The TAC and the stakeholders reviewed the infrastructure options and recommended a tiered approach when considering which facilities to move forward with (see Table 3-5). This approach suggests that none of the options are eliminated from future considerations, as during the 25-year period technologies, regulations, waste streams, waste generations, and economies may change for better or worse.

Each option was categorized into three tiers with the Tier 1 facilities representing those that are recommended for further advancement and placed in service prior to the closure of the Larimer County Landfill in 2025. The Tier 2 facilities are those that the Coalition and stakeholders will assess annually for future action, and the Tier 3 facilities will be further reviewed on an as-needed basis as industry changes occur.

The TAC and the stakeholders concurred that the Tier 1 infrastructure be approved as the facilities to be potentially placed in service in the Wasteshed prior to the closure of the Larimer County Landfill in 2025.

Table 3-5. Tiered Infrastructure Options

Tier Recommendations	SROI Criteria Benefit/ Cost Ratio	Potential Schedule			
		Local Siting Approval	Permitting/ Design	Construction	In Service
<u>Tier 1</u>					
Central Transfer Station	1.11	2019	2020	2021	2022
New County Landfill	2.13	2019	2020	2022	2023
Yard Waste Open Windrow Composting	5.89	2020	2021	2022	2022
Construction & Demolition Waste Processing	2.05	2020	2021	2022	2022
Food Waste Composting – Static Aerated Bin	3.94	2021	2021	2023	2024
<u>Tier 2</u>					
Clean Material Recovery Facility /Upgrade	2.25	Assessed Annually Moving Forward			
Anaerobic Digestion /Pre-Processing - WWTP	8.48				
<u>Tier 3</u>					
Waste to Energy (Direct Combustion)	0.47	Possible Future Consideration			
Refuse Derived Fuel Processing	0.42				
<u>Not Considered Viable</u>					
Mixed Waste Processing - Dirty MRF	0.75	Not Currently Viable			
Status Quo	N/A				

Additional information on this topic can be found in Volume II – Memo D, Analysis of Infrastructure Options Technical Memo.

3.6 Phase 2 Study – Blended Infrastructure Scenarios

Upon completion of the individual infrastructure options evaluation represented in Table 3-2 and Table 3-3, the TAC carefully considered the impacts, costs, and benefits of a complete and comprehensive solid waste infrastructure system that would likely include more than one infrastructure option.

- Scenario #1 blended the Central Transfer Station and a new Landfill.
- Scenario #2 blended the Central Transfer Station, new Landfill, C&D Processing Facility, and Yard and Food Waste Composting (yard waste composting in outdoor open windrows and food waste composting in aerated static bins located in a building).
- Scenario #3 included all elements of Scenario #2 and added Food Waste being Pre- Processed for treatment at the Wastewater Treatment Plant.

Implementing multiple infrastructure options and co-locating them at the existing Larimer County Landfill facility (except for the new Landfill), as considered in Scenario #2 and Scenario #3, provides shared resources and operational efficiencies, resulting in a positive impact on costs. For example, the yard and food waste composting facility cost was refined to represent a single operation where prior to accepting food waste the yard waste composting process would consist of outdoor windrows. When food waste collection is implemented and combined with yard waste, an enclosed building would be added to the facility for accepting food waste to control odors. Furthermore the windrow and composting area would be upgraded to static aerated piles to further control odors.

The infrastructure costs were further refined to reflect the shared resources and operational efficiencies, and overhead costs were also included (Household Hazardous Waste, solid waste administration, education, recycling, and reserve replacement funds). Additionally, Larimer County has the benefit of an existing reserve replacement fund that will be contributing a significant amount of funds for the capital expenditure of the facilities. The TAC refined the costs for each infrastructure option based on tons captured, process controls implemented, and available capital for construction of each option. Table 3-6 reflects the refined costs associated with the above mentioned considerations.

Table 3-6. Refined Infrastructure Costs Table

	Capital Costs (2017 \$)	Tons Captured (2025)	Tipping Fee (2017 \$)
New County Landfill	\$11.7M (1 st Phase) \$11.7M (Equity) \$0.0M Finance	344,800	\$14.79 / Ton
Central Transfer Station	\$15.8M \$15.8M (Equity) \$0.0M Finance	321,600	\$30.79 / Ton
Construction & Demolition Processing	\$13.7M \$13.7M (Equity) \$0.0M Finance	150,000	\$34.32 / Ton
Yard Waste & Food Waste Composting	\$11.8M \$0.0M (Equity) \$11.8M Finance	72,200	\$37.92 / Ton
WWTP Pre-Processing	\$3.1M \$0.0M (Equity) \$3.1M Finance	14,000	\$83.65 / Ton

The blended scenarios were then evaluated in the SROI process and compared with the total cost of the scenario package along with the anticipated waste diversion capable of being achieved. An overview of the three scenarios is outlined in Table 3-7.

Table 3-7. Blended Infrastructure Options

	Infrastructure Options Included	Benefit-Cost Ratio	Total Cost of Package	Additional Diversion Percentage
Scenario #1	Transfer Station Landfill	> 1.00	\$27.5M	0%
Scenario #2	Transfer Station Landfill C&D Processing Yard & Food Waste	> 1.00	\$53M	38%
Scenario #3	Transfer Station Landfill C&D Processing Yard & Food Waste WWTP Pre-Processing	< 1.00	\$56.1M	41%

The Coalition recommended moving forward with Scenario #2.

3.7 Phase 2 Study – Process Controls

As part of the Phase 2 Study, the TAC considered potential process controls to be adopted to support the infrastructure options selected. The recommended process controls also support the goals and objectives set forth by the Coalition.

Eight potential process controls were evaluated:

- Hauler Licensing
- Process Control (Operating criteria)
- Waste Ban (Yard, C&D, etc.)
- Unregulated Open Market
- Flow Control for C&D and Single Stream Recycling
- Non-Exclusive Franchise
- County-Wide User Fee
- Incentives

Each process control type was reviewed based on advantages and disadvantages for adoption within the Wasteshed. Flow control for MSW was not considered as part of this study. The complete information can be found in Volume II – Technical Memos, Memo E. Key findings resulting from the review of potential process controls:

- Currently, there are limited controls, policies, and regulations in place in the Wasteshed to guarantee that waste is directed to infrastructure that supports the goals and objectives that the Coalition has established to enhance waste reduction and diversion.
- It is common practice for municipalities and local government to employ some method of process control, whether it be through ordinances, codes, policies or procedures to ensure waste is handled in an environmentally responsible manner.
- Due to the competitive nature of the waste industry, local governments can be subject to the risk of rising costs if process control is not established. Process controls ensures there is enough material coming each of the facilities to make them financially viable.
- Process controls protect the health, safety and the welfare of the citizens by providing greater control and oversight of solid waste management activities and protects natural resources by allowing the municipalities to designate disposal and recycling sites that meet required environmental standards.

Given the recommended Tier 1 infrastructure options (New County Landfill, Central Transfer Station, C&D Processing Facility, and Yard Waste Composting/Food Waste), the existing waste market, and the anticipated capture rates utilizing the projected waste generation in the five zones of the Wasteshed, the following

findings were considered to assist in achieving a successful solid waste management system that serves the citizens of the Wasteshed:

Municipal Solid Waste (MSW)

Residents and businesses (including trash haulers) may dispose of garbage at any landfill they choose. Flow control is not being proposed for trash; haulers would not be required to take trash to the Larimer County Landfill or Transfer Station. It is recommended to initiate a competitive tipping fee rate structure to capture appreciable volume in these zones. The majority of MSW is generated within Zones 1 and 2 which primarily consist of the City of Loveland and City of Fort Collins. The City of Loveland currently provides waste collection services to over 90 percent of the residents within the city while in the City of Fort Collins waste collection is offered through an open market system utilizing private waste haulers. The City of Loveland disposes of municipal solid waste at the current Larimer County Landfill. Waste disposal within Zone 1 and 2 is subject to the private waste hauler's choice in waste disposal facilities which will greatly depend on hauling distance and competitive tipping fees. Zones 3, 4, and 5 of the Wasteshed are generally serviced by Larimer County's convenience centers and the Town of Estes Park's transfer station and some private haulers. The waste generated in these zones will most likely continue to be serviced by Larimer County and their associated facilities.

Construction & Demolition Debris (C&D)

C&D makes up a large percentage of materials being disposed of at the Larimer County Landfill. In order to increase diversion, lengthen the life of disposal facilities, and achieve the goals and objectives set forth by the Coalition, it is recommended to develop and implement flow control for a fixed time of 10 years to direct mixed construction and demolition debris to an indoor, County-owned processing facility that strives to recycle and/or reuse a significant portion of the waste and develop end markets for the materials. This measure is needed to ensure financial viability of such a facility and to enable the operator to develop end markets for these materials based on guaranteed quantities.

Construction and demolition debris separated at the project site for recycling would not be subject to flow control. The processing facility would most likely include both manual and mechanical means of source separation and processing. With end market development, consideration must be given to other on-site reprocessing services that could utilize or beneficially re-use source separated products such as fines and other inert materials, clean wood, wallboard, and cardboard.

Yard Waste

A yard waste ban is recommended to deter the disposal of yard waste into landfills as the yard waste materials may be utilized to create valuable products (such as compost and mulch). It is common for yard waste to be collected separately from other waste materials, which makes it easier to divert waste to a central composting facility. A significant amount of yard waste is generated within the Wasteshed, with a portion going to existing compost facilities. However, the remaining portion of yard waste continues to be disposed of in landfills. Recognizing that there are

currently several public and private options for recycling yard waste, a waste ban would help support the diversion of more materials to all facilities able to process green waste and the business model of the composting facility.

Food Waste

No process controls are currently recommended for food waste. It is recommended that the Coalition develop a timeline for identifying food waste customers and developing a collection system consistent within the Wasteshed. Food waste can be used in composting facilities and anaerobic digesters. Collection of food waste is typically the largest hurdle in developing facilities to handle food waste. Consideration should be given to the development of collection opportunities for commercial and industrial food waste first, which will likely be the easier waste stream to capture for increased diversion.

Single-Stream Recycling

It is recommended that all single-stream recycling materials be directed to the Larimer County recycling center through flow control measures. Larimer County owns a recycling center that handles the majority of the single-stream recycling materials in the Wasteshed. Flow control provides the predictability needed to encourage the facility operator to invest resources into improving and expanding the center in the future.

Considering the current market trends and relatively low volume of recyclables, a fully functional materials recovery facility would not be sustainable. The Wasteshed could benefit from increased volume and recycling participation with new private/public relationships arriving at more stable and competitive rates for market ready products that can meet all new contamination thresholds.

Additional information on this subject can be found in Volume II – Memo E, Potential Local Government Options and Policies Technical Memo.

3.8 Phase 2 Study - Stakeholder Engagement

To ensure alignment with the needs and expectations of the local businesses and communities, the Coalition actively engaged a stakeholder group made up of 88 representatives from a variety of public and private entities throughout the County (see Volume III, Appendix C). A total of six (6) initial stakeholder meetings were held throughout Phase 2 (with an additional meeting further outlined in Section 3.10). Each meeting covered specific topics discussed in prior sections of this Plan and included progress updates of the infrastructure evaluations. Prior to each meeting, an email invitation was sent to the entire stakeholder list to inform them of the meeting date, time, location, and topic. A website was established specific to the stakeholders that housed documents shared with the stakeholders and provided a forum for submitting comments in the event they missed a meeting.

The stakeholder group was identified with the assistance of each member of the Coalition, and was comprised of representatives of general businesses throughout the Wasteshed, government and agency representatives, advisory groups,

education sector, solid waste industry sector, business/industry sector, and various associations.

Each meeting shared information via PowerPoint presentation, collected feedback through discussion and real-time audience response devices, and measured the level of acceptance as the infrastructure options developed. Below is a general summary of each of the stakeholder meetings.

Stakeholder Meeting #1 – May 31, 2017 - Orientation and Goals and Objectives

Topics Discussed:

Project team members shared the background and purpose of the North Front Range Regional Wasteshed Planning Study and the function of the stakeholder group, and shared and collected feedback on the Coalition's draft goals and objectives. Input was gathered via discussion and optional hard copy comment forms. An online survey was also sent to all stakeholders after the meeting and solicited fourteen (14) total responses from June 7 through July 6, 2017.

Stakeholder attendees: 32.

Feedback Shared:

Stakeholders emphasized many of their expectations of the planning study, which primarily consisted of the following:

- The study should look at the Wasteshed system comprehensively
- The goal of evenly sharing responsibility across all municipalities in the Wasteshed was strongly supported
- Affordability for residents, producers, and the commercial sector
- Increased diversion rates in the Wasteshed was of high priority and was a shared value

Stakeholder Meeting #2 – June 28, 2017 - Emerging Technologies

Topics Discussed:

Project team members shared the eleven (11) infrastructure options selected for evaluation as part of Phase 2 of the study, the results of the 2016 waste characterization study, and successful waste management practices throughout the country. An online survey was available for stakeholders to supplement feedback, and was open from June 28 through July 27, 2017. Stakeholders also provided feedback via hard copy comment forms and real-time audience response devices. Stakeholder attendees: 31.

Feedback Shared:

Stakeholders expressed support for the following infrastructure options: Aerobic Composting, Central Transfer Station, New County Landfill, Materials Recovery Facility (Clean), Construction and Demolition Processing Facility, Aerobic Composting Facility, and Anaerobic Composting. They generally expressed dislike for the option of keeping with the Status Quo, Energy from Waste, Dirty Material

Recovery Facility, and RDF Processing. The following question was also asked of the stakeholders via anonymous, real-time response devices:

Question	Response	Percentage of Responses
The infrastructure options presented contribute to achieving the Goals & Objectives.	Strongly Agree	64.29%
	Agree	25%
	Neutral	3.57%
	Disagree	0
	Strongly Disagree	0
	Not sure, need more information	7.14%

Stakeholder Meeting #3 – August 2, 2017 - Solid Waste Volumes

Topics Discussed:

Project team members presented the final Goals and Objectives, detailed solid waste volumes, a population zone map, current per capita waste generation, and estimated waste per capita by 2050. Stakeholder attendees: 21.

Feedback Shared:

Stakeholders generally agreed that the solid waste volumes were accurate and comprehensive, with the exception of food waste; however, stakeholders recognized the challenges in measuring the food waste generated within the County.

Stakeholders also discussed the role of population growth and the increasing need for a reliable waste system.

The following questions were asked of the stakeholders via anonymous, real-time response devices:

Question #1	Response	Percentage of Responses
The solid waste volume data collected is detailed enough to support the next phases of this project.	Strongly Agree	42.11%
	Agree	52.63%
	Neutral	0
	Disagree	5.26%
	Strongly Disagree	0

Question #2	Response	Percentage of Responses
The Final Goals and Objectives outlined this evening meet my expectations.	Strongly Agree	73.68%
	Agree	21.05%
	Neutral	5.26%
	Disagree	0
	Strongly Disagree	0

Stakeholder Meeting #4 – October 25, 2017 - Sustainable Return on Investment

Topics Discussed:

Project team members presented the SROI process and results for the Central Transfer Station. This included HDR's sustainability value assessment services, potential impacts, inputs, projected operational costs, preliminary estimates for residential cost per household impact, and example process controls and ordinances. Stakeholder attendees: 23.

Feedback Shared:

Stakeholders responded to the information presented with the recognition that a successful implementation of new infrastructure options would require uniformity across the next steps that need to be taken in order to ensure that waste stays within the County and is diverted appropriately. They discussed possible requirements and how to incentivize the correct actions, including the likelihood that the County will need to establish ordinances.

The following questions were asked of the stakeholders via anonymous, real-time response devices:

Question #1	Response	Percentage of Responses
The SROI model is sound and inclusive of all potential impacts	Strongly Agree	28.57%
	Agree	42.86%
	Neutral	19.05%
	Disagree	4.76%
	Strongly Disagree	4.76%

Question #2	Response	Percentage of Responses
To what degree do you support the Coalition implementing process controls/ordinances for the handling of construction and demolition waste, in order to increase rates of diversion?	Strongly Support	50%
	Support	40.91%
	Neutral	4.55%
	Do not support	4.55%
	Strongly Oppose	0

Question #3	Response	Percentage of Responses
To what degree do you support the Coalition implementing process controls/ordinances for the handling of source-separated organics (yard and food), in order to increase rates of diversion?	Strongly Support	60.87%
	Support	17.39%
	Neutral	13.04%
	Do not support	8.7%
	Strongly Oppose	0

Stakeholder Meeting #5 – January 31, 2018 - Infrastructure Option Analyses and Recommendations

Topics Discussed:

Project team members presented the considerations for each infrastructure option, including cost per ton, BCRs, capital costs, and waste volume managed. Tier recommendations were presented, including the Tier 2 work plan. Stakeholder attendees: 30.

Feedback Shared:

Upon review of the information presented, stakeholders displayed general support for the Tiered Recommendations, and reiterated that they would like the Coalition to continue the consideration of Tier 2 Recommendations as funding and technology evolve. Other sentiments included stakeholder interest in ensuring that the selected infrastructure options will handle a meaningful percentage of the waste stream and the importance of the BCR within the full context of all factors that determine the viability of each infrastructure option.

The following questions were asked of the stakeholders via anonymous, real-time response devices:

Question #1	Response	Percentage of Responses
To what degree do you agree that the Coalition has worked to find the balance of reasonable infrastructure options that will serve the waste management needs of the Wasteshed while enhancing and improving diversion of waste?	Strongly Agree	57.14%
	Disagree	25%
	Neutral	0
	Disagree	0
	Strongly Disagree	17.86%

Question #2	Response	Percentage of Responses
To what degree do you support the infrastructure options identified as Tier 1 Recommendations?	Strongly in Favor	73.33%
	In Favor	23.33%
	Neutral	3.33%
	Against	0
	Strongly Against	0

Stakeholder Meeting #6 – March 21, 2018 - Blended Options Analysis and Solid Waste Process Controls

Topics Discussed:

Project team members presented the selected Tier 1 Infrastructure options; an overview of the Infrastructure Analysis including base information and capital costs, Blended Options, and SROI Analysis; and the recommended solid waste process controls. Stakeholder attendees: 24.

Feedback Shared:

Stakeholders responded with recognition that an Intergovernmental Agreement presented the best option for the County to achieve uniformity and collaboration in the Coalition's efforts to secure the necessary volume of waste to each recommended facility. They also reminded the project team of the realities of implementing process controls, in addition to the need to educate the public in preparation of these process controls.

The following questions were asked of the stakeholders via anonymous, real-time response devices:

Question #1	Response	Percentage of Responses
I support the recommended solid waste process controls presented for capturing the necessary volume of Construction and Demolition (C&D) debris generated in Larimer County.	Strongly Agree	65%
	Agree	35%
	Neutral	0
	Disagree	0
	Strongly Disagree	0

Question #2	Response	Percentage of Responses
I support the recommended limited-term flow control requirements for mixed Construction & Demolition (C&D) debris generate in Larimer Co.	Strongly Agree	71%
	Agree	19%
	Neutral	10%
	Disagree	0
	Strongly Disagree	0

Question #3	Response	Percentage of Responses
I support the solid waste process controls presented for capturing necessary volume of Yard Waste generated in Larimer Co.	Strongly Agree	74%
	Agree	26%
	Neutral	0
	Disagree	0
	Strongly Disagree	0

Question #4	Response	Percentage of Responses
I support the recommended flow control requirements for all single-stream recycling generated in Larimer County.	Strongly Agree	82%
	Agree	18%
	Neutral	0
	Disagree	0
	Strongly Disagree	0

Separate meetings were also held with local haulers, both individually and in a group setting, to present information and solicit input. A seventh and final stakeholder meeting was held to review specific information related to landfill disposal options. A summary can be found in Section 3.10.

Additional information on the stakeholder meetings can be found in Volume III.

3.9 Phase 2 Study – Public Outreach

The Coalition held a series of four public meetings for members of the public to learn more about the future of solid waste in the region and to provide feedback on the draft regional master plan concepts for waste recovery and disposal. The meetings were held in an open-house format, displaying 11 informational boards throughout the room and included a brief presentation. Comment forms were provided for the public to fill out and hand to project team members. Notice of the meetings was given via press release published in several local news outlets, through social media posts, and posted to the Larimer County website.

Meeting 1

Fort Collins on Monday, May 7, 2018 from 4:30 – 6:30 p.m. at the Northside Aztlan Community Center (112 E. Willow St). About 50 attendees were present, including a representative from KUNC News, who interviewed TAC members and members of the public. Meeting attendees were very engaged and asked TAC member's questions throughout the meeting.

Meeting 2

Wellington on Wednesday, May 9, 2018 from 4:30 – 6:30 p.m. at the Leeper Center (3800 Wilson Ave). About 15 attendees were present and asked TAC members questions, many specifically related to the proposed New County Landfill site and precautions that would be implemented with the facility.

Meeting 3

Loveland on Thursday, May 10, 2018 from 4:30 – 7:00 p.m. at the Loveland Public Works Building (2525 W. 1st St.). About 20 attendees were present for the meeting.

Meeting 4

Estes Park on Wednesday, May 16, 2018 from 4:30 – 6:30 p.m. at the Estes Park Museum (200 4th St). About 15 attendees were present and were engaged in the materials presented.

3.10 Phase 2 Study – Landfill Infrastructure Options – Public vs. Private

The New County Landfill infrastructure option was initially evaluated as a publicly owned and operated facility. Subsequent to the initial evaluation, the TAC received an unsolicited offer for a private disposal option in-lieu of building a new County-owned landfill. As a result, the option of contracting disposal of MSW from the Central Transfer Station to a privately owned and operated facility was evaluated, including:

- advantages and disadvantages of each type of landfill facility
- risks associated with each,
- comparisons of benefit/cost ratios, and
- stakeholder feedback.

Based on this further evaluation, the Coalition recommendation is to move forward with the option of a publicly owned and operated landfill.

3.10.1 Public vs Private Landfill – Advantages and Disadvantages

There are differences between public and private landfills including operating philosophies and goals and objectives. Each entity has different purposes in serving a community. In order to further consider these types of operations, potential advantages and disadvantages were developed and compiled for comparison. Table 3-8 and Table 3-9 briefly describe the advantages and disadvantages identified for each type of facility. The complete information can be found in Volume II – Technical Memos, Memo F.

Table 3-8. Publicly Owned/Operated Disposal Site Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> Control and stability for waste disposal Ability to direct waste to new or evolving resource recovery options Increased service quality and flexibility Tip fees set by local government at competitive rates Control over transfer trailer haul timing/impacts Facility inspections and performance are maintained at a local level Ease of future change to other disposal options Early mitigation and closure of existing landfill 	<ul style="list-style-type: none"> Competitive market could reduce volumes, resulting in higher tip fees Capital costs for construction and equipment Closure/post-closure financial assurance Long-term environmental liability Political process can slow response to regulatory changes with financial impacts Takes time to investigate, permit, design, and construct Potential land value impacts Increased traffic to new landfill No current guarantee property is suitable for landfill use

Table 3-9. Alternative (Privately Owned/Operated) Disposal Site Considerations

Advantages	Disadvantages
<ul style="list-style-type: none"> No capital costs for construction No Operations and Management costs No closure/post-closure financial assurance Potential cost savings measures, as tip fees can be negotiated Choice of providers through competition Environmental liability is partially mitigated National waste management expertise and resources Quick response to changes in technology/regulation Mitigates landfill closing due to wind No permitting, inspections, and engineering design 	<ul style="list-style-type: none"> Loss of control and stability Potentially discourages resource recovery Loss of flexibility and accountability Contract disputes if terms are not clear Volume or type of waste increases or decreases over time, impacting pricing Site does not operate as designed and permitted, resulting in redirection of waste Lengthy time requirement necessary if decision to develop public landfill after commitment to private landfill No control over transfer hauling Landfill design/operation likely to maximize potential profit for operator, which may conflict with Wasteshed social and environmental goals

3.10.2 Risk Assessment

Risks exist with each infrastructure option evaluated. However, when public versus private landfills and the final disposal of municipal solid waste are further considered, certain risks can change how waste is managed. Risks can be mitigated, avoided, transferred, or accepted. Through the more refined evaluation, a Risk Assessment Matrix was completed for both the publicly owned and operated landfill and the potential privately owned and operated landfill scenarios. Each risk identified was assessed based on the probability, or likelihood, of occurrence and the impact, or severity, of the effect on the Wasteshed goals and objectives. Strategies for handling each of the risks were also developed. The complete information can be found in Volume II – Technical Memos, Memo F.

The publicly owned and operated landfill risks and assessment matrix is presented in Figure 3-5.

Public Landfill Risks Assessed

1. Competition lowers tipping fees.
2. Capital costs exceed budget.
3. Closure/post closure funding.
4. Long-term environmental liability.
5. Political process can result in slow responses to changes.
6. Permitting, inspections and design process can be time intensive.
7. Service disruption can occur (e.g. wind events).
8. Traffic impacts due to commercial trucks.
9. Potential impacts to property value, road serviceability, and community growth near landfill.

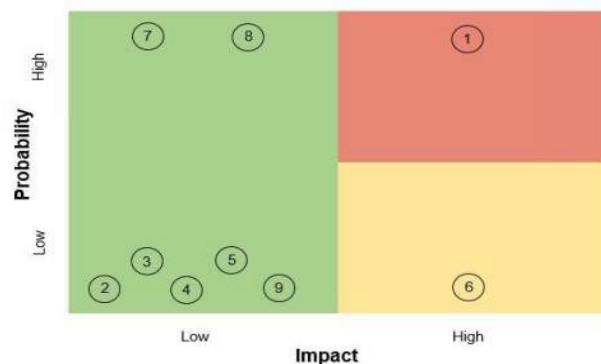


Figure 3-5. Public Landfill Risk Assessment Matrix

The privately owned and operated landfill risks and assessment matrix are presented in Figure 3-6.

Private Landfill Risks Assessed

1. Loss of control and stability (put or pay).
2. Redirection of waste with greater haul distance.
3. Limits diversion and recovery opportunities.
4. Reduced flexibility and accountability.
5. Varying volumes of waste could impact pricing.
6. Possible contractual disputes if terms not clear.

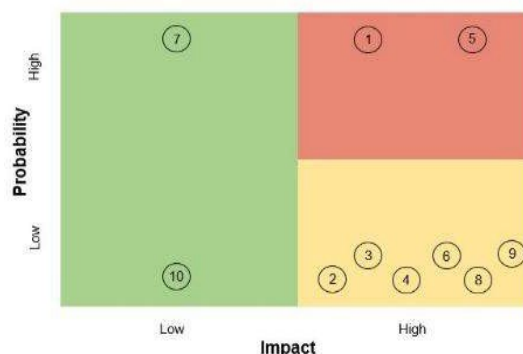


Figure 3-6. Private Landfill Risk Assessment Matrix

7. Additional staffing to enforce contract terms.
8. Changes in regulatory requirements trigger increased fees for disposal.
9. Loss of control over transfer haul time.
10. Time required to permit public landfill once commitment to private landfill.

3.10.3 Sustainable Return on Investment

Determining the potential Benefit-Cost Ratio (BCR) for private entities was a challenge due to the unknown capital budgets, specific operations, investments, and environmental benefits of specific sites. Thus the sustainable return on investment process was simplified to permit the comparison of a publicly owned and operated landfill to a privately owned and operated landfill through tipping fees and hauling distances. The BCRs from a range of tipping fees and hauling distance are outlined in Table 3-10.

Table 3-10. SROI Public vs. Private Landfill						
Tipping Fee:	\$10	\$12	\$14	\$16	\$18	\$20
Private Landfill - Miles from Central Transfer Station	Benefit-Cost Ratio (BCR)					
26 Miles	3.31	2.76	2.37	2.07	1.84	1.66
43 Miles	1.87	1.56	1.34	1.17	1.04	0.94
63 Miles	0.18	0.15	0.13	0.11	0.10	0.09
Public Owned Landfill 25 Miles from Central Transfer Station			2.41			

3.10.4 Stakeholder Engagement

An additional Stakeholder Meeting #7 was held on September 19, 2018, to solicit input on the further evaluation of the two landfill disposal options (see Volume III, Appendix C).

Topics Discussed:

Project team members presented a review of the Solid Waste Infrastructure Master Plan, recommended facilities with costs and a proposed timeline, proposed process controls and estimated tipping fees, a summary of landfill disposal site options and the respective SROI results, public vs. private advantages and disadvantages and a Risk Assessment Matrix of either option. Stakeholder attendees: 21.

Feedback Shared:

Stakeholders generally agreed that the private disposal site option has been evaluated similar to the other infrastructure options and that the probability and impact values in the risk assessment were accurate.

The following questions were asked of the stakeholders via anonymous, real-time response devices:

Question #1	Response	Percentage of Responses
The private disposal site has been thoroughly evaluated in a similar manner to the other infrastructure options.	Strongly Agree	29%
	Agree	38%
	Neutral	29%
	Disagree	0%
	Strongly Disagree	5%

Question #2	Response	Percentage of Responses
I prefer the following for the Wasteshed:	Public landfill no matter what	33%
	Public landfill only if costs are equal to or less than private landfill	14%
	Public landfill only if better BCR than private	19%
	Public landfill for another reason	5%
	No preference	10%
	Private landfill for another reason	5%
	Private landfill only if better BCR than public	5%
	Private landfill only if costs are equal to or less than public landfill	5%
	Private option no matter what	5%

4 Moving Forward

4.1 Phase 2 Study Recommendations

The following recommendations are made based on the Phase 2 Study results and input from Coalition members and stakeholders.

4.1.1 Infrastructure Recommendations

Through a collaborative effort with the TAC and stakeholders, eleven potential infrastructure options were initially selected for further evaluation. Criteria was established for the evaluation of each option which included facility needs (sizing), financial impacts (capital costs, operations and maintenance costs), programmatic impacts, regulatory and permitting requirements and risks/barriers. Additional information evaluated included implementation schedules and public/private partnership opportunities.

Each of the eleven potential infrastructure options were then analyzed through a SROI process that considers a wide-range of goals and incorporates triple bottom line aspects and outcomes based on financial, environmental and social factors. This process assigns dollar values to benefit categories that are difficult to monetize and compares value directly with cost. Results of this analysis included monetized benefits and costs, net present values and benefit-cost ratio.

Following these analyses, the Coalition and stakeholders recommended that five infrastructure options become the Tier 1 recommendations to be approved as the facilities to be placed in-service in the Wasteshed prior to the closure of the Larimer County Landfill, estimated to occur in 2025. The recommended infrastructure facilities are:

- Central Transfer Station
- New County Landfill
- Yard Waste Open Windrow Composting
- Construction and Demolition Waste Processing
- Food Waste Composting – Static Aerated Bin

As the New County Landfill infrastructure option moves forward, additional investigation of the site owned by the County will need to be initiated to ensure suitability for construction of a landfill facility. Should the additional investigation conclude that the proposed site is not suitable for a landfill, the TAC and PAC will reconvene and consider additional disposal options.

The Tier 2 infrastructure facilities will be reviewed on an annual basis by the Coalition for possible implementation at a later date.

4.1.2 Policy and Process Control Recommendations

Draft policy language should be developed by the TAC through a collaborative process that establish a regional materials management system, develops waste diversion and reduction goals for all jurisdictions, implements programs and facilities and conducts a strong consistent public education and outreach program that will yield specific results while achieving consistency amongst the stakeholders and community members. Once drafted, the policies/codes should be vetted through each of the Coalition's government entities for comments. The following are general policy and process control recommendations, which will require refinement and further specific language during the development process:

Intergovernmental Agreement (IGA)

1. Establish coordinated hauler licensing program throughout Larimer County.
2. Establish consistent solid waste process controls.
3. Coordinate data collection and reporting throughout the Wasteshed.
4. Establish Solid Waste Policy Advisory Council.
5. Document performance requirements for County to deliver facilities and infrastructure.
6. Document performance requirements for municipalities to adopt controls and licensing requirements.
7. Provide for continuity of services including a provision to coordinate future modifications to the operations of Tier 1 facilities, once placed into service.

This Plan recommends that the IGA be developed to specifically address the following elements related to process controls:

A Continuity of Service

Providing for continuity of services to the operations of the Tier 1 facilities, once these facilities are placed into service will allow for development of municipal programs for processing and disposal of materials within the Wasteshed.

For example, a robust food waste collection program in a city may be dependent on the continued operations of the Food Waste Composting Facility at the current landfill site. When considering revisions including termination to the Tier 1 facilities, the County will provide for discussion with the Solid Waste Policy Advisory Council alternative options for maintaining services. Should revisions to the Tier 1 facilities be determined, the County will provide written notice to each of the municipalities in Larimer County and the Solid Waste Policy Advisory Council a minimum of 18 months prior implementing revisions in order to provide adequate time for regional consideration and contingency planning.

This provision would not restrict the County from expanding or improving Tier 1 facilities, responding to State and Federal regulations, or temporarily

suspending certain operations in response to a substantial need to protect the health and safety of citizens within Larimer County.

B. Municipal Solid Waste

In order to maintain a competitive tipping fee rate structure, ensure that municipal solid waste generated within the Wasteshed is properly disposed, and continued participation in recycling programs is enhanced, the following are recommended:

1. Hauler Licensing/Process Control Requirements
 - a. Pay As You Throw (PAYT) – different price for different size containers; options for bear-resistant containers.
 - b. Provide single-stream recycling (map to depict areas requiring single-stream recycling), yard waste (map to depict areas requiring yard waste collection).
 - c. Develop demarcation line on County map for direct haul allowed to new landfill.
 - d. If MSW collected goes to a permitted landfill facility, the landfill facility must eventually develop an active landfill gas collection system.
 - e. Data collection and recording requirements that at a minimum include hauler vehicle description information, types of services provided, collection methods, facilities used, community in which material was collected, sector it was collected from and total annual quantities of waste collected (categorized by tons landfilled, tons recycled, tons composted, etc.).
 - f. Public education and outreach program.
 - g. Disposal facility receiving MSW must have Certificate of Designation from local jurisdiction.

C. Construction and Demolition Debris

Construction and demolition debris (C&D) make up a large percentage of the wastestream. In order to increase diversion, lengthen the life of disposal facilities and achieve the goals and objectives set forth by the Coalition, it is recommended that flow control and hauler licensing requirements be developed and implemented as follows (excludes materials separated on a project site for recycling):

1. Flow Control Requirements:
 - a. Flow Control (10-year term):
 - i. All mixed C&D debris (commingled collection of concrete and masonry, wood, metals, cardboard, and dry wall) generated and collected within Larimer County will be delivered to Larimer County Facilities.
 - ii. Construction Waste Management Plan required for projects that will yield over 1,000 tons of C&D debris and must be submitted to Larimer County for review and approval.
 - iii. Projects yielding over 1,000 tons of C&D debris may be

processed on site and processed materials may be distributed to markets outside of Larimer County.

- iv. New buildings, additions, demolition projects, and remodels over 1,000 square feet.
- b. Data collection and reporting requirements.
- c. Education program.

D. Yard Waste

A significant volume of yard waste is generated within the Wasteshed and while a portion is currently diverted to existing composting facilities, yard waste continues to be disposed in the landfill. It is recommended that the following be implemented for yard waste:

1. Hauler Licensing/Yard Waste Ban Requirements:
 - a. Waste ban within specified zones, depicted on a map.
 - b. Requires haulers to provide yard waste collection to customers within designated service area; yard waste may be bundled with trash and recycling for single family residential customers.
 - c. Commercial landscaping businesses are required to be licensed.
 - d. Centralized data collection and reporting requirements.
 - e. Requirements to implement education programs.
 - f. Yard Waste Ban prohibits disposal of yard waste in MSW landfills, including collection of trash collection carts with yard waste above a certain portion.
 - g. Public sector commitment to provide selected facilities to receive yard waste.
 - h. Commitment by County and municipalities to use a certain portion of generated material as soil amendments on land use projects.

E. Food Waste

Food waste collection and processing should be implemented to increase diversion opportunities within the Wasteshed. It is recommended that the Coalition consider implementation of the following over time for food waste collection and processing:

1. Hauler Licensing/Process Control Requirements:
 - a. County-wide adoption of requirement similar to Fort Collins Code; Section 12-23 – Requires grocers to send food scraps to a permitted facility that processes food waste; bans landfill disposal; applies to grocers that generate more than 96 gallons of food scraps per week; surplus edible food may be donated - commences by a specified date.
 - b. Food scraps to include both Pre-Consumer (food scraps generated from meal preparation and grocery stores) and Post- Consumer (food scraps generated from plate

scrapings, uneaten food that has already been prepared or served) will be considered for future landfill diversion; restaurants, institutional and residential – commences by specified dates.

- c. Centralized data collection and reporting requirements.
- d. Requirements to implement education programs.

F. Single-Stream Recycling

In order to increase recyclable material volumes and participation, it is recommended that all single-stream recycling materials be directed to the Larimer County materials recovery facility and the following be implemented:

1. Flow Control:
 - a. All single-stream recyclables generated and collected within Larimer County shall be delivered to Larimer County Facilities.
 - b. Requirement to provide single-stream recycling within designated zones.
 - c. Frequency of service – minimum every other week.
 - d. Data collection and reporting requirements.
 - e. Education program.
 - f. Specific sized roll carts, etc.

4.1.3 Administration and Education

The following are recommendations for administration and enforcement:

- The Coalition members should work cooperatively to establish a public education and outreach program to educate the citizens and stakeholders on upcoming changes to the waste management system in the Wasteshed.
- Upon adoption of the Intergovernmental Agreement, a Policy Advisory Council should be established that consists of Coalition members, stakeholders, and members of the public to advise on solid waste management issues.

4.2 Implementation Plan

The following Table 4-1 Implementation Schedule outlines the 7-year plan for implementation of the recommended actions.

Table 4-1. Implementation Schedule								
Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
Infrastructure								
The Coalition and Stakeholders recommend that the Tier 1 Infrastructure be approved as the facilities to be placed in-service in the Wasteshed prior to the closure of the Larimer County Landfill in 2025. Those infrastructure include:	Larimer County							
• Central Transfer Station (Jan 2019–Jan 2023)			✓	✓	✓	✓		
• New County Landfill ¹ (Jan 2019–Jan 2024)			✓	✓	✓	✓	✓	
• Yardwaste Open Windrow Composting (Jan 2020–Jan 2023)				✓	✓	✓		
• Construction and Demolition Waste Processing (Jan 2020–Jan 2023)				✓	✓	✓		
• Food Waste Composting – Static Aerated Bin (Oct 2021–Feb 2025)					✓	✓	✓	✓

Table 4-1. Implementation Schedule

Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
The Tier 2 Infrastructure will be reviewed on an annual basis by the Coalition for possible implementation at a later date.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Ongoing						
Policy and Process Controls								
Draft policy language will be developed through a collaborative process by the TAC for process controls, waste bans, and hauler licensing that will yield specific results associated with waste diversion, reductions, and recycling while achieving consistency among the Coalition members. Once drafted, the policies/codes should be vetted through each of the Coalition’s government entities for comments.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Q4	-	-	-	-	-	
An Intergovernmental Agreement for Solid Waste handling will be drafted by the Coalition members and adopted by each of the Coalition’s government entities.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	-	Q1	-	-	-	-	

Table 4-1. Implementation Schedule

Recommendation	Implementation Responsibility	Implementation Year						
		2018	2019	2020	2021	2022	2023	2024
Administration and Enforcement								
The Coalition members will work cooperatively to establish a public education and outreach program to educate the citizens and stakeholders on upcoming changes to the waste management system in the Wasteshed.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	Ongoing						
Upon adoption of the Intergovernmental Agreement, an Advisory Board should be established which consists of Coalition members, stakeholders, and members of the public to advise on solid waste management issues.	Larimer County City of Fort Collins City of Loveland Town of Estes Park	-	Q3	-	-	-	-	-

¹The recommendation will require an initial site evaluation to determine if the County owned site is suitable for landfill infrastructure.